# Status of Homestead Biodiversity in the Offshore Island of Bangladesh

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**Abstract:** Diversity of plant, livestock and fish species, species richness and preferences of farmers were studied in one of the offshore islands of Bangladesh. Assessment was done by means of multistage random sampling. A total of 142 plant species belonging to 61 families were identified in the island, of which 76 species were recorded as tree species, 25 shrub species and 41 herb species. Again out of the plant species, 34 species were fruit producing species, 24 timber species, 21 fuel wood species, 15 medicinal species, 11 ornamental species, 32 vegetable species and 5 species of spices. Most of the farmer (76%) preferred to plant fruit tree species for future plantation followed by timber species (62%). Diversity and abundance of fruit species was found higher in all homestead. Poultry (64%) was the major livestock component of each household followed by Goat (12%), Cattle (10%), Buffalo (8%), and sheep (6%). A total of 24 species of cultured fishes under 14 families were recorded. Among them 9 species were identified as Large sized fishes (Boromaach) and 15 species as Small sized fishes (*chhotomaach*). The annual income from the homestead biodiversity varies from Tk. 12500 to Tk. 41000 depending on the hosuehold size.

**Key words:** Homestead forest, biodiversity, offshore island, livestock, Bangladesh

## INTRODUCTION

From ecological and conservation point of view, assessment of biodiversity of any habitat or locality has been regarded as one of the vital issue for careful preservation, promotion and management of the variety of life-forms. Increased human population and associated development activities in the last few decades has resulted directly and indirectly in depletion of the natural vegetation which in turn increase the pressure on the homestead forest specially in the developing countries to meet various needs of the human beings. In this circumstances correct inventory and assessment of biodiversity in different habitats is necessary for evolving a long term strategy for conserving the endangered species and improvement of the existing species.

Bangladesh is situated at the complex interface of the Himalayan and the Southeast Asian Bio-geographic regions, and historically was well endowed with very diverse complements of terrestrial and aquatic flora and fauna. It has 15.4 million homesteads occupying 0.3 million hectares of land and are providing major requirement of food, fruit, vegetables, timber and fuelwood[1]. Wide range of plant biodiversity for timber and food crops were found in the homesteads[6].

Homestead is an operational unit in which a number of crops including trees are grown with livestock, poultry and fish production mainly for the purpose of satisfying the farmer's basic needs[15]. It is the most prospective form of production site along with the seat/shelter of the family. Homestead fulfill basic needs of the people such as food, shelter, cash etc and high species diversity of the homestead help to reduce the environmental deterioration commonly associated with monoculture production system. Moreover, they have been producing sustained yields for a century in a most resources efficient way[1].

Study on homestead forest was carried out in different regions of Bangladesh. Alam and Mohiuddin[4], Alam et al[5], Das[10], Hassan and Mazumdar[12], Khan and Alam[14], Siddiqi and Khan[25] studied the floristic composition (mainly trees) in the homestead of Bangladesh. Ahmad[2], Bashar[6], Choudhury and Sattar[9], Islam[13], studied Homestead agroforestry. Homestead plantation and traditional uses was studied

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by Alam *et al*[3], Miah *et al*[18], Momin *et al*[22], Millat-e-Mustafa *et al*[21]. But no study was so far carried out solely on the status of homestead forest biodiversity in the offshore island of Bangladesh. From the conservation point of view, homestead forest can be considered as the ex-situ conservation sites for the wide range of plant diversity. The ecological merits of home garden are related to conservation of soil, water, nutrients and bio-diversity. Therefore this study will be a baseline information for the policy makers to understand the species richness, species and composition, structure, soil conservation methods, fruit species conservation, household food security, and socio-economic importance of homestead forest as well as to formulate biodiversity conservation planning highlighting homestead forest of Bangladesh for sustainable production and maintenance of biodiversity.

## MATERIALS AND METHODS

Field investigations were carried out in Sandwip upazila (the offshore island) over a period of three months (June-August, 2003). Sandwip upazila of Chittagong district lies in between 22°16' and 22°43' North latitude and between 91°17' and 91°37' East longitude. It comprises an area of 762.42 sq. km. Soil is formed by the Meghna estuarine floodplain alluvial soil of recent origin[11]. Tropical monsoon climate prevails in the areas with an average maximum temperature of about 25.4°C to 31.6°C and the average annual rainfall is 3600 mm. A multistage simple random sampling method was applied to locate the village and households for the study with upazila as the primary sampling unit and households of the villages as the ultimate sampling unit. From a total of 20 upazila of Chittagong district, Sandwip upazila was selected purposively as this is the only offshore island of Chittagong district and a forest poor upazila of Bangladesh. Out of 15 unions in Sandwip, three unions were firstly selected randomly. Then three villages, one from each union were randomly selected. The total number of households in the villages was obtained from the District census published by the Bangladesh Bureau of Statistics[8]. According to the EPI survey, 2002 total population of the upazila was 321676 (Male 166473 and Female 155203) and according to the Statistical pocket book, Bangladesh 2000, total households of the upazila was 43292[7]. A preliminary survey administering a pre-tested questionnaire was then conducted to determine the socio-economic status in relation to farm size of the households in the villages. From the results, it was found that the farm size is proportional to the socio-economic status of the households and they were then divided into

3 categories dependent on the farm size: large (more than 0.25 hectare), medium (between 0.05 to 0.25 hectare) and small (smaller than 0.05 hectare). To determine the farm size only land surrounding the homestead was counted i.e. house, yard (back and front) and pond (if present around home). 45 households, 15 from each category (i.e. 5 household of each category from each village) were then selected randomly using random number tables. In order to collect relevant information, interview schedule was carefully designed keeping the objectives of the study in view. The collected data were cross-checked finally in a group meetings at every village involving people at various levels. The preliminary household survey revealed that the variation on living standard, income, lifestyle etc among each farm category was not significant. So, the sample size of each household category was used as a basis for stratification. Density, Relative density as a quantitative structure, the Shanon-Winner index for diversity[19], Diversity index[24] as a measure of diversity were evaluated. Species Richness index and Species evenness index were also calculated with the help of formula given by Margalaf[16].

1. Density of a species =

Total no. of individuals of a species in all the quadrates
Total no. of quadrates studied

2. Relative density of a species =

Total no. of individuals of a species in all the quadrates X 100
Total no. of individual of all species

3. The Shanon-Winner index for diversity,
   $H = -\mathbf{j} \; Pi^* \ln Pi$

Where,  H = Index of species diversity,
         Pi = No. of individual of one species/Total no. of individuals in the samples

4. Diversity index, $D = S/N$

Where,  D = Diversity Index,
         S = Total number of species,
         N = Total number of individuals

5. Species richness index, $R = (S-1)/\log N$

Where,  R = Species richness index,
         S = Total no. of species,
         N = Total no. of individuals of all the species

6. Species evenness index, $E = H / \log S$

Where,    E = Species evenness index,
         H = Shanon-Winner index of diversity,
         S = Total no. of species

## RESULTS AND DISCUSSION

**Homestead utilization pattern:** The average size of the homestead of the study area was 0.206 ha and it varies from sizes 0.043 ha to 0.435 ha according to farm categories. Highly diversified patterns of utilization of homestead area were observed in different farm categories (Table 1). A substantial portion of the total homestead was occupied by vegetation (42.72%) followed by housing (20.87%) and pond (16.99%). The area occupied by vegetation in small farm category was smaller than that in the medium and large farm categories. Poor farmers were seldom found to have a pond in their homestead. The area of pond / ditches increased with the increase of farm size. The large farmers were also found to have more open space in front of the house for the purpose of threshing, drying of crops and for religious ceremonies and other activities.

**Species diversity:** A total of 142 plant species under 61 families were recorded from the set of 45 homesteads surveyed. The representative families and number of species under each family are given in Table 2. It was found that the family leguminosae ranks top of the list and is represented by 18 species. Cucurbitaceae (10 spp), Palmae (5 spp), Rutaceae (5spp), Anacardiaceae (5 spp) and Moraceae (5 spp) are the major families available in the surveyed area.

**Floristic Elements:** Floristic elements of the homestead flora consist of both native and exotic species. About 20 species of tree species were identified as exotics and some of them have been naturalized. *Albizia richardiana*, *Leucaena leucocephala*, *Swietenia mahagoni, Psidium guajava* are New World species, which have been naturalized. These species might introduced during Spanish trade line. Among the aliens of Malayan origin *Cassia siamea*, *Terminalia catappa* are worthy to be mentioned. *Delonix regia*, *Tamarindus indica* are elements of African flora. Most of these have been naturalized and have a long heritage of introduction. *Acacia auriculiformis,* and *Eucalyptus* species have recently been introduced from Australia and entered in village plantations and homesteads.

**Species richness:** Out of 142 species, 76 species were recorded as tree species (53%), 25 shrub species (18%) and 41 herb species (29%) (Figure 1). Rain tree (*Samanea saman*), Betel nut (*Areca catechu*), Coconut (*Cocos nucifera*), Mango (*Mangifera indica*) and Mahagoni *(Swietenia mahagoni)* were the top five tree species, whereas shrub species Papaya (*Carica papaya*) and herb species Banana (*Musa* species) were the most peominent species in the homegardens. Some of the traditional species like Katbadam (*Terminalia catappa*), Bangab (*Diospyros montana*), Borta (*Artocarpus heterophyllus*) were found to be very rare species in the homegarden. The complete flolistic list is Appended. Data obtained from Species Diversity Index (3.40) show higher value than Index of Dominance (0.066) which represents less dominancy of the tree species with more diversity. The calculated value of Species Richness Index and Species Evenness Index was 20.65 and 1.81 respectively which represent the more richness of tree species (corroborated with the previous findings) and more evenly the total number of individuals is distributed among all possible tree species.

Figure 1, Marked variation in species richness and diversity was found in the homestead of different farm categories. The highest types of species (108) were found in the large farm category whereas the lowest types of species (71) were found in the small farm category (Figure 2).

Figure 2, Again among the recorded 142 species, 34 species were fruit producing species (23%), 24 timber species (17%), 21 fuel wood species (15%), 15 medicinal plants (11%), 11 ornamental species (8%), 32 vegetable species (22%) and 5 spices (4%) (Figure 3). The study revealed that fruit trees dominated over timber trees in the homegardens. The farmers concentrate on fruit species because of their subsistence and cash need. Coconut (*Cocos nucifera*), Betel nut (*Areca catechu*), Guava (*Psidium guajava*), Banana (*Musa* spp), Papaya (Carica papaya), Date palm (*Phoenix sylvestris*), Mango (*Mangifera indica*) was cultivated in more than 75% of the homestead. Next to fruit species, people concentrate on timber species, for future investment. Mahagoni (*Swietenia mahagony*), Raintree (*Samanea saman*), Sada koroi (*Albizia procera*), Segun (*Tectona grandis*) were found common in most homestead. Poor farmers prefer those species, which gave quick and regular cash returns, required little space, and would not cast heavy shade that might cause conflict with neighbors. While larger farmers thought of fruits for long-term economic benefit, they didn't take care the neighbor's inconvenience resulting from shade.

**Table 1:** Homestead utilization pattern according to farm categories.

| Household category | Area of homestead under different use (hectares) | | | | | | |
|---|---|---|---|---|---|---|---|
| | House | Livestock shed | Yard | Pond/Ditches | Vegetation | Others | Total |
| Small | 0.014 | 0.002 | 0.007 | 0.003 | 0.016 | 0.001 | 0.043 |
| Medium | 0.035 | 0.005 | 0.021 | 0.017 | 0.061 | 0.002 | 0.141 |
| Large | 0.079 | 0.019 | 0.057 | 0.085 | 0.188 | 0.007 | 0.435 |
| Average | 0.043 (20.87%) | 0.009(4.37%) | 0.028 (13.59%) | 0.035 (16.99%) | 0.088 (42.72%) | 0.003 (1.46%) | 0.206 (100%) |

**Table 2:** Families with number of Species observed in the study area.

| Family name | Species no. | Family name | Species no. | Family Name | Species no. | Family name | Species no. |
|---|---|---|---|---|---|---|---|
| Leguminosae | 18 | Cruciferae | 3 | Liliaceae | 1 | Oxalidaceae | 1 |
| Cucurbitaceae | 10 | Amaranthaceae | 3 | Chenopodiaceae | 1 | Bursereceae | 1 |
| Anacardiaceae | 5 | Zingiberaceae | 2 | Basellaceae | 1 | Bignoniaceae | 1 |
| Moraceae | 5 | Euphorbiacea | 2 | Crassulaceae | 1 | Casuarinaceae | 1 |
| Palmae | 5 | Febaceae | 2 | Amaryllidaceae | 1 | Dipterocarpaceae | 1 |
| Rutaceae | 5 | Rosaceae | 2 | Sterculiaceae | 1 | Punicaceae | 1 |
| Myrtaceae | 4 | Magnoliaceae | 2 | Pandanaceae | 1 | Santalaceae | 1 |
| Solanaceae | 4 | Verbinaceae | 2 | Maranthaceae | 1 | Urticaceae | 1 |
| Annonaceae | 3 | Ebenaceae | 2 | Caricaceae | 1 | Dilleniaceae | 1 |
| Combrataceae | 3 | Elaocarpaceae | 2 | Umbelliferae | 1 | Rhamnaceae | 1 |
| Convolvulaceae | 3 | Oleaceae | 2 | Compositae | 1 | Graminae | 1 |
| Malvaceae | 3 | Compretaceae | 2 | Vaticeae | 1 | Sapotaceae | 1 |
| Meliaceae | 3 | Apocynaceae | 2 | Bombacaceae | 1 | Moringaceae | 1 |
| Musaceae | 3 | Labiateae | 2 | Guttiferae | 1 | | |
| Rubiaceae | 3 | Lythraceae | 2 | Caesalpiniaceae | 1 | | |
| Araceae | 3 | Lauraceae | 1 | Sapindaceae | 1 | | |
| Total No. of species | 142 | | | | | | |

**Table 3:** Number of livestock in different farm categories in the study area.

| Categories | Poultry | Goat | Cattle | Buffalo | Sheep |
|---|---|---|---|---|---|
| Small | 57 | 7 | 6 | 2 | 0 |
| Medium | 74 | 18 | 9 | 9 | 6 |
| Large | 62 | 10 | 17 | 15 | 11 |
| Total | 193 (63.69)* | 35 (11.56) | 32 (10.56) | 26 (8.58) | 17 (5.61) |
| Average per household | 4.29 | 0.78 | 0.71 | 0.58 | 0.38 |

*Figure in parentheses indicate the percentage of the total livestock resources.

Figure 3, The number of plant species (excluding vegetable species) in this study area was higher than those found in homesteads of Tangail (52 spp), Ishurdi (34 spp), Jessore (28 spp), Patuakhali (20 spp), Rajshahi (28 spp), and Rangpur (21 spp) district respectively[1]. Millat-e-Mustafa[20] identified 92 perennial plant species in one study conducted in different part of the country. Various Macro and micro- environmental factors of the homestead, needs and choices of the family influenced the distribution of the plant species. That is why the species composition varied from one location to another and from one farm category to another.
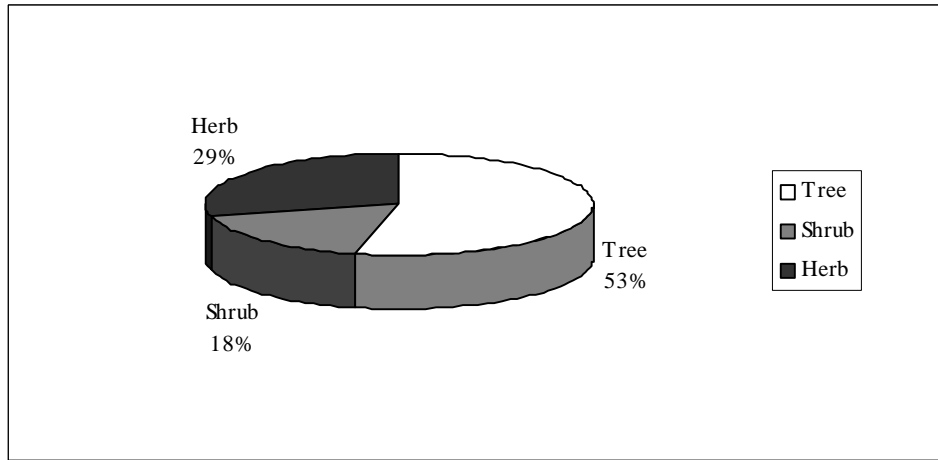
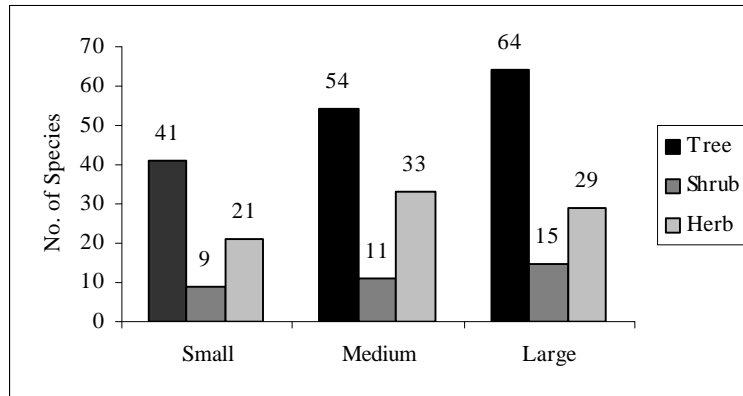**Fig. 1:** Diversity of Species in the Homegarden of Sandwip upazila.



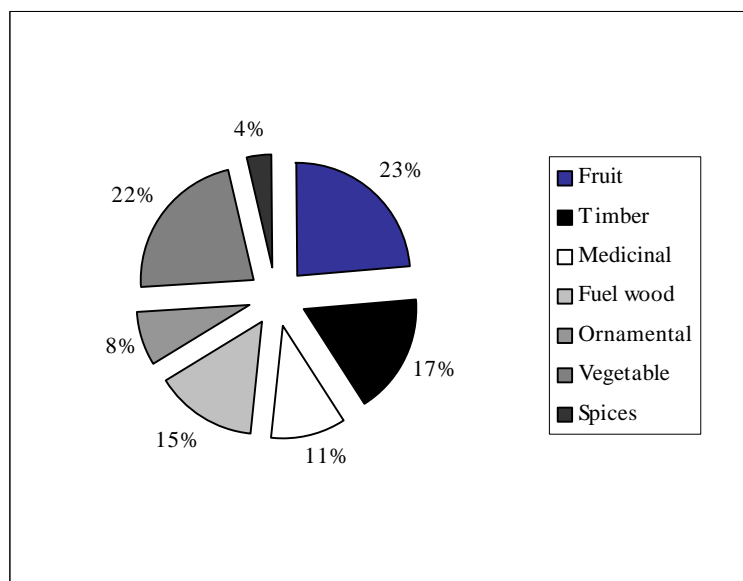**Fig. 2:** Types of plant species in homestead according to household categories.



**Fig. 3:** Different types of plant species with their percentage of occurrence

**Table 4:** Fish species diversity in the study area

Category, Local name and family name of the Fish species

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| Small sized fishes | Large sized fishes |
|---|---|
| Sarputi (Cyprinidae) | Katal (Cycrimidae) |
| Darkina (Cyprinidae) | Rui (Cyprinidae) |
| Punti (Cyprinidae) | Boal (Siluridae) |
| Chebli (Cyprinidae) | Pangas (Schilveidae) |
| Mola (Cyprinidae) | Aire (Bagridae) |
| Ghonia (Cyprinidae) | Shol (Channidae) |
| Kakila (Channidae) | Gojar (Channidae) |
| Taki (Channidae) | Silver carp (Cyprinidae) |
| Cheng (Channidae) | Grass carp (Cyprinidae) |
| Shing (Hetoropneustidae) | |
| Magur (Claridae) | |
| Pabda (Siluridae) | |
| Tengra (Schilveidae) | |
| Pholi (Notopteridae) | |
| Koi (Anabantidae) | |

It has been observed that an interaction exists between homestead trees and vegetables, which govern the selection of vegetables for homegarden. Turmeric and ginger were found to grow well under tree shade. Winter vegetables viz. Tomato, Egg plant, Cabbage, Amaranth and radish were grown only in sunny places as they did not perform well under shade. It was observed that there was a practice of growing climbing vegetables upon the trees. Country bean, sponge gourd, ash gourd, sweet gourd, ribbed gourd and yam were commonly grown in this manner. Almost all shrubs and trees were found of to be associated with such species.

**Livestock status:** It was observed from the study that farmers having large farm keep more animals than the

**Table 5:** Distribution of income according to farm category (Taka (Tk.)/ Year) (Tk.60=1$ )

| Farm category | Income from homestead per household (Tk ./ Year) | | | |
|---|---|---|---|---|
| | Plant species | Poultry and/or livestock | Fishes | Total |
| Small | 6000 | 5500 | 1000 | 12500 |
| Medium | 11000 | 10000 | 3500 | 24500 |
| Large | 15500 | 13500 | 12000 | 41000 |
| Average | 10833 | 9666 | 5500 | 26000 |

farmers who own small farms. It is depicted from Table 3 that Poultry (63.69%) was the major livestock component of each household followed by goat (11.56%), cattle (10.56%), buffalo (8.58%), and sheep (5.61%) over the surveyed area. Due to shortage of cash money, scarcity of grazing land some of the household could not able to keep livestock.

Table 3, Average number of poultry (4.29), goat (0.78) and sheep (0.38) per household is lower than the national average of poultry (7.10), goat and sheep (0.82) per household[7]. This is due to the loss of livestock by frequent cyclones and tidal surges that affect the area.

**Fish species status:** Fish species are important from the viewpoint of providing nutrition and subsistent and supplemental income to the vast majority of the rural people. There are clear dominancy of small fish varieties over large fish varieties in the homestead pond or ditches. In the study area a total of 24 species of cultured fishes under 14 families were recorded. Among them 9 species were identified as Large sized fishes (Boromaach) and 15 species as Small sized fishes (*chhotomaach*) (Table 4). Two species (Silver carp and Grass carp) of them were identified as exotic species.

Table 4, Fish farming in homestead is also common phenomena in they study area. Ponds/ ditches are not only the main source of water of the household for daily uses, but they are also used as reservoir of fish for both consumption and sale. It was found that more than 80% of the total respondents had small to large pond/ ditches. It was observed that the farmers who own large properties have more ponds/ ditches than the farmer who own small properties.

**Income from homestead:** Farmers benefited from homegarden in several ways. Homegarden act as a "reserve bank" of food and cash for farmers. The income from homegarden was significantly different with in the farm categories. Larger farm categories were getting more income than the smaller farm categories because of having large pieces of land.

It was observed that the medium farmers intensively cultivated the homegarden. This might be the reason for getting more income from their homegarden. The annual income derived from each household depending on farm size varies from Tk. 12500 to Tk. 41000 (Table 5). Income from plant species was found more in all farms groups, which is followed by income form poultry and livestock.

Table 5, As a whole, bio-diversity ensures the sustainable utilization of life support systems on earth by playing their role in various ways and thus conserving the global environment. So for maintaining a favourable environmental system for the mankind, man should take step to conserve bio-diversity. Although there are

two-production system existed in Bangladesh but the underlying problem is quite different. Large production unit, encroachments, lack of labours and staffs, illicit felling, budget allocation, mono-plantation etc. are the major problems for the management of Government forest land. Thus the forestry production system is much more unprotected than the homestead production system. Since the production unit of homestead is small and people live there, it is better protected from the problems that are acute in the forestry sector. It was reported that people exterminated many tree species from the forest and many were threatened by some manmade causes. At the same time it was observed that social attitude towards the homestead forestry was more or less positive[17].

In 1994 threatened species in Bangladesh were 60 but in 1999 (WCMC, 1999) it has increased to 176 as the government forests are not so much promising for a long time. The homestead forestry can play the vital role in Biodiversity conservation where there is peoples long time love and feelings towards nature from time immemorial. It was observed from the study that Government and NGOs initiatives to provide quality planting material and technical support to the farmers is imperative to sustain and improve the productivity of the homesteads of the study area. It is necessary to take special attitude towards the conservation and proper management of homestaed biodiversity in Bangladesh.

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