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# Tree Species Diversity and Management Practices of Woodlot in the Homegarden of the Offshore Island of Bangladesh

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**Abstract:** Diversity of tree species, management practices of woodlot in the homegarden and its contribution to the socio-economic condition of rural household has been studied in the offshore island of Bangladesh. Assessment was done by means of multistage random sampling. Based on the homestead size respondents were categorized into small, medium and large and a total of 45 homesteads 15 from each category were selected randomly for the study. The study reveals that the diversity of tree species was found to increase with the increase of homestead size of the respondent. A total of 76 tree species under 34 families were identified in the study area Floristic elements of the homestead flora consists of both native and exotics species. Most of the farmer (75.5%) preferred to plant fruit tree species for future plantation. Diversity and abundance of fruit tree species was found higher in all homestead. But recently fruit bearing were gradually being replaced by some exotic timber species such as *Swietenia mahagoni*, *Acacia auriculiformis*, *Tectona grandis* and *Eucalyptus* spp. etc. *Bambusa* spp., *Albizia saman*, *Areca catechu*, *Cocos nucifera*, *Mangifera indica* were in the top in species richness. The average annual income from homestead's plant species was 5733.33 Taka. Lack of good seed/ seedlings, lack of technical knowledge and unavailability of space appeared to be the major constrains for planting trees. The major problems faced by the farmers in tree establishment and management were the damage caused by animals, storms, pest and insects.

**Key words:** Homegarden, diversity, offshore Island, contribution, Bangladesh

## INTRODUCTION

Homestead is one of the potential sources of plant genetic diversity in Bangladesh. Wide ranges of tree diversity for timber and food crops were found in the homesteads[1]. In the backdrop of the increased rate of deforestation and limitations of the public forestry activities in rural home gardens gave assumed a special significance in recent times[2]. Homestead tree production system in villages is a mode of species and genetic conservation for a good number of trees[3].

Bangladesh occupies a unique geographic location of about 143,999 km$^2$ or 14.4 million ha. It has 15.4 million homesteads occupying 0.3 million ha of land and are providing major requirement of food, fruit, vegetables, timber and fuelwood[4]. In the view of the present scenario of rapidly growing population leading to over exploitation of natural resources and possible irreversible environment damage, there is an urgent need for developing an alternative way for sustaining the natural resources. Again, since logging in natural forests has been banded in the country, homestead forest becomes the main source to meet most of the timber and fuelwood demand.

Home gardens have numerous benefits from the perspective of production, conservation and aesthetics[5]. A homestead in Bangladesh is the most approaching form of an integrated production system and stable ecosystem that maintains the plant genetic diversity as biological wealth along with the seat/shelter of the family. From the conservation point of view, homestead can be considered as the in situ conservation sites of the wide range of plant diversity.

The coastal environment of Bangladesh is made up of a wide variety of landforms. Most of them are best considered in two broad categories: erosional and depositional. Sandwip is an unique example of a coastal island which for a long time get experienced with both the categories of landforms. As such a wide variety of tree species are usual in the homegarden of a coastal island like Sandwip.

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Many researchers[3,6-10] studied the floristic composition (mainly trees) in the homestead of different regions of Bangladesh. But no study was so far carried out solely on the assessment of tree species in the homestead of offshore island in 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, fruit species conservation, household food security and socio-economic importance of homestead forest as well as to formulate conservation planning of tree species diversity highlighting homestead forest of Bangladesh for sustainable production and maintenance of biodiversity.

Considering the above factors the study were undertaken for identifying different tree species being grown in the home gardens, their diversity, management perspective and the problem related to the loss of tree species diversity in the home gardens situated in the offshore island as well as to investigate the economic and social benefits derived by the local people from their own homegarden and to accustom with the environmentally beneficial impacts of the presence of diverse tree species in the homegarden.

## MATERIALS AND METHODS

The only offshore island of Chittagong district, Sandwip is an island of the Meghna estuary on the Bay of Bengal occupies an area of 762.42 sq. km. This island was selected purposively. Since the ecological hazards hitting the area are frequently cyclones and storm surges of various intensities and exceptionally high tides resulting in salt water flooding of agricultural lands and home gardens, which are responsible for an extensive mixture of tree species occurs in this area.

Sandwip lies between latitude 22°22' N and 22°43' N and longitude 91°18' E and 91°34' E and is situated at Lower Meghna Estuary. In water transport it is about 45 km away from Chittagong zilla sadar. According to the EPI survey, 2002 total population of the upazila was 321676. According to Statistical pocket book, Bangladesh 2000, total households of the upazila was 43292[11]. Annual population growth rate is 0.64[12]. Sandwip upazilla consists of 19 union parishads, 31 mouzas and 34 villages[13]. The average literacy rate for Sandwip upazila is 45% (male 40.8%; female 29.5%)[13]. The mean annual rainfall over the study area is about 3600 mm (rainfall station, Sandwip). Average Maximum temperatures vary from about 25.4 to 31.6°C. Topographically the only physiographic region named Meghna estuary flood plain constitutes the whole area of Sandwip.

There are 20 upazilla in Chittagong district, from where Sandwip upazila was selected for the study. Three unions were selected for the study out of 19 unions that comprises Sandwip upazilla. Initially a list of households spreading over the study area was prepared according to different farm size categories i.e. small (<0.05 ha), medium (between 0.05 to 0.25 ha) and large (>0.25 ha). Out of these categories 45 households, 15 from each category, were then selected randomly and those homesteads were surveyed for data on tree diversity and their system of management. Related socio-economic information was collected through a presorted questionnaire during May and July, 2004. Means, densities, relative density, the Shanon-Winner index for diversity[14], Diversity index[15] as measures of diversity were evaluated. Species richness index and species evenness index were also calculated.

## RESULTS AND DISCUSSION

**Species composition:** A total of 76 plant species under 34 families were recorded from the set of 45 homesteads surveyed. This high diversity of tree species is the result of abundance of different tree seedlings as well as peoples consciousness. The representative main families and number of species under each family are given in Table 1. It was found that most of the species (14) belongs to the family leguminosae ranks top of the list. Moraceae (5 spp.), Combretaceae (5 spp.), Palmae (5 spp.), Rutaceae (4 spp.), Anacardiaceae (4 spp.) and Myrtaceae (4 spp.) are the major families available in the surveyed area.

**Species richness:** Rain tree (*Samanea saman*), Betel nut (*Areca catechu*), Coconut (*Cocos nucifera*), Mango (*Mangifera indica*) and Mahagoni (*Swietenia mahagoni*) were the top five tree species in the home gardens in terms of species richness. This is because to have mainly the economic return with some nutritional requirement. Some of the traditional species like Katbadam (*Terminalia catappa*), Bangab (*Diospyros montana*) and Borta (*Artocarpus heterophyllus*) were found to be very rare species in the homegarden. Data obtained from species diversity index (3.48) 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 1.85, 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 (Table 2).

Table 1: Main families with number of tree species

| Serial No. | Family name | No. of species | Serial No. | Family name | No. of species |
|---|---|---|---|---|---|
| 1 | Anacardiaceae | 4 | 18 | Lythraceae | 1 |
| 2 | Annonaceae | 3 | 19 | Moraceae | 5 |
| 3 | Bombacaceae | 1 | 20 | Magnoliaceae | 2 |
| 4 | Bignoniaceae | 1 | 21 | Moringaceae | 1 |
| 5 | Bursereceae | 1 | 22 | Meliaceae | 3 |
| 6 | Casuarinaceae | 1 | 23 | Myrtaceae | 4 |
| 7 | Caesalpiniaceae | 1 | 24 | Oxalidaceae | 1 |
| 8 | Combretaceae | 5 | 25 | Palmae | 5 |
| 9 | Dilleniaceae | 1 | 26 | Punicaceae | 1 |
| 10 | Dipterocarpus | 1 | 27 | Rubiaceae | 1 |
| 11 | Elaocarpaceae | 2 | 28 | Rutaceae | 4 |
| 12 | Euphorbiaceae | 1 | 29 | Rhamnaceae | 1 |
| 13 | Ebenaceae | 2 | 30 | Sapindaceae | 1 |
| 14 | Graminae | 1 | 31 | Santalaceae | 1 |
| 15 | Guttiferae | 1 | 32 | Sapotaceae | 1 |
| 16 | Lauraceae | 1 | 33 | Urticaceae | 1 |
| 17 | Leguminosae | 14 | 34 | Verbinaceae | 2 |

Table 2: Data obtained from diversity and density analysis of the tree species

| Parameters | Value |
|---|---|
| No. of species = S | 76 |
| No. of individuals = N | 4359 |
| Shanon Winner index of diversity, H = -Σpi*Ln(Pi) | 3.48 |
| Diversity Index, SDI = S/N | 0.017435192 |
| Index of Dominance, ID =Σ(Pi*Pi) | 0.066 |
| Species Richness Index, R = (S-1)/LogN | 20.65 |
| Species Evenness Index, E = H/LogS | 1.850263106 |

The number of tree species in this study area was higher than those found in homesteads of Tangail, Ishurdi, Jessore, Patuakhali, Rajshahi and Rangpur district, respectively[4]. This may because as the rural people here hold a belief that homestead plantation will act as a safety measure from frequent cyclone i.e. the rich the homestead forest resources the more it will reduce the loss that is caused by the frequent cyclone and tidal surges. Again the rural people mainly dependent on their homegarden for woodfuel and nutritional requirement as there is no forest available in the island. Though purchasing of woodfuel has already been started to meet the increasing demand but these are mainly consumed in the tea stalls and brickfields. As a result the homestead forest usually bear highly diversified feature of plant species.

Marked variation in species richness and diversity was found in the homegarden of different farm categories. The highest No. of tree species (64) was found in the large farm category whereas the lowest No. of tree species (41) was found in the small farm category (Table 3).

Again among the 76 species of tree 28 were fruit producing (37%), 23 timber (30%), 19 fuel wood (25%), 5 medicinal (7%) and 1 ornamental species (1%) (Table 4). The study revealed that the number of fruit producing species was higher than other species in each homegarden. The farmers concentrate on fruit

Table 3: No of tree species in homestead according to household categories

| Household category | No. of tree species |
|---|---|
| Small | 41 |
| Medium | 54 |
| Large | 64 |

Table 4: Different types of plant species with their percentage of occurrence

| Types of plant species | Percentage of occurrence |
|---|---|
| Fruit | 37(28) |
| Timber | 30(23) |
| Medicinal | 7(5) |
| Fuel wood | 25(19) |
| Ornamental | 1(1) |

* Figure in parentheses indicate the No. of species in different categories.

Table 5: No. of individuals according to age groups in the household categories

| Age category | Small | Medium | Large |
|---|---|---|---|
| <5 | 350 | 482 | 834 |
| 5-10 | 226 | 306 | 483 |
| 10-15 | 47 | 99 | 136 |
| 15-20 | 34 | 49 | 105 |
| >20 | 22 | 29 | 46 |

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*) and 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*) and Segun (*Tectona grandis*) were found common in most homestead. Raintree (*Samanea saman*), Bamboo (*Bambusa* spp.). The reason that poorer farmers liked 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 took care the neighbor's inconvenience resulting from shade.

Macro and micro-environmental factors of the homestead, needs and choices of the family influenced the distribution of the tree species. That is why the species-mix varied from one location to another and from one farm category to another.

**Age distribution of trees:** The age of the trees in homegarden is an indicator of the development of consciousness for tree planting. Most of the trees were found in the age group of 1-10 irrespective of farm categories (Table 5). It indicates that there is a tendency to plant new trees in their homesteads. The Governments and NGO's campaign on tree plantation might have supplemented to enrich the homegarden with new trees in all farm categories.

Rather homestead dwellers used to cut trees immediately after first boost and do not retain trees beyond the age of maximum wood production. Consequently, the study area exhibited maximum number of trees of 1-10 year old. Homestead management is different from typical forest management and people harness maximum benefit through felling trees at early age. Similar trend was observed in India and Indonesia[16].

The ecological hazards hitting the area are frequently cyclones and storm surges of various intensities. The large trees having broader crown affected greatly by the heavy wind velocity of the storms and get uprooted, which is a common phenomenon in this area and thus restricted to maintain mature trees in the area. According to the Red Crescent Society, the drastic cyclone on the 29th April 1991 destroys 99% of the tree species of Sandwip. Thus least number of trees was found in the group of above 20 years of age. The larger farm categories had more trees (>20 years) than the smaller farm categories (Table 5). The solvent house owner may want to get return from the trees for year together and they can invest more to get much more from the trees, but the needy ones desire quick return from their small investment.

The positive interest and awareness of planting trees in the homestead area was found among all farm groups during the interview. They are interested to plant horticultural and first growing exotic species.

**Tree crop association:** Homegarden is an integral pattern of farming system where horticulture and forest species are grown with associate of vegetables and species. Farmers often grow vegetables and spices under the trees as trellis. In association with trees, different categories of crops, in respect to light requirement, plant height, canopy structure and leaf size, can be grown in the farm yard and home yard under multi layered production system of agroforestry[17]. On the other hand, it was also observed that higher interception of light by the canopy in densely populated homegarden had limited normal growth and productivity of some crop species due to over shading.

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.

**Management practice of the home gardens:** Most of the respondents 52% purchase their planting materials from the market. The common planting materials in the study area were seed, seedling and vegetative propagules. The farmers prefer seedling mostly because of its availability and better survivability. Only 22% of the planting materials were obtained from the homegarden. Farmers also bought planting materials from government nurseries 14% and other sources 12% (Table 6).

**Protection measures of trees in homestead:** The study revealed 71.11% household took various measures such as fencing, binding with hard stick, plantations of thorny shrubs, regular observations etc. to protect seedlings planted in the homestead and 28.89% household were reported to take no measures for protecting the planted seedlings (Table 7).

**Tree management problem:** The study area encountered some common problems faced by the farmers in tree establishment practices. The major problems faced by the farmers in tree establishment was the damage caused by animals 53% (Table 8). Animals were reported to eat leaves and branches of trees and trample the seedling and saplings. Seedling was also damaged by storm 51%, pest and insects 27% and by children 22%. Lack of technical knowledge, unavailability of space and losses by stealing were also encountered as tree management problem.

**Importance or significance of homestead:** Homegarden tree diversity acts as a reserve bank of food and cash for farmers. The income from tree species was significantly different within the farm categories. It was observed that

Table 6: Source of planting materials/ seedlings

| Source | % Respondent |
|---|---|
| Market/ private nursery | 52 |
| Govt. nursery | 14 |
| Own | 22 |
| Neighbors relative and others | 12 |

Table 7: Measures taken to protect the trees in homestead

| | Respondent | |
|---|---|---|
| Response | Number | Percentage (%) |
| Yes | 32 | 71.11 |
| No | 13 | 28.89 |

Table 8: Problems faced by the household in establishment and raising trees

| Farm category | % of the respondent |
|---|---|
| Damaged by animals | 53 |
| Damaged by storm | 51 |
| Damaged by pest and insects | 27 |
| Damaged by children | 22 |
| Lack of technical knowledge | 18 |
| Unavailability of space | 11 |
| Stolen | 11 |
| No problems | 7 |

Table 9: Distribution of income according to farm category (Tk/year)

| Farm category | Small | Medium | Large | Average |
|---|---|---|---|---|
| Income from tree species (Tk/year) | 3400 | 6100 | 7700 | 5733.3 |

the medium farmers intensively cultivated the homegarden to get monetary benefit (Table 9).

**Species conservation:** Home garden is an example of ex-situ conservation strategy where preservation of forest trees specially that are in endangered condition can be done. The present study revealed that some of the traditional fruit species like Dewa, Dalim, Deshigub, Lichu, Amloki, Dumur, Chalta, Katbadam were found very rare in homegarden due to paying less attention by the respondents and low economic value. Some farmers reported that they had felled some of the indigenous species for their slow growing and low economic value and replaced by planting exotic species. Ahmad[18] indicated that about 31 minor fruit species, have reached a stage of near extinction from the home in Bangladesh. No strategy and policy has been taken by government or non-governmental institution to preserve the indigenous and minor species from the verge of extinction.

Because of increasing unimaginary human need our historical, cultural and ethical resources have in danger[19]. 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 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 man made causes. At the same time it was observed that social attitude towards the homestead forestry was more or less positive. Finally it is recommended that as the ethical, aesthetic, cultural and economic values of plant diversity are increasingly recognized, it is necessary to take special attitude towards the conservation and proper management of homegarden plant diversity.

## REFERENCES


1. Bashar, M.A., 1999. Homegarden agroforestry: Impact on biodiversity conservation and household food security (A case study of Gajipur district, Bangladesh), M.Sc Thesis, Agricultural University of Norway, pp: 21-34.
2. Khan, M.S., 1998. Importance and use of the indigenous knowledge in sustainable development. Module No.3, Tech. Develop. Dissemination. Intl. Course in Regen. Agric., October 3-28, IIRR, Silang, Philippines, pp: 31-45.
3. Alam, M.K., M. Mohiuddin and S.R. Basak, 1996. Village trees in Bangladesh: Diversity and economic aspects. Bangladesh J. For. Sci., 25: 21-36.
4. Abedin, Z. and M.A. Quddus, 1990. Household Fuel Situation, Home Gardens and Agroforestry Practices at Six Agro-ecologically Different Locations of Bangladesh. In: Abedin, Z., C.K. Lai and M.O. Ali, (Eds.). Homestead Plantation and Agroforestry in Bangladesh. B Agric. Res. Inst. (BARI), WINROCK Intl. BARC, pp: 19-34.
5. Wickramasinghe, A., 1995. The evaluation of Canadian (Srilanka) homegarden. An indigenous strategy for conservation of biodiversity out side the protected area. IUCN.
6. Alam, M.K. and M. Mohiuddin, 1992. Some potential multipurpose trees for homesteads in Bangladesh. Agroforestry Information Series 2. Bangladesh Agric. Res. Council-Winrock Intl., Dhaka, Bangladesh, pp: 170.
7. Das, D.K., 1990. List of Bangladesh village tree species. For. Res. Instl., Chittagong, Bangladesh, pp: 11.
8. Hassan, M.M. and A.H. Mazumdar, 1990. An exploratory survey of trees on homestead and waste land of Bangladesh. ADAB News, March-April, pp: 26-32.
9. Khan, S.A. and M.K. Alam, 1996. Homestead flora of Bangladesh. Bangaldesh Agric. Res. Coun., Intl. Develop. Res. Centre, Village and Farm Forestry Project (SDC). Dhaka, Bangaldesh, pp: 4-85.
10. Siddiqi, M.S. and N.A. Khan, 1999. Floristic composition and socio-economic aspects of rural homestead forestry in Chittagong: A case study. Bangladesh J. For. Sci., 28: 94-101.
11. BBS., 1996. Bangladesh Agricultural Census, Bangladesh Bureau of Statistics, Ministry of Planning, Government of Bangladesh, pp: 21-40.
12. BBS., 1993. National-Series, Bangladesh Population Census, 1991. Zilla: Chittagong, Ministry of Planning: Dhaka, Bangladesh, pp: 21-40.
13. GOB., 2003 Banglapedia: National Encyclopedia of Bangladesh. In: Islam, S., (Ed.), Asiatic Society of Bangladesh, Nimtali, Dhaka, Bangladesh, 9: 45-46.
14. Michael, P., 1990. Ecological Methods for Field and Laboratory Investigation. Teta McGraw Hill Publishing Co. Ltd., New Delhi, pp: 404.

15. Odum, E.P., 1971. Fundamentals of Ecology. W.B. Saunders and Co. Phiadelphia, pp: 574.
16. Christanty, L., 1985. Home gardens in tropical Asia: A special reference to Indonesia. Paper Presented to the 1st Intl. Workshop on Trop. Home gardens. Inst. Ecology. Padjadjaran University. Bandung, Indonesia, pp: 14-36.
17. Rahim, M.A., 1994. Horticultural crops and agroforestry in Bangladesh. Proc. Workshop on Agroforestry, GTI. BAU, Mymenshingh, Bangladesh.
18. Ahmad, K.U., 1997. Minor Fruits in Homestead Agroforestry. In: Alam, M.K., F.U. Ahmed and S.M.R. Amin, (Eds.), Agroforestry Bangladesh Perspective, APAAN, NAWG and BARC Publication, Dhaka, pp: 165-169.
19. Agarwal, S.R., 1990. Trees, flowers and fruits in indian folk songs, folk proverbs and folk tales. Contribution to ethnobotany of India. Botanical Survey of India, Hawra, West Bengal, India, pp: 29-38.