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Homestead Plant Species Diversity and Its Contribution to the Household Economy: a Case Study from Northern Part of Bangladesh

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ABSTRACT : This paper analyzes data on the plant species diversity and their contribution to the livelihoods of rural people in five villages of Domar upazila, Nilphamari district, Bangladesh. Assessment was done by means of multistage random sampling. Information collected from a total of 40 households ranging from small, medium and large categories. A total of 52 plant species belonging to 34 families were identified as being important to local livelihoods. Fruits (37%), timber (23%) and medicinal (17%) species were the most important plant use categories. Determination of the relative density of the different species revealed that *Areca catechu* constitutes 19.17% of homestead vegetation of the area followed by *Artocarpus heterophyllus*, which occupies 10.34%. Margalef index showed that there is no major difference (5.11 for large, 5.49 for medium, 4.73 for small) across the different size classes and Shannon-Weiner Index of the study area varies from 2.75 to 2.98. Results show that the average annual homestead income varied from US$108.69 to US$291.67 and contribute 6.63% of the household income.

Keywords : Homestead, Rural livelihoods, Species diversity, Bangladesh

INTRODUCTION

The significance of homestead to rural livelihoods is well appreciated throughout the world (Fernandes and Nair, 1986; Soemarwoto, 1987; Torquebiau, 1992; Nair, 2006). The homestead has been described as an important social and economic unit of rural households, from which a diverse and stable supply of economic products and benefits are derived (Shackleton et al., 2008). Continued cultivation and use of homegardens over the past millennium has played a key role in successful achievement of sustainable livelihoods and self-sufficiency (Maroyi, 2009). On the other hand, from the conservation point of view, homesteads are the *in situ* conservation sites of a wide range of plant biodiversity (Uddin et al., 2001). Under this system, people plant or retain multipurpose trees and annual or perennial crops are inter-planted among the trees. The importance of homegardens in Bangladesh is enormous in the forestry sector, and this recognized in all quarters. Tree husbandry appears to be a universal practice in Bangladesh (Raintree, 1991). Homestead forests are a major source of forest products that play an important role in the economic life of the country by supplying the bulk of wood and other forest products in the market. Although relatively small in area, homestead forests supply 70% of timber and 90% of fuelwood and bamboo (Singh, 2000). In the last few decades increased human population has resulted directly and indirectly in depletion of the natural vegetation which in turn increases the pressure on the homestead forest especially in the developing countries (Alam and Masum, 2005) to meet various needs of the human beings as it provides basic needs of the people such as food, shelter, cash etc with their diversified species. There have been a few attempts to study different aspects on the homestead in different regions of Bangladesh. The floristic composition (mainly trees) in the homestead of

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Table 1. Description of the study area

Items	Description
Location	Domar Upazilais bounded by West Bengal of India on the north, Nilphamari sadar upazila on the south, Dimla and Jaldhaka upazilas on the east, Debiganj upazila on the west.
Area	Total area: 25,084 ha Total land under cultivation 20382.94 ha Forest cover 388 ha
Land type	High land: 13,706 ha (65.7%) Medium high land: 7,137 ha (34.21%) Medium low-land: 18 ha (0.9%)
Climate	Annual temperature: maximum 32.3°C, minimum 11.2°C Annual rainfall 2931 mm.
Population	2,98,988; (M/F ratio: 1.03)
No. of villages	47
No. of households	45786
Avg. household size	4.71 persons
Literacy rate	63% for both sex; male: 66% female: 60%

Source: DAE, 2009 & Banglapedia, 2009

Bangladesh was studied by various researchers (Das, 1990; Hassan and Mazumdar, 1990; Alam and Mohiuddin, 1992; Alam et al., 1996; Siddiqi and Khan, 1999; Motiur et al., 2005). While some other authors studied on homestead agroforestry and their uses (Alam et al., 1990; Miah et al., 1990; Momin et al., 1990; Choudhury and Sattar, 1993; Ahmad, 1997; Millat-e-Mustafa et al., 2002). Masum et al. (2008) carried out a combined study on ecological and socioeconomic importance of homestead forest in an offshore area of Bangladesh and for most parts of Bangladesh there is lacking of such kind of research. Within this context the present study was an initiative to identify the plant diversity and the contribution of homestead forest to the livelihoods of the people at Domar Upazila (subdistrict) in Nilphamari district, Bangladesh.

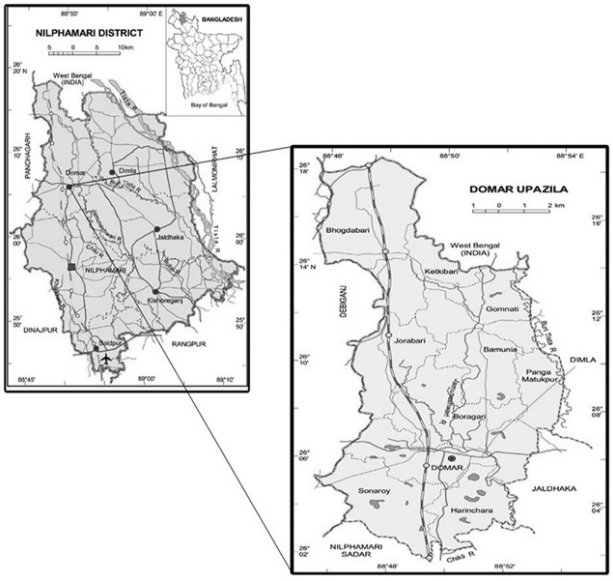

Figure 1. Map of the study area (Banglapedia, 2009)

Materials and methods

Study area

The study was conducted in Domar upazila under Nilphamari district of Bangladesh lying in between 26°02' and 26°18' north latitudes and between 88°46' and 88°54' east longitudes. The upazila is bounded on the north by West Bengal of India, on the south by Sadar upazila, and on the west by Debiganj upazila (Figure 1). Table 1 describes the main features of the study area.

Research method

Multistage sampling design was employed to collect data from the population. Among the ten unions (local

government unit) of the upazila, five unions as primary units (PUs) were selected randomly for the study. Then five villages (secondary units) one from each union were randomly selected and socio-economic survey was carried out for categorizing the households. It was found that the farm size is proportional to the socio-economic status of the households and they were then divided into three categories dependent on the farm size: large (>0.2ha), medium (0.14-0.2 ha) and small (<0.14 ha) (Millat-e-Mustafa, 1997). 40 households (10 from large category, 15 from both small and medium categories) were then selected randomly as ultimate sampling unit for data collection and the head of the household (irrespective of sex) were interviewed with the help of semi-structured questionnaire. All 40 gardens used in this study were inventoried for their plants. All plant species that were deemed useful to the farmer found in the sample area were listed. Number of individuals of each species per homestead were noted to determine the density (the numerical strength of a species in relation to a definite unit space is called its density, Shukla and Chandel, 1980), relative density (RD), Shannon-Wiener Index (H), Margalef Index, evenness index (e), and index of dominance (c). Later four were calculated for each category of land holding size classes. As described by Margalef (1958) and Krebs (1985), the following equations were used:

$$RD = (\text{Total no. of individuals of a species in all the quadrates} / \text{Total no. of individual of all species}) \times 100 \quad (1)$$

$$\text{Margalef Index} = (S-1) / \ln N \quad (2)$$

$$H = -\sum Pi \ln Pi \quad (3)$$

$$c = \sum (n_i/N)^2 \quad (4)$$

$$e = H/\log S \quad (5)$$

Where, S is the number of species; n_i is the number of individuals of each species, Pi is the number of individuals of one species divided by total number of individuals in the samples; N is the total number of individuals in the sample.

Results and discussion

Homestead plant species and their using categories

Table 2 represents the complete list of the species including their family, density and relative density. A total of 52 plant species under 34 families were identified from the study area and it was found that family leguminosae comprises the highest number of species (6) followed by anacardiaceae, meliaceae, palmae and rutaceae 3 species each. The number of plant species (excluding vegetable species) of the study area was lower than those found in homesteads of Tangail (52 species), and higher than Ishurdi (34 species), Jessore (28 species), Patuakhali (20 species), Rajshahi (28 species), and Rangpur (21 species) district respectively (Abedin and Quddus, 1990). Determination of the relative density of the different species revealed that *Areca catechu* (Supari) constitutes 19.17% of homestead vegetation of the area followed by *Artocarpus heterophyllus* (Kanthal) and *Mangifera indica* (Am), which occupies 10.34% and 7.96% respectively (Table 2). Again among the recorded 52 species, five different main uses were identified: 19 species were fruit producing species (37%), 12 species of timber, fuelwood and fodder (23%), 9 medicinal plants (17%), 8 vegetables and spices (15%) and 4 ornamental species (8%) (Figure 2). The study shows that all fruit species occupy 53.83% (relative density) of the total homestead vegetation in the study area and dominated over timber and other species. Similar findings also observed by several authors (Alam and Masum, 2005; Motiur et al., 2005; Millat-e-Mustafa, 1997; Siddiqi and Khan, 1999) in different region of Bangladesh. The farmers focus on fruit species because of their subsistence and cash need, while they planted timber species for cash return and future investment (Alam and Masum, 2005). In study area *Swietenia mahogany* (Mahogoni) and *Melia sempervirens* (Goraneem) were found as important timber species which used for

Table 2. List of species found in study area with their Density and Relative Density (RD)

Family	Scientific name	Local name	Density/ha	RD %
Acanthaceae	*Adhatoda vasica* N.	Bashok	0.52	0.14
Anacardiaceae	*Mangifera indica* L.	Am	30.30	7.96
	Spondias pinnata Kurz.	Amra	1.22	0.32
	Odina wooder	Sorjiga	0.70	0.18
Annonaceae	*Annona muricata* L.	Ata	0.70	0.18
Apocynaceae	*Alstonia scholaris* Br.	Chatim	2.26	0.59
Araceae	*Alocasia indica* (Roxb.) Schott	Mankochu	11.32	2.97
	Colocasia esculenta (L.) Schott	Kochu	16.54	4.35
Asclepiadaceae	*Calotropis gigantea* Br.	Akanda	0.70	0.18
Bixaceae	*Bixa orellana* Linn.	Latkon	0.70	0.18
Bombacaceae	*Bombax ceiba* L.	Shemul	0.87	0.23
Caricaceae	*Carica papaya* L.	Papaya	5.40	1.42
Compositae	*Tagetes patula* L.	Gadaful	2.26	0.59
Compretaceae	*Terminalia arjuna* Bedd.	Arjun	2.09	0.55
Cucurbitaceae	*Benincasa hispida* (Thunb) Cogn.	Chal kumra	1.22	0.32
	Lagenaria siceraria (Mol.) Stand	Lau	3.48	0.91
Elaeocarpaceae	*Elaeocarpus robustus* Roxb.	Jalpai	7.66	2.01
Euphorbiaceae	*Codiaeum variegatum* Bl.	Patabahar	1.57	0.41
	Ricinus communis L.	Verenda	0.87	0.23
Labiatae	*Ocimum sanctum* L.	Tulshi	1.92	0.50
Lauraceae	*Cinnamomum tamala* Nees	Tejpata	0.70	0.18
Leguminosae	*Acacia auriculiformis* A.Cunnex Be	Akashmoni	1.57	0.41
	Albizia spp.	Koroi	1.74	0.46
	Delonix regia (Boj) Raf.	Krishnochura	0.52	0.14
	Dolichos purpureus	Sheem	2.09	0.55
	Leucaena leucocephala (Ham.)	Ipil-ipil	0.35	0.09
	Tamarindus indica L.	Tetul	0.70	0.18
Lythraceae	*Lawsonia ineromis* Linn.	Mehedi	3.31	0.87
Malvaceae	*Hibiscus rosasinensis* L.	Joba	1.04	0.27
Meliaceae	*Azadiracta indica* A. Juss.	Neem	1.57	0.41
	Melia sempervirens (L.) All	Goraneem	14.63	3.84
	Swietenia mahogany (L.) Jacq	Mahogoni	26.82	7.04
Moraceae	*Artocarpus heterophyllus* Lamk.	Kanthal	39.36	10.34
Moringaceae	*Moringa olefera* Lamk.	Sojina	2.96	0.78
Musaceae	*Musa sapientum* L.	Kola	2.61	0.69
Myrtaceae	*Eucalyptus* spp	Eucalyptus	6.27	1.65
	Syzygium cumini (L.) Skeel.	Kalojam	6.10	1.60
Nyrtaceae	*Psidium guajava* (L.) Bat.	Peyara	6.62	1.74
Palmae	*Cocos nucifera* L.	Narikel	7.84	2.06
	Phoenix sylvestis (L.) Roxb.	Khejur	4.01	1.05
	Areca catechu L.	Supari	72.97	19.17
Punicaceae	*Punica granatum* L.	Dalim	4.18	1.10
Rhamnaceae	*Zizyphus mauritiana* Lamk.	Boroi	2.79	0.73
Rosaceae	*Rosa damacena* Mill.	Golap	2.96	0.78
Rubiaceae	*Anthocephalus chinensis* (Lam.) Rich	Kadam	4.53	1.19
Rutaceae	*Aegle marmelos* (L.) Correa	Bel	3.83	1.01
	Citrus aurantium L.	Kagji-Lebu	6.44	1.69
	Citrus grandis (L.) Osb.	Jambura	3.13	0.82
Sapindaceae	*Litchi chinensis* Sonner	Lichu	2.26	0.59
Ulmaceae	*Trema orientalis* Bl.	Jigni	5.05	1.33
Zingiberaceae	*Curcuma longa* L.	Holud	26.30	6.91
	Zingiber officinale	Ada	23.16	6.08

Source: Analysis of field data 2009.

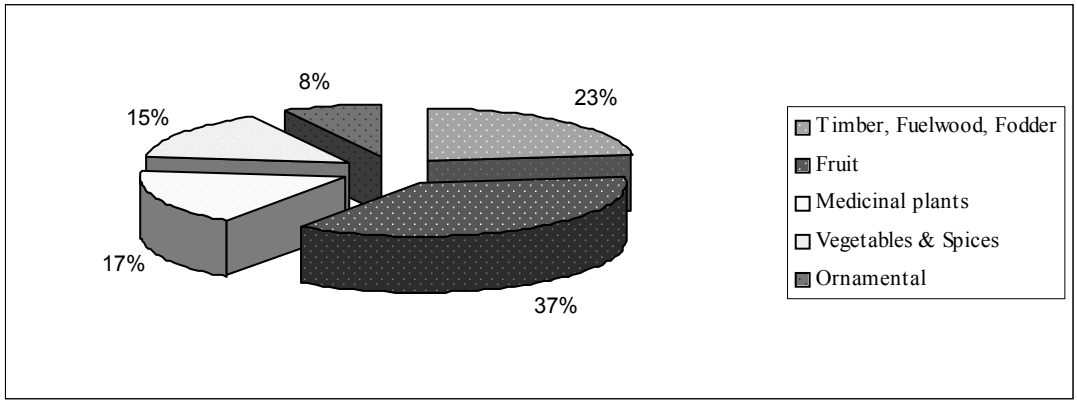

Figure 2. Different types of plant species with their percentage of occurrence

wide range of purpose such as furniture, construction etc. Vegetables grown around the home are used mainly for household's own consumption which formed a major part of the diet of households. In most of the cases it was found that the households planted fruits trees and vegetable species near and around their house for the purpose of protection and care.

Table 3. Ecological characteristics of 40 homesteads in study area

	Large (n=10)	Medium (n=15)	Small (n=15)
Total no. of observed species	35	38	31
Margalef Index	5.11	5.49	4.73
Shannon-Weiner Index	2.98	2.95	2.75
Evenness Index	1.92	1.86	1.84
Index of Dominance	0.07	0.09	0.10

Source: Analysis of field data 2009.

Plants diversity

Table 3 shows the ecological characteristics of 40 homesteads surveyed in the study area according to their land holding size classes. Highest number of species (38) were observed in medium category (average size 0.165ha) followed by large (average size 0.242ha) and small (average size 0.055ha) categories, which has 35 and 31 species respectively. In case of Margalef index, the results showed that there is no major difference (5.11 for large, 5.49 for medium, 4.73 for small) across the different size classes. Which may be because of that the species richness was not affected by homestead size. Similar results were also observed by Mohan (2004) in homestead at Kerala, India. Motiur et al. (2005) found a fairly high species richness index (7.7) in northeastern part of Bangladesh. The reason behind it may be the presence of large number of less significant species in that area. Shannon-Weiner Index of the study area varies from 2.75 to 2.98 with respect to their land holding size. This result can be fairly comparable with several other results from different parts of the tropics. Where Gajaseni and Gajaseni (1999) conducted Shannon tests in the homesteads of Thailand and found ranges from 1.9 to 2.7, Kumar et al. (1994) found 1.12 to 3.0 in Kerala, India and Motiur et al. (2005) found 3.1 in Sylhet region of Bangladesh. The calculated value of evenness indices are almost similar for each category and index of dominance of the study area revealed that the total number of individuals are more evenly distributed among all species present at the study area. Though fruit species were moderately dominant, but none showed absolute dominance as reflected by the very low index of dominance (0.1, maximum index of dominance was found for small category).

Role of homestead plants species in household economy

The average household income, homestead forest income, forest production, and self-use of homestead forest products across landholding size classes are given in table 4.

Table 4. Annual average income, homestead forest income, production and self-use

LHSC	AI	IOS	HFI	HFI/AI(%)	HSU	HFP
Large	2017.39	1826.09	191.30	9.48	81.16	272.46
Medium	1652.17	1565.22	86.95	5.26	71.73	158.68
Small	1286.95	1217.39	69.56	5.41	39.13	108.69
Overall	1606.52	1500	106.52	6.63	61.86	168.38

Source: Analysis of field data 2009. All figures given in US$. AI, average income; IOS, income form other sources; HFP, homestead forest production; HFSU, homestead forest self-use; HFI, homestead forest income

Farmers benefited from homegarden in several ways. Homestead plant diversity acts as a "reserve bank" of food and cash for farmers (Masum et al., 2008). The result shows that the average annual household income is equal to US $1606.52 and average annual gross production (includes both sale and self-use) of homestead forests is equal to US $168.38 per household, which accounts for 6.63% of the average annual household income. Out of this, homestead forest owners use US $61.86 (36.7%) to meet household needs and US $106.52 (63.3%) is sold to generate cash income. Highest forest income (includes the total sales of fruit, timber, fuelwood etc) was received by large landholding class US $191.3, while lowest was received by small class US $69.56. From this study it was found that homestead forest production, income and self use increases with the increasing landholding classes.

Conclusion

In an extremely environmentally and economically stressed country such as Bangladesh, where over 80% farmers are smallholders, homestead forest may be the only viable means of survival for the large rural populace (Ali, 2005). Homestead forest plays an important role in household economy by providing subsistence cash income and supplying various materials for household usage. From the study it was revealed that the homestead supports varied plant species and acts as a production unit for diverse goods and services. The results of this investigation indicate that a considerable array of plant species are nurtured in homesteads and these are an essential resource on which families depend. Therefore effective development and management of homestead forest is essential for sustainable growth and poverty reduction.

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