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Cultivated Plants in the Diversified Homegardens of Local Communities in Ganges Valley, Bangladesh

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ABSTRACT

Homestead agroforestry, in the form of homegardens, has a long tradition in many developing countries. These systems are an intimate mix of diversified agricultural crops and multipurpose trees planted, maintained by members of the household. This paper aims to explore the species composition commonly found in the homestead agroforestry systems in the Ganges valley of northern Bangladesh and their contribution to local livelihoods. Three villages i.e., 'Capasia', 'Chak Capasia' and 'Baduria' were selected as the primary study area. Data were collected by (1) rapid rural appraisal, (2) direct observation, (3) informal and structured interviews with a purposive sample of 90 households. A total of 53 plant species under 32 families were identified from the study area and it was found that the relative density were highest for *Areca catechu* (areca palm), *Artocarpus heterophyllus* (jackfruit) and *Mangifera indica* (mango). Financial analysis showed that homestead agroforestry net benefit increases with the increasing landholding classes. However, no significant difference was found between the number of species in different farm sizes, contrasting other studies that accused this relationship. The comparison of Shannon-Wiener index between agroforestry systems and natural forest showed no statistical difference, reinforcing the role of homegardens in biological conservation in Bangladesh. Therefore, increasing agroforestry practices in homesteads, should be the strategy for enhancing tree cover in order to meet basic needs of the local people and for environmental sustainability.

KEYWORDS: Home garden, multi-storied configuration, species, livelihoods

INTRODUCTION

People have been cultivating a wide range of plant species in and around their homes since the early stages of human history. Plant domestication began as an alternative and improved source of forest products as well as cultural services (Alam 2011). One of the oldest forms of managed land-use systems are agroforestry systems. Agroforestry combines agriculture and forestry techniques to create more integrated, diverse, productive, profitable, healthy and sustainable land-use systems with the direct integration of trees into the cropping system (Ahmed and Rahman 2004).

Homestead agroforestry or agroforestry homegardens are a traditional agroforestry practice described as "*land use practices involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and, invariably, livestock, within the compounds of individual houses, the whole crop-tree-animal unit being intensively managed by family labour*" (Fernandes and Nair 1986). Although several authors have tried to precisely define the term 'homegarden,' none is perhaps universally accepted as 'the definition' (Kumar and Nair 2004). However, there is a consensus that these systems are an intimate mix of diversified agricultural crops and multipurpose trees planted, maintained by members of the household and whose products are intended primarily for household consumption (Nair 1993).

Homestead practices are prevalent in many African, Latin American and South and Southeast Asian countries, including Bangladesh (Muhammed et al. 2012). These farming systems are described in English as agroforestry homegardens, household or homestead farms, compound farms, backyard gardens, village forest gardens, dooryard gardens and house gardens (Kumar and Nair 2004) and receive different local names such as Talun-Kebun and Pekarangan in Java (Indonesia), Shamba and Chagga in East Africa, and Huertos Familiares in Central America (Nair 1993).

In Bangladesh homestead agroforestry is referred to as 'Bosotvita Bagan' and is commonly considered as a small-scale enterprise established and maintained for household consumption, with additional household income through the sales of produce and environmental services (Rahman et al. 2005; Alam 2012). They constitute the most important source of wood, bamboo and other non-timber forest products in the country; attaining 15 to 25 times greater productivity than government administered forest lands (Miah and Hossain 2002). Hence, homegardens in Bangladesh may act as refuges for many native and rare plants (Kabir and Webb 2008).

Homestead agroforestry systems attained international popularity because they represent good examples of sustainable and resilient farming systems (Nair 1993; Kabir and Webb 2008). They offer practical responses to today's challenges such as land degradation, depletion of forest resources, and the rural energy crisis. Furthermore it contributes to the optimum utilization of scarce land, while enhancing environmental and landscape outcomes (Akhter et al. 2010).

The main attributes of these systems, that have been identified as contributing to conservation and livelihoods, are: the high levels of biological diversity; efficient nutrient cycling offered by multispecies and multistrata composition; conservation of bio-cultural diversity; low dependence on external inputs; improvement of household income; product diversification (thus avoiding risk and vulnerability), as well as nonmarket values of products and services; and social and cultural values including the opportunity for gender equality in managing the systems (Kumar and Nair 2004; Alam et al. 2005; Alam 2011).

Due to their social, economic, ecological and environmental benefits, homegardens are receiving increasing attention from scientists, practitioners and policymakers (Alam 2011). However, there are still many gaps in the current knowledge since homestead forests around the world often exhibit remarkable variation in floral composition and structure depending on the physiographic and climatic conditions of the area and a wide variety of household characteristics (Muhammed et al. 2012). In this context, this paper aims to explore the species composition commonly found in the homestead agroforestry systems in the Ganges valley of northern Bangladesh and their relative contribution to local livelihoods.

RESEARCH METHODS

Three villages i.e., 'Capasia', 'Chak Capasia' and 'Baduria' in the Ganges Valley of Rajshahi, Northern Bangladesh were selected as the study area, the main reason being the presence of household experience and prevalence of homestead agroforestry systems. Fieldwork took place between November 2010 and June 2011.These villages lie between $24^0 25'$ to $24^0 20'$ North latitudes and between $88^0 40'$ to $88^0 45'$ East longitudes. The study area is characterized by a tropical monsoon climate. The maximum mean temperature observed is about $32^0 c$ to $36^0 c$ during the months of April, May, June and July; and the minimum temperature recorded in January is about $07^0 c$ to $16^0 c$. The annual average air humidity is 80% and the annual average rainfall is 1,448mm (BBS 2011).

The primary data were collected by (1) rapid rural appraisal (RRA) for basic information on the areas, (2) direct observation, (3) informal and structured interviews with a purposive sample of 90 households. Additional interviews were conducted with key informants to gain more insight with regard to species composition of homegardens. As it became clear that farm size is proportional to the socio-economic status of the households, a classification was made into three categories dependent on the size of agricultural holdings: large (>0.2ha), medium (0.14-0.2 ha) and small (<0.14 ha) (Millat-e-Mustafa 1997). The numbers of sample household in each unit is proportional (1%) to the size of each village. 90 households (20 from large category, 35 from both small and medium categories) were then selected purposively as ultimate sampling units for data collection. The head of the households were interviewed with the use of an informal and semi-structured questionnaire.

Secondary data was collected from local administrative, statistical yearbooks and related sources. The data collected from household interviews were cross-checked with key informants and people from various levels of society. At the stage of data analysis, qualitative and semi-quantitative analyses were carried out.

The Shanon-Wiener index for diversity is used to measure the density and relative density of homegardens. Species richness index and species evenness index were also calculated using Margalaf's formula (1958):

(A) Density of a species=

$$\frac{\text{Total no. of individuals of a species in all the quadrats}}{\text{Total no. of quadrates studied}}$$

(B) Relative density (RD) of a species =

$$\frac{\text{Total no. of individuals of a species in all the quadrats X 100}}{\text{Total no. of individual of all species}}$$

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(C) Shannon Wiener Index (H)=-∑Pi lnPi

(D)   Index of dominance (C)=∑ (ni/N)²

(E) Species richness index, (R)= (S-1) / lnN

(F) Eveness index (E) = H/log S

Where, S is the number of species; ni 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.

In order to evaluate the profitability of farm size, financial analysis was carried out considering the timing of benefit and costs throughout the rotation period of specific plant species. Three discounted measures were used in the present study.

$$BCR = \sum_{t=1}^{n} [B_t/(1+i)^t]/[C_t/(1+i)^t]$$
$$NPV = \sum_{t=1}^{n} [B_t - C_t]/(1+i)^t$$

Where, BCR is the benefit cost ratio, NPV the net present value, B_t the benefit in each year, C_t the cost in each year, t = 1, 2,……, n, n the number of years, and i the interest (discount) rate (assuming 0.10). The BCR is a relative measure, which is used to compare benefit per unit of cost. The NPV is an absolute measure, which estimates the net worth of plant species. In analysis, yearly total cost and return per tree was calculated from farmers perspective.

RESULTS

Homestead agroforestry's species composition and their using categories

Table 1 represents the complete list of the species including their family, density and relative density as a quantitative structure of homestead agroforestry in the study area. A total of 53 plant species under 32 families were identified from the study area and it was found that members of the family Leguminosae comprise the highest number of species (5) followed by Myrtaceae and Rutaceae (four species each). Finding of the relative density of the different species revealed that *Areca catechu* (Supari) constitutes 10.62% of the homestead vegetation of the area followed by *Artocarpus heterophyllus* (Kanthal) and *Mangifera indica* (Am), which occupies 9.10% and 8.34% respectively (Table 1).

From the recorded 53 species, seven different main uses were identified: 25 species were fruit producing species (33%), 18 species of timber, (24%), 12 species of firewood (16%), 7 species of vegetables (9%), 3 species of spices (4%), 5 medicinal plants (6%), and 6 ornamental species (8%) (Figure 1).

Table 1. Species composition with their density, relative density (RD) and usage category in study area

Family	Local name	Scientific name	Density	RD %	Usage
Anacardiaceae	Am	*Mangifera indica* Linn	13.05	8.34	F, T, *F
Acanthaceae	Bashok	*Adhatoda vasica* N.	1.30	0.83	M
	Amra	*Spondias pinnata* Kurz.	2.67	1.71	F
Annonaceae	Ata	*Annona muricata* Linn.	1.42	0.91	F
Araceae	Mankochu	*Alocasia indica* (Roxb.) Schott	3.56	2.28	V
	Kochu	*Colocasia esculenta* (L.) Schott	7.12	4.55	V
Bixaceae	Latkon	*Bixa orellana* Linn.	1.30	0.83	F
Bombacaceae	Shimul	*Bombex ceiba* Linn	0.83	0.53	T
Caricaceae	Papaya	*Carica papaya* Linn	4.74	3.03	F
Compositae	Gadaful	*Tagetes patula* L.	1.48	0.95	M,O
Cucurbitaceae	Chal kumra	*Benincasa hispida* (Thunb) Cogn.	3.26	2.09	V
	Lau	*Lagenaria siceraria* (Mol.) Stand	4.74	3.03	V
Dilleniaceae	Chalta	*Dillenia indica* Lmn.	0.95	0.61	F,T
Ebenaceae	Gav	*Diospyros embryopteris* Pets	0.77	0.49	F,T
Euphorbiaceae	Patabahar	*Codiaeum variegatum* Bl.	0.83	0.53	O
	Verenda	*Ricinus communis* L.	0.89	0.57	*F
Lauraceae	Tejpata	*Cinnamomum tamala* Nees	1.07	0.68	S
Leguminosae	Krishnochura	*Delonix regia* (Boj.) Raf.	0.95	0.61	O
	Rain tree	*Samanea saman* (Jacq.) Merr.	4.69	3.00	T, *F
	Sonalu	*Cassia fistula* Linn	0.53	0.34	T,*F
	Sheem	*Dolichos purpureus*	3.80	2.43	V
	Tetul	*Tamarindus indica* Linn.	0.47	0.30	F,T,*F
Labiatae	Tulshi	*Ocimum sanctum* L.	1.48	0.95	M
Lythraceae	Mendi	*Lawsonia inermis* Linn.	0.89	0.57	M
Meliaceae	Neem	*Azadirachta indica* A. Juss.	1.48	0.95	M, T
	Ghora neem	*Melia azadirachta* Linn.	2.91	1.86	T
	Mahogony	*Swietenia macrophylla* King.	5.81	3.72	T,*F
Moraceae	Dewa	*Artocarpus lakoocha* Roxb.	0.36	0.23	F,T,*F
	Kanthal	*Artocarpus heterophyllus* Lamk	14.23	9.10	F,T,*F
	Dumor	*Ficus hispida* L.f.	0.53	0.34	V
Moringaceae	Sajna	*Moringa oleifera* Lamk.	0.65	0.42	V
Myrtaceae	Peyara	*Psidium guajava* Linn.	4.74	3.03	F,*F
	Jam	*Syzygium cumuni* (Linn.) Skeel.	2.25	1.44	F,T
	Eucalyptus	*Eucalyptus* spp	3.32	2.12	T
	Gulab jamun	*Syzygium jambos*	1.13	0.72	F,T
Musaceae	Kola	*Musa sapientum* L.	4.45	2.84	F
Malvaceae	Joba	*Hibiscus rosasinensis* L	1.01	0.64	O
Oxalidaceae	Kamranga	*Averrhoa carambola*	0.77	0.49	F
Palmae	Narikel	*Cocos nucifera* Linn.	3.91	2.50	F,T
	Supari	*Areca catechu* Linn.	16.61	10.62	F
	Khejur	*Phoenix sylvestis* (L.) Roxb.	1.72	1.10	F
Punicaceae	Dalim	*Punica granatum* Linn	1.07	0.68	F
Rosaceae	Golap	*Rosa damacena* Mill.	0.89	0.57	O
Rubiaceae	Kadam	*Anthocephallus chinensis* (Lamk.)	2.55	1.63	*F
Rutaceae	Jambura	*Citrus acida* (Linn.)	0.71	0.46	F
	Kagji-Lebu	*Citrus aurantium* L.	1.36	0.87	F

	Bel	*Aegle marmelos* (L.) Correa	0.53	0.34	T,F
	Jalpai	*Elaeocarpus robustus*	1.01	0.64	F,*F
Rhamnaceae	Boroi	*Zizyphus mauritiana* Lamk.	2.67	1.71	F,T,*F
Sapindaceae	Litchu	*Litchi chinensis* Sonn.	0.89	0.57	F
Sapotaceae	Bakul	*Mimusops elengi*	0.30	0.19	O
Zingiberaceae	Holud	*Curcuma longa* L.	9.85	6.30	S
	Ada	*Zingiber officinale*	5.87	3.75	S

Note: F=Fruit, *F=Firewood, T=Timber,Vegetables=V, Spices=S, O=Ornamental, M=Medicinal
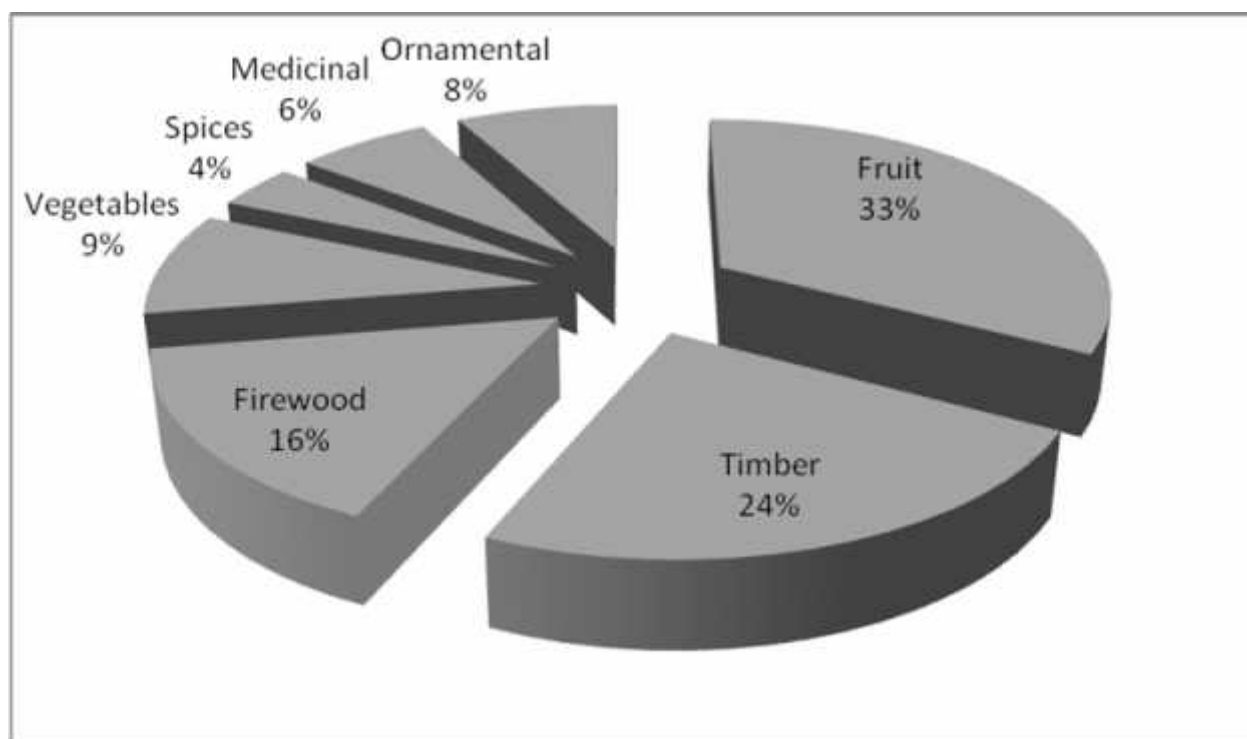

Figure 1. Different types of species with their percentage of occurrence

Vertical structure of the homestead agroforestry

The homestead agroforestry systems found in the study site form a three to four vertical canopy structure which is characterized by high species diversity, and which results in intimate plant associations. The layered canopy configurations and combination of compatible species are the most conspicuous characteristics of all systems. Contrary to the appearance of random arrangement, the gardens are usually carefully structured systems with each component having a specific place and function.

Figure 2. Homestead agroforestry in the study area (Capasia village)

The vertical canopy structure in the study site consists of a lower, intermediate and upper layer. The lower layer can usually be partitioned into two sub-layers, with the lowermost (less than 1 m height) dominated by different vegetable, herbs and medicinal plants, and the second layer (1-3 m height) being composed of food plants such as cassava, banana, papaya and yam. The intermediate layer of 3-10 m height is dominated by various fruit trees, some of which would continue to grow taller. The upper tree layer can also be divided into two sub-layers, consisting of medium-sized trees of 10-25 m occupying the lower layer, and emergent, fully grown timber and fruit trees occupying the uppermost layer of over 25 m height. This layered structure is never static, the pool of replacement species results in a productive structure, which is always dynamic while the overall structure and function of the system are maintained (Table 2).

Table 2. Vertical profiles of a homestead agroforestry

Vertical profile		Height/m	Species
Upper tree layer	Emergent layer	≥25	Mango, timber and other fruit trees occupying the uppermost layer
	Medium layer	10–25	Mango, occupying the next lower layer

Intermediate layer		3-10	Dominated by various fruit trees
Lower layer	Second layer	1-3	Composed of food plants such as cassava, banana, papaya, yam
	Lowermost layer	≤1	Dominated by different vegetables, medicinal plants, herbs and creepers: ginger, turmeric, and sweet potatoes

Species diversity

Table 3 shows the ecological features of the 90 homesteads surveyed in this study according to their landholding size classes. The highest number of species (41) were observed in the medium category (average size 0.159ha) followed by large (average size 0.275ha) and smaller (average size 0.047ha) categories, which has 38 and 33 species respectively. The Margalef index showed that there is no major difference (5.40 for large, 5.76 for medium, 4.93 for small) between the different size classes which may be because

species richness was not affected by homestead agroforestry size. The Shannon-Weiner Index of the study area varies from 3.21 to 3.47 with respect to their landholding size. The calculated value of evenness indices is almost similar for each category and index of dominance in the study area revealed that the total number of individuals is evenly distributed among all species present at the study area. Although fruit species were moderately dominant, none showed absolute dominance as reflected by the very low index of dominance (0.05, maximum index of dominance was found for small category).

Table 3. Ecological features of 90 homestead agroforestry in study area

	Large (n=20)	Medium (n=35)	Small (n=35)
Total no. of observed species	38	41	33
Species richness Index	5.40	5.76	4.93
Shannon-Weiner Index	3.39	3.47	3.21
Evenness Index	1.05	1.03	0.92
Index of Dominance	0.04	0.03	0.05

Potential of homestead agroforestry

The average net benefit, net present value, and benefit-cost ratio (BCR) of homestead agroforestry products across landholding size classes (including both sale and self-use except benefit from other sources in household benefit) are given in table 4.

The benefits from homestead agroforestry are different between farm sizes. Large farm size means more benefit than small farm size because more can be cultivated. However it is observed that medium sized farms have more intensively cultivated species than the larger farm sizes. The annual net

present value derived from each household depending on farm size varies from US $ 1.75 to US $ 2.42 (Table 4). Highest net benefit (this includes the total sale of fruit, timber, fuelwood, vegetables, spices, ornamental, medicinal etc.) was received by large landholding class US $ 2.84, while the lowest was received by small class US $ 2.09. From this study it was found that homestead agroforestry net benefit (includes both sale and self-use) increases with the increasing landholding classes.

Larger farm size was found profitable because of a high benefit-cost ratio (BCR) and a high net present value (NPV). The average BCR for larger farm size was about 19.26 followed by medium (15.42) and small (14.38).

Table 4. Comparision of average net benefit, net present value and benefit cost ratio of homestead agroforestry in different farm sizes (includes both sale and self-use)

Farm Size	NB	NPV	BCR
Large	2.84	2.42	19.26
Medium	2.37	1.94	15.42
Small	2.09	1.75	14.38

Note: All figures given in US$ and calculated values are valid only average per species in one year. Net benefits (NB), net present value (NPV) and benefit-cost ratio (BCR)

Food production from homestead agroforestry

In the study site, the magnitude and rate of production, as well as the amount of workload, of the homestead agroforestry system depend on its species composition. Although the choice of species is determined to a large extent by environmental and socioeconomic factors, as well as the dietary habits and local market demands, there is a remarkable similarity with respect to species composition among different homegardens, especially with respect to the herbaceous components. This can be explained by the fact that food production is the predominant role of most herbaceous species and the presence of an over story requires that the species are shade-tolerant. Thus, tuber crops such as ginger, turmeric and sweet potato dominate because they can be grown with relatively little care as an understory species in partial shade and yet be expected to yield reasonable levels of carbohydrate-rich produce. Harvesting can be staggered over several weeks depending upon household needs.

We found that apart from providing a steady supply of edible products fruit trees such as guava, jackfruit, mango, and other food-producing trees such as *Moringa oleifera* often provide a substantial proportion of the energy and nutritive requirement of the local diet. Food production is thus the primary function and the role of most, if not all, homegardens. An important characteristic of food production in homegardens is the nearly continuous production throughout the year. The combination of crops with different production cycles results in a relatively uninterrupted supply of food products. Depending on the climate and other environmental characteristics, there are peak and slack seasons for harvesting the various products, but generally

there is something to harvest daily from most homegardens. Most of this production is for home consumption, but any marketable surplus can provide a safeguard against future crop failures and security. Additionally, these harvesting and maintenance operations require only a relatively small amount of labor from the members of the family.

Social benefits

Homestead agroforestry has two categories of social benefits: livelihood and cultural. Livelihood benefits are derived from both non-market and market issues. Cultural benefits include the useful household and community activities, continued ability to observe special practices and transfer knowledge from one generation to another. These benefits are not exclusive, but meet multiple needs of the local people.

a) Livelihood Benefit

In the study area homestead agroforestry contributes to local livelihoods through both market and non-market perspectives. Non-market perspectives are personal consumption, and dietary benefits simply as a healthy diet from fresh produce. Market perspective includes the sale of agroforestry products. At the study site, farmers use 30% fruits i. e., mango, banana, papaya etc., for personal consumption and gifts. Another 70% they sell in the local markets (Figure 3). 80% crops i.e., ginger and turmeric, they used for personal consumption.
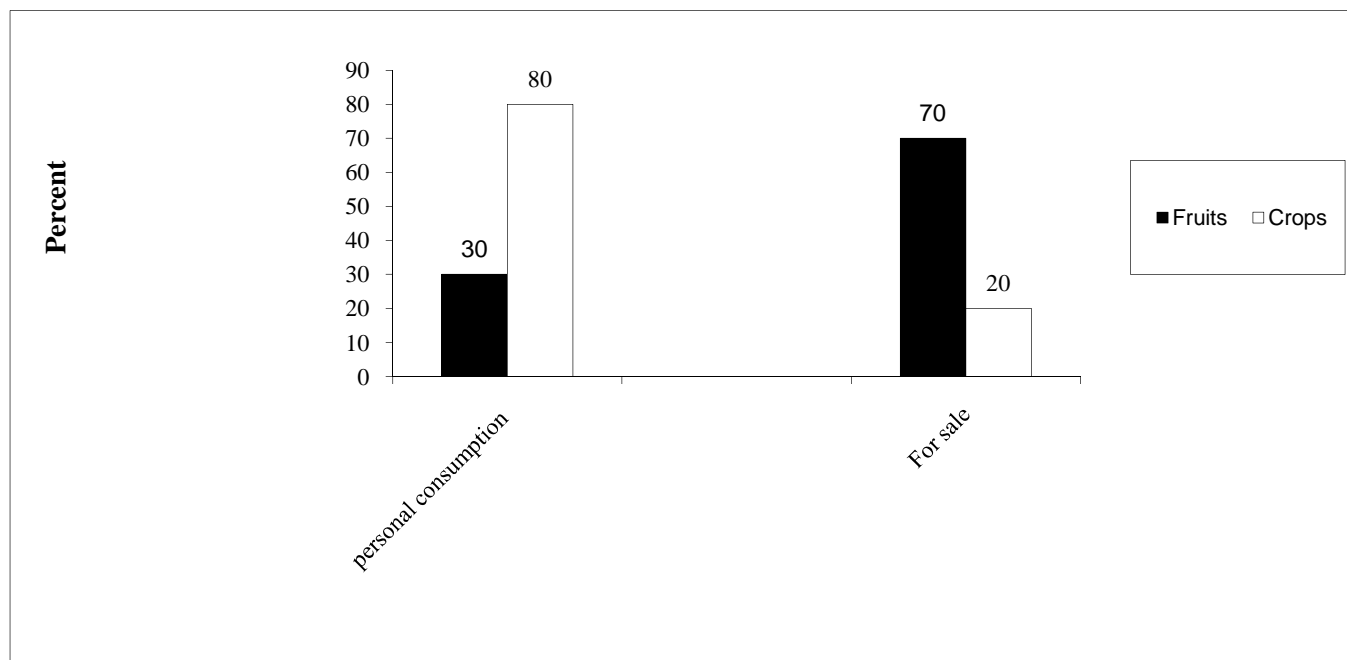
Figure 3. Amount of fruits and crops for personal consumption and for commercial purpose

b) Cultural Benefit

Homestead agroforestry also has important cultural values to the local people. For example, fruits are often given as a gift and play a critical role in building and maintaining social networks. The banana is used for many functions. For example the whole plant is use to make wedding gates and the leaves as a plate to provide wedding foods to the guests. Mango and banana are also considered important religious plants, and their leaves and fruits are used for religious ceremonies, such as a holy goods in the prayers of Hindu religion. It is also an opportunity for the older family members to pass traditional cultivation knowledge on to the next generation.

DISCUSSION

In our study it is found that fruit species are dominant over timber species (33% and 24%, respectively). The species with higher relative density (*Areca catechu, Artocarpus heterophyllus* and *Mangifera indica*) were also highlighted as species of the major floral composition in previous studies of homestead plant diversity (Hocking et al. 1996; Ahmed and Rahman 2004; Muhammed et al. 2012; Alam and Sarker 2011). Similar results were found by Motiur et al. (2005). But, contrasting with the hegemonic view of preferences for fruit species, Muhammed et al. (2012) noticed that in the newly planted homestead plants, timber species are gradually increasing indicating a probable change in future homestead plant structure and composition. The current form and composition of homegardens is an outcome of farmers' numerous practices of 'trial and error' (Alam 2011).

In spite of the very small average size of the management units in the study area, it was verified a complex vertical structure with three or four strata supporting high species richness. The number and the height of different strata in homestead agroforests varies to an extent depending on the species composition and regional climate and soil characteristics that determine tree growth (Alam 2011). Millat-e-Mustafa et al. (1996) registered six vertical strata with higher plant density and species richness recorded in the lower three. Nevertheless, three to five layers are the most common numbers reported for homestead systems in Bangladesh (Alam 2011). Regardless of the specific number of layers or strata, the maintenance of a complex vertical structure is an efficient strategy not only to increase biodiversity but is also for poor farmers use their small areas of land more effectively (Momen et al. 2006).

In this study, there is no major differences between the number of species in different farm sizes, contrasting other studies that accused this relationship. Millat-e-Mustafa et al. (1996) observed a direct association between species richness and farm size, indicating a greater diversity of resources at the disposal of larger farmers. The same pattern was observed by several authors (Rahman et al. 2005; Kabir and Webb 2008; Alam and Sarker 2011). Since the reason behind this trend might be the fact that larger farms had a greater spatial extent to plant more species, as suggested by Alam and Sarker (2011), probably the small-farmers in our study site are compensating the lack of horizontal space using many vertical strata.

With regard to the diversity indexes, the values obtained were very similar to the ones found in other studies about species diversity in homestead agroforestry in Bangladesh (Rahman et al. 2005; Motiur et al. 2005, Muhammed et al. 2012). The average Shannon-Wiener diversity index calculated in this study (3.36) is also close to the national average (3.23) (GOB 2009) and to the value presented in a recent synthesis that compiled the published literature on agroforestry systems (3.50) (Bardhan et al. 2012). Compared with other studies across the world, homegardens in Bangladesh exhibit high species richness (Kabir and Webb 2008). The comparison of Shannon-Wiener index between agroforestry systems and natural forest showed no statistical difference, reinforcing the role of homegardens in biological conservation in Bangladesh (Bardhan et al. 2012). The wide range of uses of homegarden plants indicates that Bangladesh farmers possess and

nurture a rich heritage of such traditions, and reflects the importance of conserving them (Millat-e-Mustafa et al. 2002). In ecological terms, homegardens improve the ecological conditions of cultivated areas through reduction of soil erosion, increasing tree coverage, and maintaining soil fertility (Nath et al. 2005).

Homestead agroforestry systems play an important role in the subsistence of local livelihoods in rural Bangladesh (Shin et al. 2004). It was verified that food and timber production is the primary function of the sampled homegardens. While homestead agroforestry may appear unimportant in rural livelihoods, in reality its contribution to ensure food security is crucial (Rahman et al. 2005). In the case of the studied homegardens the combination of species with different life cycles guarantees the continuous food production throughout the year, a strategy already described in literature (Rahman et al. 2005). The preference for horticultural species over timber species found in this study can reflect the relevance of the former to household food and nutrition requirement, as was also observed by Momen et al. (2006).

The results obtained in this study confirm that homestead systems can play a significant role in improving food security for the resource poor rural households in developing countries such as Bangladesh, as pointed out by Asaduzzaman et al. (2011). Homestead production, if combined with nutrition education, can have a significant impact on nutritional status. Furthermore, homestead agroforests are maintained by at least 20 million households and provide most of the supply of timber and non-timber products in Bangladesh, reducing the pressure on natural forests which cover less than 10 percent of the country (Kabir and Webb 2008; Muhammed et al. 2012).

Homestead agroforestry is a time-tested example of sustainable, multi species, agroforestry land-use, practiced as a subset of the farming system. As assemblages and repositories of a vast number of plants in small parcels of land around the home in direct and constant interaction with its owners, the homegardens fulfil specific economic, social, and cultural needs of the individual owners and provide biological conservation, carbon sequestration, and such other intangible yet valuable benefits to the society. Besides these benefits, farmers faced several problems, which included inadequacy of planting materials, shortage of land, land tenure insecurity, marketing of products, and above all, that is a land use with difficult-to-follow cropping patterns being required to avoid shading effects on the undergrowth (Nath et al. 2005).

To overcome all of the mentioned problems, the development and encouragement of homestead forestry should be one aim of the general policy of many government and non-governmental agencies (Salam et al. 2000). The supply of quality seedlings, effective institutional support, and efficient marketing facilities of homegarden products are essential (Akhter et al. 2010) while in ecological terms, the protection and propagation of rare species are crucial (Kabir and Webb 2009).

CONCLUSION

To obtain fruits, fuelwood, timber and various other agricultural products as well as to maintain equilibrium in the ecosystem, establishment of multi-layered cropping systems in the homesteads is inevitable. Although the existing forest policy of Bangladesh supports the importance of homegardens, no implementation efforts can be detected to improve overall system performance. Government and non-government agencies should work closely with local people to provide advisory and material support to play significant roles in creating a better future for these people and trees, and to make more proactive, locally-oriented development pathways. This will also require better collaboration between conservation, industry, state and community actors at the local level. Increasing agroforestry practices in homesteads, should be the strategy for enhancing tree cover in the Ganges valley of Northern Bangladesh in order to meet basic needs of the local people and for environmental sustainability.

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