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Homestead tree species diversity: An inventory by secondary school students in Mymensingh, Bangladesh

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ABSTRACT

Continued loss of forest vegetation in Bangladesh's national forests and protected areas poses a threat to forest productivity and biodiversity due to human population growth and other biotic and abiotic factors. An inventory was conducted by the students of Jagir Uddin High school of Muktagacha *upazila Mymensingh district, Bangladesh with an objectives to quantify the tree species diversity of their homestead areas. The study was conducted with during the period of 2021. A total of 159 students were involved with this studies. 3959 individuals belongs to 38 types of tree species were was recorded by the students from 11 villages those were belongs to 33 genera and 20 families. Areca catechu (Supari), Mangifera indica (Mango) and Acacia auriculiformis (Akashmoni) constituted the major floral composition. Species diversity of the survey area was 2.5. In all of the locations studied, horticulture plants were more numerous than timber species. However, there is a noticeable uptick in the number of timber species among the newly planted homestead plants. This pattern of floral dynamics suggests that the make-up of homestead plants will likely shift in the not-too-distant future. The results of this study show that there is a great deal of plant diversity in Bangladesh's homestead forests, despite their sparse distribution.*

Key Words: *Bangladesh, Homestead forests, Shannon–Weaver index, Simpson index and Plant diversity*

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I. Introduction

Homestead forestry refers to a traditional agroforestry system in which food, fibre and fuel crops are grown on and around the homestead. The floral make-up and structure of homestead woods around the world are impacted by a wide range of factors, including local climate, topography and other

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aspects of individual households. Many countries in South and Southeast Asia, Latin America and Africa use household forestry systems. Home gardens and backyard agroforest gardens are popular in the Philippines, while "village-forest gardens" (Michon, 1983) are popular in Java and "mixed gardens" are popular in Central America. In Bangladesh, the terms "homestead forest" and "tree cover" are frequently heard. Bangladesh received FAO assistance in the early 1980s to complete a homestead forestry inventory. Homestead forests in Bangladesh have been found to be a valuable food, fodder and fuelwood resource, according to this inventory study (FAO, 1981). It is a subject that is always being studied, with countless studies focused on various aspects of home forestry. Bangladesh's National Forest and Tree Resources Assessment from 2005–2007 (GOB, 2009a), Bangladeshi home gardens' structure, floristics, vegetational characteristics and indigenous management (Mustafa et al., 1996 and 2000; Mustafa and Haruni, 2002), flood plain tree resources (Miah and Hossain, 2002), home garden farming systems (Ali, 2005) and home garden agro-structure forestry and diversity (Mustafa et al., 2000).

Preliminary research has shown that homestead woods in Bangladesh are rich in flora and serve a significant role in the country's rural economy, notably in terms of providing firewood and lumber, according to prior studies. Over two-thirds of Bangladesh's landmass (147.570 km^2) is dedicated to agriculture, with forestland accounting for 17.8 percent and urban areas accounting for 8.3 percent, respectively. Water and other land use activities make up the remaining 9.9%. (GOB, 1995). With only 0.022 hectares of forest per person, Bangladesh is near the bottom of the world in terms of forest cover (FAO, 2011). Due to continuing deforestation, the forest's vegetation has been reduced to grass, brush or shrubs. Despite Bangladesh's 17.8% forest coverage, less than 30% of the forest's land is covered in trees on 40% of the country's forest land (GOB, 2009a). Forest loss in Bangladesh is being exacerbated by factors such as a lack of public awareness, the transfer of forest land to non-forest uses and a lack of institutional and administrative capacity by the Forest Department (FD). Reduce demand for fuel and timber while also preventing deforestation and lessening the strain on natural forests with homestead forestry.

Forestry, agroforestry, deforestation and climate change are only a few of the agricultural subjects taught at Bangladesh's secondary schools. Along with textbook study, the student completed a variety of other tasks, including data collection, group projects, plant observation, a tree planter project and several other assignments. The tree species on the student's property and the variety of tree species were studied as part of these pursuits to assess the situation at the time.

II. Materials and Methods

Study areas

Participants were high school students from Jagir Uddin High School in the Muktagacha upazila of the Mymensingh District in Bangladesh. The area of the district is about 4363 km^2 and it is made up of a number of little valleys sandwiched between high woods (GOB, 2009b). The average annual rainfall is around 2174 mm, while the temperature fluctuates from 12^0C to 33^0C.

Sampling and data collection

The study was conducted by high school students from Jagir Uddin in order to learn more about the kind of plants found in the woodlands surrounding their homes. In March (2019), researchers surveyed 159 children from grades six through nine in 10 randomly selected communities. During the course of the fieldwork, we recorded the names and quantities of all plant species found in each of the randomly selected homes. All students and teachers were briefed on the questionnaire before the survey was taken out into the field. Before starting the survey proper, we did a pilot project in the field. With the assistance of a local senior citizen, students were able to correctly identify the plants in the guardian income situations. Since their economic value to the homesteaders was low and their potential utility was unclear, herbaceous plants were disregarded.

Data analysis

The English name, local name, scientific name, type, number and relative abundance of all species discovered at all homestead sites have all been recorded. Microsoft Excel and Paste were used for the statistical analysis.

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Table 01. Phytosociological parameters and diversity indices recorded by Jagir Uddin school students in their homestead

Biodiversity Attributes	Definitions	Sources
Density (D)	$D = \frac{a}{b}$	Shukla and Chandel (2000)
Frequency (F)	$F = \frac{c}{b}$	Shukla and Chandel (2000)
Abundance (A)	$z = \frac{a}{c}$	Shukla and Chandel (2000)
Relative Density (RD)	$RD = \frac{n}{N} \times 100$	Dallmeier et al. (1992); Misra (1968)
Relative Frequency (RF)	$RF = \frac{y_i}{\sum_{i=1}^{k}(y_i)} \times 100$	Dallmeier et al. (1992); Misra (1968)
Shannon-Wiener Index (H)	$H = -\sum_{i=1}^{N} P_i(lnP_i)$	Shannon and Wiener (1963)
Simpson Index (CD)	$CD = \frac{\sum_{i=1}^{N} n_i(n_i - 1)}{N(N-1)}$	Simpson (1949)

Notes: a = Total number of individuals of a species in all the plots; b = Total number of plots; c = Total number of plots in which the species occurs; d = Total basal area of a species in a plot; e= Diameter at breast height in meter: k = Total number of plots; N = total number of individuals of all the species; n = Number of individuals of a species; P = n/N; S = Total number of species

III. Results and Discussion

Basic demographic information of student's households

The mean homestead size was 11.21 decimal/household across the study area. During this study, a total of 159 students (Out of 334 students) spontaneously surveyed 11 different villages. Among them, 85 from class six, 57 from class seven and 22 from class nine. The highest number of students were from Nimuria villages (35.85%), followed by Raghunathpur (11.32%), Rampur (10.69%), Shashora (10.06%) and so on. The lowest number of students were from Araibaria and Bishnupur village (3.14% each) (Table 02).

Table 02. Number students according to class and villages

Sl no.	Name of villages	Class 6		Class 7		Class 9		Total
		Total	Girls	Total	Girls	Total	Girls	
1.	Araibaria	4	3	1	1	0	0	5
2.	Bhattabari	3	0	1	0	3	2	7
3.	Bishnupur	2	1	3	0	0	0	5
4.	Choukhuria	3	2	1	0	3	0	7
5.	Ghoga	8	5	1	0	3	1	12
6.	Joyda	4	3	1	0	1	0	6
7.	Khudro kakinati	2	1	7	3	0	0	9
8.	Nimuria	30	17	18	14	9	5	57
9.	Raghunathpur	11	5	6	3	1	0	18
10.	Rampur	11	5	6	1	0	0	17
11.	Shoshora	7	3	7	1	2	1	16
	Total	85	45	52	23	22	9	159

Species composition

A total of 3959 individuals belongs to 38 types of tree species were recorded from 11 villages of Muktagacha upazila, Mymensingh surveyed by the students where *Areca catechu* L. (Supari), *Mangifera indica* (Mango) and *Acacia auriculiformis* (Akashmoni) were found the most dominant (Table 02) followed by *Artocarpus heterophyllus* (Kathal), *Cocos nucifera* (Narikel), *Psidium guajava* (Peyara), *Syzygium cumini* (Jam), *Ziziphus jujuba* (Boroi), *Litchi chinensis* (Litchu) *and* so on. Only a single individual was recorded in case of *Lannea coromandelica* (Jiga), *Phyllanthus acidus* (Arboroi) and *Phyllanthus emblica* (Amloki). According to the National Forest and Tree Resource Assessment report (GOB, 2009a), 15 species account for 80% of the total tree volume in the village forests: *Cocos nucifera, Samanea saman, Mangifera indica, Areca catechu, Swietenia spp., Artocarpus heterophyllus,*

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Phoenix sylvestis, Borassus flabellifer, Albizia procera, Artocarpus chaplasha, Bombax ceiba, Lannea coromandelica, Anthocephalus cinensis, Syzygium cumini and *Albizia richardiana*. Our findings are consistent with those of Muhammed et al. (2011), who found that four species— *Cocos nucifera, Samanea saman, Mangifera indica and Areca catechu* —accounted for over half of the total volume.

Species family composition

The Fabaceae family had the most species with five, followed by Rutaceae with four and Phyllanthaceae, Anacardiaceae, Arecaceae and Meliaceae with three each. Moraceae denoted two species, while the rest of the families only had one (Table 03). Among them, 20 families (60%) represented only one species followed by two species were represented by one family (5%); three and three species are represented by five families (25%) and 4 species (10%) and 5 species (5%), respectively. According to the genera, species belongs to 33 genera. Citrus has the most species (3), followed by Albizia, Artocarpus and Phyllanthus (2 species each). The remaining genera (87.88 percent) are represented by a single species.

Table 03. Homestead flora of the study areas

Sl No.	English Name	Local Name	Scientific name	Family	Habitat	Individual no
1)	Acacia	Akashmoni	*Acacia auriculiformis* Benth.	Fabaceae	T	472
2)	Bengal quince	Bel	*Aegle marmelos* (L.) Corrêa	Rutaceae	Ht	26
3)	Lebbek tree	Kala koroi	*Albizia lebbeck* (L.) Benth.	Fabaceae	T	6
4)	Rain tree	koroi	*Albizia saman* (Jacq.) Merr.	Fabaceae	T	23
5)	Custard apple	Ata	*Annona squamosa* L.	Annonaceae	Hp	54
6)	Pithraj	Pitraj	*Aphanamixis polystachya* (Wall.) R.Parker	Meliaceae	T	5
7)	Betel nut	Supari	*Areca catechu* L. i	Arecaceae	Ht	983
8)	Jackfruit	Kathal	*Artocarpus heterophyllus* Lam.	Moraceae	Ht	270
9)	Green Tampang	Dewa	*Artocarpus lacucha* Buch.-Ham.	Moraceae	Ht	3
10)	Star fruit	Kamranga	*Averrhoa carambola* L.	Oxalidaceae	Ht	2
11)	Neem tree	Neem	*Azadirachta indica* A.Juss.	Meliaceae	T, Mp	11
12)	Rambai	Latkan	*Baccaurea motleyana* (Müll.Arg.) Müll.Arg.	Phyllanthaceae	Mp	4
13)	Palm	Taal	*Borassus flabellifer* L.	Arecaceae	Ht	24
14)	Papaya	Pepe	*Carica papaya* L.	Caricaceae	Ht	33
15)	Grape fruit	Jambura	*Citrus grandis* (L.) Osbeck	Rutaceae	Ht	31
16)	Lemon Lebu	lebu	*Citrus limon* (L.) Osbeck	Rutaceae	Hp	31
17)	Sweet orange	Malta	*Citrus sinensis* (L.) Osbeck	Rutaceae	Hp	2
18)	Coconut	Narikel	*Cocos nucifera* L.	Fabaceae	Ht	255
19)	Elephant apple	Chalta	*Dillenia indica* L.	Dilleniaceae	T	2
20)	Velvet apple	Gub	*Diospyros discolor* Willd.	Ebenaceae	Ht	2
21)	Olive	Jolpai	*Elaeocarpus floribundus* Blume	Elaeocarpaceae	Ht	64
22)	Eucalyptus	Eucalyptus	*Eucalyptus globulus* Labill.	Myrtaceae	T	48
23)	Indian ash tree	Jiga	*Lannea coromandelica* (Houtt.) Merr.	Anacardiaceae	T	1
24)	Litchi	Litchu	*Litchi chinensis* Sonn.	Sapindaceae	Hp	106
25)	Mango	Aam	*Mangifera indica* L.	Anacardiaceae	Ht	678
26)	Moringa	Sajina	*Moringa oleifera* Lam.	Moringaceae	Mp	2
27)	Bur-flower tree	Kadam	*Neolamarckia cadamba* (Roxb.) Bosser	Rubiaceae	T	19
28)	Dates	Khejur	*Phoenix dactylifera* L.	Arecaceae	Ht	25
29)	Gooseberry	Arboroi	*Phyllanthus acidus* (L.) Skeels	Phyllanthaceae	Ht	1
30)	Indian gooseberry	Amloki	*Phyllanthus emblica* L.	Phyllanthaceae	Ht, Mp	1
31)	Guava	Peyara	*Psidium guajava* L.	Myrtaceae	Hp	251
32)	Pomegranate	Dalim	*Punica granatum* L	Lythraceae	Ht	16
33)	Hog pulm	Amara	*Spondias mombin* L	Anacardiaceae	Hp	10
34)	Mahogany	Mahogoni	Swietenia mahagoni (L.) Jacq.	Meliaceae	T	79
35)	Mango	Aam	*Syzygium cumini* (L.) Skeels	Myrtaceae	Hp	245
36)	Tamarind	Tetul	*Tamarindus indica* L.	Fabaceae	Ht	10
37)	Teak	Shegun	*Tectona grandis* L.f.	Lamiaceae	T	16
38)	Indian jujube	Boroi	*Ziziphus jujuba* Mill.	Rhamnaceae	Ht	148

Ht- horticultural tree species-18; Hp-horticultural plant-6; T- tree species-11; Mp-medicinal plants-4.

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Choice of Species Grown for Different Usages/ Horticultural versus timber species

As far as growing species go, homestead species in the study region are rather complex. Students' species records showed that in the study villages, horticulture species were more common than timber species (Table 03). Only a small fraction of them have any therapeutic value (Indian gooseberry, Neem, Rambai and Moringa). Multiple studies (Millat-E-Mustafa, 1997; Siddiqi and Khan, 1999; Masum et al., 2008) and surveys of households across the country confirm that most people prefer fruit species (45%) for economic reasons and to meet family needs. Sixty-six percent are fruit trees, while forty fruit trees are found in homestead areas, according to a study by Muhammed et al. (2011). The majority of homestead forests in the research areas were found to have abundant, economically and nutritionally valuable plant species such as banana, betel nut, jackfruit and mango.

Ecological diversity indices of homestead species

Students in grades 6 and 7 recorded the greatest diversity of taxa (35 each) (Table 05). The students in Class IX were able to document 26 different taxonomic groups. Nimuria village had the highest number of documented taxa (34), followed by Shashara (26) and Kudrokakinati (20), Rampur (19) and Bhattabari (19), Ghoga (18) and so on. Araibaria and Joyda villages recorded the fewest total taxa (13) (Table 04). In his research on the plains of the Barind tract, Zaman et al. (2010) found only 28 different tree species. While conducting research in three different places, Rahman et al. (2009) discovered that species richness decreased in each. Millat-e-Mustafa (1997) documented 92 species of perennial flora over 4 locations. In his research on homestead-agro forestry in Rangpur, Islam (1998) identified 77 different species. There are 237 beneficial species in the Yatinuwara area of the Kandy district of Sri Lanka, as discovered by Sellathural (1997). While conducting his survey in Gazipur, Bashar (1999) found 136 species of practical importance in people's houses. Abedin and Quddus (1988), citing Alam et al. (2005), reported a total of 34 plant species in the Ishurdi district, 28 in the Jessore region, 20 in Patuakhali, 28 in the Rajshahi area and 21 in the Rangpur region.

We discovered that the average homestead plant species diversity index was 2.5, which is lower than the national average (3.23; GOB, 2009a), though it was 3.15 in four upazila of Mymensingh (Muhammed et al., 2011). The Shannon-Weiner Index for the study region ranges from 2.177 to 2.577 for the villages and from 2.428 to 2.572 for the student groups. Several additional results from the tropics can be compared favorably to this one. In the homesteads of Thailand, Gajaseni and Gajaseni (1999) conducted Shannon tests and discovered ranges of 1.9 to 2.7; in Kerala, India, Kumar et al. (1994) found 1.12 to 3.0 and in the Sylhet region of Bangladesh, Motiur et al. (2005) found 3.1. In contrast to a study conducted in a particular flood plain district of Bangladesh by Miah and Hossain (2002), who found a diversity index of 0.379 there, our plant diversity index is significantly higher. In contrast, the species diversity index was only 2.79 for Javanese farms and 3.71 for Sudanese farms (Christanty et al., 1986).

Table 04. Village wise floral indices

Villages	No of species	Sum	Density	Relative abundance	Shannon-Weiner index	Simpson's diversity index	Margalef index
Araibaria	13	94	18.800	29.41	-2.216	0.862	2.641
Bhattabari	19	202	28.857	22.28	-2.278	0.860	3.391
Bishnupur	17	212	42.400	26.76	-2.206	0.848	2.987
Chaukhuria	15	166	23.714	23.85	-2.285	0.867	2.739
Ghogha	18	252	21.000	17.33	-2.245	0.857	3.074
Joyda	13	93	15.500	23.10	-2.364	0.896	2.647
Kakinati	20	238	26.444	17.55	-2.298	0.835	3.472
Nimuria	34	1532	26.877	4.92	-2.577	0.873	4.499
Raghunathpur	17	374	19.684	12.72	-2.177	0.847	2.703
Rampur	19	352	20.706	18.17	-2.348	0.867	3.07
Shoshara	26	446	27.875	9.31	-2.385	0.864	4.098

Total individuals are more similarly distributed among all species present in the study region, as shown by the estimated value of evenness indices being almost similar for each category and index of dominance of the study area. There were parallel findings in the Simpson's diversity index. The study's results also showed that species distribution was quite even.

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In terms of the Margalef index, the results showed no significant variation between the classes (3.93 for class 9, 4.72 for class 7, and 4.46 for class 6) (Table 05). Which may explain why there was no difference in species richness between age groups. According to Motiur et al. (2005), the northeastern part of Bangladesh has a species richness index of 7.7, which is fairly high. This could be due to the abundance of relatively unimportant species in the region.

Table 05. Floral indices according to class categories

Categories	No of species	Individuals	Simpson's diversity index	Shannon-Weiner index	Evenness indices	Margalef index
Class IX	26	578	0.8751	2.462	0.4512	3.931
Class VII	35	1342	0.8864	2.572	0.3739	4.721
Class VI	35	2039	0.863	2.428	0.3238	4.462

IV. Conclusion

The study areas' diverse and delicate homestead forests suggest that local people are rich in indigenous and traditional homestead forestry knowledge. All land, including homesteads, must be put into production because many people in the study area and Bangladesh have very little per capita landholding. People support scientifically-based homestead forestry. These examples show that homestead forestry can improve economic and environmental well-being. Homesteaders should receive technical and managerial training. Planting more tree species suggests a change in homestead plant structure and composition in the study areas. To develop effective homestead forestry models, more research on available knowledge, homestead practices, and knowledge synthesis is needed.

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