Tree resources in the floodplain areas of Bangladesh

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Keywords: Homesteads; species composition; dominance; diversity; agroforestry, Bangladesh. FDK 26 : 915 : 181 : (54)

Abstract: Tree resources in one of the floodplain area of Bangladesh were enumerated considering the composition, distribution and diversity of the species. The enumeration was done in the homesteads, campuses of the institutes and waste/marginal lands. *Artocarpus heterophyllus* and *Swietenia mahagoni* were found to be the most common and major tree species.

Abstract: Die Rohstoff und Früchte liefernden Bäume in einem der Überschwemmungsgebiete von Bangladesh wurden im Hinblick auf die Häufigkeit, das Vorkommen, die Zusammensetzung und Verteilung der Baumarten sowie die Diversität untersucht. Die Auszählung erfolgte im Gelände von Wohnstätten, Schulen und Instituten sowie auf marginal genutzten Ödländereien. *Artocarpus heterophyllus* und *Swietenia mahagoni* waren die am häufigsten vorkommenden Baumarten.

1. Introduction

Bangladesh, one of the world's most densely populated countries, lies in the northeastern part of South Asia between 20°34′ and 26°38′N latitude and 88°01′ and 92°41′E longitude (BBS 1999). About 85% of the population live in rural areas in 15.4 million households spread over 68 000 villages (ADB 1993). In Bangladesh, the homesteads are generally small, some 80% are less than 0.162 ha and 17% of the household have no homestead. However, homesteads in Bangladesh cover an area of 270 000 ha (ADB 1993) and ADB (1993) reported that some 10 million households annually supply about five million m^3 of wood and 0.53 million metric tons of air-dried bamboo. These homesteads grow trees and other crops under an intensive and efficient system of agroforestry, using traditional knowledge, combining multipurpose trees, food and forage plants, bamboo, palms, medicinal plants, and spices and they attain 15 to 25 times greater productivity than government administered forest lands. Today, homestead forests are the most important source of wood, bamboo and other non-wood forest products in the country. Recently, a positive trend of institutional and strip plantation is being implemented on the initiative of both governmental and non-governmental organizations, especially in the floodplain areas of Bangladesh. As floodplain areas are far away from the traditional governmental forests, the afforestation initiative is significant in these areas in meeting the various forestry needs. There is, however, no program to improve the overall productivity of these forests, or to produce yield-increasing technology. Systematic research in these fields is a pressing need. Millat-e-Mustafa *et al.* (2000) concluded that further study is necessary regarding tree species composition in specific areas of Bangladesh in order to obtain an important tool for sustainable forest management.

Some studies exist on different regions of Bangladesh regarding the species composition, structure (especially perennial species) and the constraints of homestead tree production, as, for example, those by Islam & Ahmed (1987), Akhtar *et al.* (1989), Alam *et al.* (1990), Abedin & Quddus (1990a), Momin *et al.* (1990), Miah *et al.* (1990), Millat-e-Mustafa *et al.* (1994, 1996), Akhter *et al.* (1997), Hossain & Rakibbu (1993) and Misbahuzzaman & Ahmed (1993). Khaleque (1987) and Leuschner & Khaleque (1987) reported the findings of homesteads from seven districts representing a cross section of the agro-ecological zones. Since the ethical, aesthetic and cultural values of biodiversity are increasingly recognized (Kemp & Chai 1993), it is necessary to investigate the tree resources of various geographic locations. Most of the cited studies only provide information on homestead tree species resources. Very few authors investigated the tree resources in a district as a whole, taking all factors into consideration that could provide realistic figures on the tree species composition and structure. Thus, the present study aims at identifying the tree species composition, uses, dominance and diversity in the homesteads, government, semi-government and private institutions and waste/marginal lands of all the representative locations of the district of Narsingdi, a flood plain area of Bangladesh.

2. Materials and methods

The study was carried out in all six *thanas* (sub-districts) of the Narsingdi district, a floodplain area of Bangladesh, which lies between 23°46′ and 24°15′N latitude and 90°34′ and 90°59′E longitude. The total area of the district is 1140.76 km^2 consisting of 6 *thanas,* 70 rural unions, and 1061 villages with a total 315 749 households (BBS 1995). Most of the soils (80%) are floodplain, the remainder are terrace (BBS 1999). The climate is fairly equable, with a maximum temperature of 41.67 °C and a minimum of 6.66 °C (average 26.66 °C). The maximum rainfall recorded is 4562 mm, with an annual average of 2320 mm (BBS 1995). Based on preliminary investigations of maps and statistical information, a multistage random sampling technique was employed in all the six *thanas* of the Narsingdi district to record tree species presence and variability. The following sites were chosen for sampling: homesteads, campus of academic institutes (schools, colleges, *madrasha),* waste/marginal lands (highways, roads, canal and riverbanks) and government, semi-government and private institutions (hospitals, offices, mills/factories). From each of the six *thanas,* 35 unions were selected (50% of the total) and 25 villages (5%) were then randomly selected from each union. 5 homesteads were randomly selected from each village (125 in all). Among the academic institutes and other government, semi-government and private organizations, 30 schools, 8 colleges, 15 *madrashas* (institutes for Arabic study), 6 government hospitals, 15 government and semi-government offices and 12 semi-government and private mills/factories were randomly selected and represented 15% of the sample. To identify the tree species composition in waste/marginal land a total of 10 km highways, 25 km feeder roads, 10 km canal and 22 km riverbanks were sampled randomly. The fieldwork was carried out from November 2000 to March 2001.

The distribution of different tree species on the selected sites was recorded physically. In homesteads and on the campus of the institutions a full enumeration process was adopt-

ed. After the vegetation survey, a list of the tree species present in the district was made with the basic reference of PRAIN (1981). A tree use matrix exercise was then conducted to explore the uses of the species and lists compiled according to use as timber, fuelwood or fruit trees.

To determine species dominance, an Importance Value Index (IVI) was calculated for all tree species using the following formula (SHUKLA & CHANDEL 1980).

IVI = Relative density + Relative dominance + Relative frequency

where,

$$\text{Relative density} = \frac{\text{Number of individuals of a species}}{\text{Total number of individuals of all species}} \times 100$$

$$\text{Relative dominance} = \frac{\text{Combined basal area of a single species}}{\text{Total basal area of all species}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of one species}}{\text{Sum of all frequencies}} \times 100$$

In the study, the IVI of each species was calculated and then ranked by *thana.* Finally, the dominant species was determined by comparing the mean ranking of each species.

Tree species diversity was determined using Shannon's index (FOWLER & COHEN 1992):

$$H_i = -\Sigma P_i \ln P_i$$

where, P_i = Proportion of a particular species in a sample.

Shannon's index was calculated on the basis of all samples in each *thana* (sub-district). The index for the entire district was the average value for all *thanas.*

3. Results and discussion

3.1 General tree species diversity

The study reveals the presence of 102 tree species belonging to 80 genera and 41 families in the Narsingdi district *(table 1).* The family Leguminosae dominates with 21 species followed by Myrtaceae, Moraceae, Rutaceae, Arecaceae and Meliaceae, comprising 8, 7, 6, 6 and 5 species, respectively, whereas 26 families represent single species only. The total number of species represented by Raipura, Belabo, Palash, Shibpur, Monohordi and Narsingdi *thana* were 62, 60, 64, 62, 59 and 65, respectively. A total of 36 species was recorded from the campus of academic institutes, finding 29 from schools, 22 from colleges and 16 from *madrashas.* The relative presence of the important tree species in these institutions is represented in the *table 2.* The presence of 64 tree species was recorded from the government, semi-government and private institutions of the district. Although the availability of land varies from one institution to another, the presence of 31 tree species were observed in hospitals, 47 in offices and 45 in the mills/factories. A total of 58 tree species was recorded in the waste/marginal lands; 42 were found along highways, 39 on feeder roads, and 26 and 15 along canal and riverbanks, respectively. Main tree species occurrence in this type of land is shown in the *table 3.*

3.2 Specifications on homesteads and villages

MILLAT-E-MUSTAFA (1997) recorded 92 perennial species from a set of 80 homesteads in Bangladesh. In a sample of only one village in the Chittagong region AKHTAR *et al.* (1997) found 37 different tree species. Similarly, HOSSAIN & RAKIBBU (1993) found 35 tree species in Bogra, MISBAHUZZAMAN & AHMED (1993) found 31 in Cox's Bazar and MILLAT-E-MUSTAFA *et al.* (1994) found 29 in the Comilla floodplain areas of Bangladesh.

Table 1: **List of tree species with family, scientific and local names found in the Narsingdi district, Bangladesh.**

Tabelle 1: Liste der Baumarten mit Bezeichnung der Familie, des wissenschaftlichen und des lokalen Namens, welche im Distrikt von Narsingdi vorkommen.

No.	Family	No.	Scientific name	Local name
1	Anacardiaceae	1	*Anacardium occidentale* L.	Kaju Badam
		2	*Mangifera indica* L.	Am
		3	*Spondias pinnata* (L.f.) Kurz	Amra
2	Annonaceae	4	*Annona muricata* L.	Atafal
		5	*Annona squamosa* L.	Sourpa
		6	*Polyalthia longifolia* Benth. & Hook.f.	Debdaru
3	Apocynaceae	7	*Alstonia scholaris* Br.	Chatian
		8	*Brownlowia elata* Roxb.	Maus
4	Araucariaceae	9	*Araucaria excelsa*	Christmas tree
5	Averrhoaceae	10	*Averrhoa carambola* L.	Kamranga
6	Bignoniaceae	11	*Stereospermum chelonioides* (L.f.) DC.	Dharmara
7	Euphorbiaceae	12	*Baccaurea ramiflora* L.	Latkan
8	Bombacaceae	13	*Bombax ceiba* L.	Simultula
9	Burseraceae	14	*Bursera serrata* Wall.	Gutguitta
		15	*Guruga pinnata* Roxb.	Kapila
10	Casuarinaceae	16	*Casuarina equisetifolia* Forst.	Jhau
11	Combretaceae	17	*Terminalia arjuna* Bedd.	Arjun
		18	*Terminalia belerica* Roxb.	Bahera
		19	*Terminalia catappa* L.	Katbadam
12	Compositae (Asteraceae)	20	*Trewia nudiflora* L.	Meragoda
13	Dilleniaceae	21	*Dillenia indica* L.	Chalta
14	Dipterocarpaceae	22	*Dipterocarpus turbinatus* Gaertn.	Garjan
15	Ebenaceae	23	*Diospyros peregrina* L.	Gub
16	Elaeocarpaceae	24	*Elaeocarpus robustus* Roxb.	Jalpai
17	Euphorbiaceae	25	*Cicca acida* L.	Arboroi
		26	*Bischofia javanica* Bl.	Fela goda
		27	*Emblica officinalis* L.	Amlaki
		28	*Jatropha curcas* L.	Barun

No.	Family	No.	Scientific name	Local name
18	Guttifereae	29	*Garcinia xanthochymus* H.K.f.	Tamal
19	Lauraceae	30	*Cinnamomum tamala* Nees.	Tezpata
20	Lecythidaceae	31	*Barringtonia acutangula* (L.) Gaertn.	Hijal
21	Leguminosae	32	*Acacia auriculiformis* A. Cunn. ex. Benth.	Akashmoni
	(Caesalpiniaceae,	33	*Acacia intisia* Will.	Kuchuai
	Mimosaceae and	34	*Acacia mangium* Willd.	Mangium
	Papilionaceae)	35	*Acacia nilotica* L.	Babla
		36	*Aeschynomene aspera* L.	Shola
		37	*Albizia chinensis* (Osb). Merr.	Chakua Koroi
		38	*Albizia lebbek* (L.) Benth.	Kalakoroi
		39	*Albizia procera* Benth.	Sil Koroi
		40	*Albizia richardiana* King	Rajkoroi
		41	*Butea monosperma* (L.) Toub	Palash
		42	*Caesalpinia pulcherrima* Sw.	Radhachura
		43	*Cassia fistula* L.	Badarlathi
		44	*Cassia nodosa* Ham.	Bonsonalu
		45	*Cassia siamea* Lamk.	Minjiri
		46	*Dalbergia sissoo* Roxb.	Sissokat
		47	*Delonix regia* (Boj.) Raf.	Krisnachura
		48	*Erythrina indica* L.	Mandail
		49	*Leucaena leucocephala* (L.) Gills.	Ipil ipil
		50	*Samanea saman* (Jacq.) Merr.	Rendi
		51	*Sesbania grandiflora* Pers.	Bakul
		52	*Tamarindus indica* L.	Tentul
22	Lythraceae	53	*Lagerstroemia speciosa* (L.) Pers.	Jarul
23	Magnoliaceae	54	*Michelia champaca* L.	Champa
24	Malvaceae	55	*Gossypium harbaceum* L.	Karpastula
25	Meliaceae	56	*Aphanamixis polystachya* (Wall.) R.N. Park	Roinna/Pitraj
		57	*Cedrella toona* Roxb. ex. Rott.	Rangi, Poo
		58	*Melia sempervirens* (L.) All.	Bokain
		59	*Azadirachta indica* A. Juss.	Neem
		60	*Swietenia mahagoni* King	Mehegoni
26	Moraceae	61	*Artocarpus heterophyllus* Lamk.	Kanthal
		62	*Artocarpus lakoocha* Buch. Hum.	Dehua
		63	*Balanostreblus illicifolius* Kurz.	Sheora
		64	*Ficus elastica* Roxb.	Indian Rubber
		65	*Ficus bengalensis* L.	Bot
		66	*Ficus hispida* L.f.	Dumur
		67	*Ficus religiosa* L.	Ashath
27	Moringaceae	68	*Moringa oleifera* Lamk.	Sajna
28	Myrtaceae	69	*Callistemon citrinus* Stapf.	Bottle brush
		70	*Eucalyptus camaldulensis* Hook.	Eucalyptus
		71	*Psidium guajava* (L.) Bat.	Peara
		72	*Syzygium cuminii* (L.) Skeels	Kalajam
		73	*Syzygium fruticosum* (Rosb.) DC.	Putijam
		74	*Syzygium grandis* (Wt.) Wall.	Dhakijam
		75	*Syzygium jamboos* (L.) Alston	Gulab-jam
		76	*Syzygium samarangensis* (Bl.) Merr.	Jamrul
29	Oleaceae	77	*Olea dioica* Roxb.	Kao
30	Palmae (Arecaceae)	78	*Areca catechu* L.	Supari, Gua
		79	*Areca triandra* Roxb.	Ban Supari
		80	*Borassus flabellifer* L.	Tal
		81	*Cocos nucifera* L.	Dab, Narikel
		82	*Oxeodoxa regia* H.B. & K.	Bottle palm
		83	*Phoenix sylvestris* (L.) Roxb.	Khejur
31	Pinaceae	84	*Pinus longifolia* Roxb.	Pine
32	Rhamnaceae	85	*Zizyphus jujuba* Lamk.	Boroi
33	Rubiaceae	86	*Rendia longiflora* Lamk.	Ehoira
		87	*Anthocephalus chinensis* (Lam.) Rich ex.Walp.	Kadam
34	Rutaceae	88	*Aegle marmelos* (L.) Correa	Bel
		89	*Citrus aurantifolia* (Christ.) Swingle	Kagojilebo
		90	*Citrus grandis* (L.) Osb.	Jambura
		91	*Citrus reticulata* Blanco	Kamala
		92	*Murraya paniculata* (L.) Jacq.	Kamini
		93	*Zanthoxylum budrunge* Roxb. DC.	Bajna
35	Sapindaceae	94	*Litchi chinensis* Sonn.	Lichu
36	Sapotaceae	95	*Achras sapota* L.	Safeda
		96	*Mimusops elengi* L.	Bakul
37	Magnoliaceae	97	*Madhuca indica* G. Mell.	Mahua
38	Tiliaceae	98	*Microcos paniculata* L.	Patka
39	Ulmaceae	99	*Trema orientalis* Bl.	Naircha
40	Urticaceae	100	*Sachochlamsys pulcherrima* Gaud.	Korobi
41	Verbenaceae	101	*Gmelina arborea* (Roxb.) DC.	Jogini, Gamar
		102	*Tectona grandis* L.f.	Shegun

The present study covered a large number of samples from different representative locations. As a consequence, the study reveals a larger number of tree species. Recent positive attitudes towards tree planting on the part of householders, governmental and non-governmental organizations has led to an increase in species richness. In this context Uddin *et al.* (1998) cites initiatives to grow various short rotation and medium rotation tree species in the district. Our findings correspond with the report of Alam *et al.* (1996) where they concluded that about 183 species (excluding bamboo) comprising 136 genera under 48 families largely represent village trees in Bangladesh. Among them, Leguminosae (Caesalpiniaceae, Mimosaceae and Papilionaceae) are also high on the list.

3.2.1 Diversity of timber trees

A total of 36 timber species was recorded from the district. The main timber species are shown in *table 4. Swietenia mahagoni* was reported as the most common timber species throughout the whole district, in contrast to the study of Akhtar *et al.* (1997) where *Samanea saman* was the most common followed by *Streblus asper* and *Erythrina fusca.*

3.2.2 Diversity of fuelwood trees

The study found 19 tree species used mainly for fuelwood. Among the species, *Trewia nudiflora* was recorded as an intensive species followed by *Aeschynomene aspera, Eucalyptus camaldulensis, Acacia auriculiformis* etc. Important fuelwood species of the district are shown in *table 5.* The result shows that the acute shortage of fuelwood encouraged householders to plant fast growing exotic species, formerly reported by the researchers (e.g. Hossain 1991; Bhuiyan *et al.* 1995). Fuelwood is recognized as a dominant domestic fuel both in rural and urban areas of the developing countries. The present study confirms this in the floodplain area of Bangladesh.

3.2.3 Diversity of fruit trees

A total of 31 fruit tree species was recorded *(table 6). Artocarpus heterophyllus* was recorded as the major fruit tree species throughout the whole district. The articles of Ahmed (1997), Haque (1992), Leuschner & Khaleque (1987) and Khaleque (1987) corroborate the presence of other minor fruit tree species.

The study observes that most tree species on homesteads have multiple uses, e.g. *Artocarpus heterophyllus* and *Mangifera indica* are planted primarily for fruit and timber, but eventually provide fuel and fodder. The most common use for household trees is for fuel, although very few farmers plant trees primarily for this purpose. Trees are usually planted in lines and wild trees allowed to grow scatteredly. Again, our findings are confirmed by Abedin & Quddus (1990a, 1990b), Khaleque (1987) and Leuschner & Khaleque (1987).

3.3 Species dominance

To determine species dominance, 52 common tree species were identified, present at least once in each village of the Narsingdi district. Tree species recorded from homesteads in all six *thanas* of the district show that Jackfruit *(Artocarpus heterophyllus)* was the dominant species with a mean number of 69 trees/homestead followed by Mahogany *(Swietenia mahagoni)* with 16 trees/homestead, and Mango *(Mangifera indica)* with 10 trees/homestead *(tables 4* & *6).* The distribution and number of tree species in the institutions and

No.	Species	Institutions (Average number of individuals per campus)							
		School (30)*	College (8)	*Madrasha* (15)	Hospital (5)	Office (15)	Mills (12)	Mean**	Standard error
1	*Swietenia mahagoni*	45.3	7.4	102.7	119.2	59.0	300.9	105.75	103.72
2	*Mangifera indica*	9.5	3.3	2.7	14.3	21.0	192.5	40.55	74.76
3	*Acacia auriculiformis*	1.9	15.4	3.0	8.9	7.5	133.3	28.33	51.65
4	*Melia azedirach*	5.3	14.0	6.7	10.0	31.6	74.0	23.6	26.46
5	*Melia sempervirens*	5.3	14	6.7	10.0	31.6	74.0	23.60	26.46
6	*Dalbergia sissoo*	0.5	38	5.0	2.9	12.0	45.3	11.58	16.97
7	*Artocarpus heterophyllus*	3.9	11.8	3.0	25.8	2.2	19.2	10.98	9.79
8	*Cocos nucifera*	4.9	5.4	13.7	4.5	3.7	14.2	7.73	4.85
9	*Delonix regia*	1.2	1.4	0.9	1.5	5.2	29.8	6.67	11.44
10	*Samanea saman.*	4.4	6.4	5.4	1.3	2.1	1.8	6.57	6.77

* Figures in brackets indicate the total samples of the type.
** The term «mean» was found as the average of the number of individuals of the mentioned species.

Table 2: **The ten most important tree species recorded from the Institution.**

Tabelle 2: Die zehn wichtigsten Baumarten, die auf Institutsgelände erfasst wurden.

No.	Species	Waste/marginal lands (Average number of individual per one kilometer)					
		Highway (10 km)*	Feeder road (25 km)	Canal bank (10 km)	River bank (22 km)	Mean**	Standard error
1	*Swietenia mahagoni*	301.2	13.6	22.5	0.3	84.40	144.82
2	*Trewia nudiflora*	15.8	19.9	10.5	177.0	55.80	80.89
3	*Mangifera indica*	10.5	90.5	3.5	10.4	28.73	41.31
4	*Artocarpus heterophyllus*	18.8	49.8		3.4	24.00	23.63
5	*Samanea saman*	51.8	11.9	1.0	3.3	17.00	23.67
6	*Bombax ceiba*	11.9	16.8	12.5	18.8	15.00	3.34
7	*Albizia procera*	11.8	6.2	2.4	22.5	10.73	8.75
8	*Zizyphus mauritiana*	2.3	10.0	1.2	18.4	7.98	7.98
9	*Syzygium cuminii*	8.9	9.9	0.2	1.3	5.08	5.03
10	*Aphanamixis polystachya*	1.8	2.2	1.4	4.9	2.58	1.58

* Figures in brackets indicate the total sampled waste/marginal lands of the type.
** The term «mean» was found as the average of the number of individuals of the mentioned species.

Table 3: **The ten most important tree species present in waste/marginal lands.**

Tabelle 3: Die zehn wichtigsten Baumarten der Ödländereien.

Table 4: **The ten most important timber species present in the homesteads.**

Tabelle 4: Die zehn wichtigsten Nutzholz-Baumarten im Gelände der Wohnstätten.

No.	Species	Thana (Sub-district) (Average number of individual per homestead)							
		Raipura	Belabo	Palash	Shibpur	Monohordi	Narsingdi	Mean*	Standard error
1	*Swietenia mahagoni*	22.0	24.0	15.7	6.3	12.5	15.7	16.03	6.43
2	*Samanea saman*	5.5	1.2	2.3	2.0	2.6	1.2	2.47	1.59
3	*Bombax ceiba*	4.0	2.0	1.2	1.0	2.0	1.2	1.90	1.12
4	*Albizia procera*	2.9	1.2	2.0	0.8	1.4	0.9	1.53	0.79
5	*Aphanamixis polystachya*	1.3	2.5	2.9	0.1	0.9	1.2	1.48	1.04
6	*Melia sempervirens*	1.3	0.6	1.2	1.9	1.2	1.4	1.27	0.42
7	*Dalbergia sissoo*	1.0	1.0	1.2	1.0	1.0	2.0	1.20	0.40
8	*Azadirachta indica*	2.3	0.1	1.4	0.7	2.0	0.1	1.10	0.95
9	*Cassia fistula*	2.4	0.1	1.2	0.1	0.1	0.4	0.72	0.93
10	*Anthocephalus kadamba*	1.0	0.5	0.2	0.9	0.9	0.5	0.67	0.31

* The term «mean» was found as the average of the number of individuals of the mentioned species.

Table 5: **The ten most important fuelwood species present in the homesteads.**

Tabelle 5: Die zehn wichtigsten Brennholz-Baumarten im Gelände der Wohnstätten.

No.	Species	Thana (Sub-district) (Average number of individual per homestead)							
		Raipura	Belabo	Palash	Shibpur	Monohordi	Narsingdi	Mean*	Standard error
1	*Trewia nudiflora*	4.5	0.1	2.4	1.3	10.5	3.6	3.73	3.67
2	*Aeschynomene aspera*	5.4	1.3	4.5	1.4	1.0	2.0	2.60	1.87
3	*Ficus hispida*	1.5	1.0	1.3	2.3	2.3	0.9	1.55	0.62
4	*Eucalyptus camaldulensis*	2.3	0.5	1.3	1.2	1.7	1.3	1.38	0.59
5	*Acacia auriculiformis*	1.6	1.2	1.3	0.6	1.7	0.9	1.22	0.42
6	*Acacia mangium*	0.5	0.9	1.2	2.3	1.2	0.7	1.13	0.63
7	*Rendia longiflora*	0.7	0.8	1.0	0.1	0.9	0.9	0.73	0.33
8	*Microcos paniculata*	0.2	0.6	0.8	0.6	0.8	0.7	0.62	0.22
9	*Leucaena leucocephala*	0.2	0.8	0.5	0.7	0.6	0.1	0.48	0.28
10	*Diospyros peregrina*	0.1	0.5	0.2	0.5	0.2	0.4	0.32	0.17

* The term «mean» was found as the average of the number of individuals of the mentioned species.

Table 6: **The ten most important fruit tree species present in the homesteads of the Narsingdi district, Bangladesh.**

Tabelle 6: Die zehn wichtigsten Früchte liefernden Baumarten im Gelände der Wohnstätten.

No.	Species	Thana (Sub-district) (Average number of individual per homestead)							
		Raipura	Belabo	Palash	Shibpur	Monohordi	Narsingdi	Mean*	Standard error
1	*Artocarpus heterophyllus*	5.8	170.5	12.8	160.8	51.8	12.5	69.03	76.64
2	*Mangifera indica*	13.0	14.8	5.3	15.8	7.3	3.9	10.02	5.14
3	*Elaeocarpus robustus*	2.0	10.4	5.0	13.6	3.5	0.1	5.77	5.19
4	*Zizyphus mauritiana*	4.0	2.4	1.3	3.4	2.4	0.8	2.38	1.21
5	*Averrhoa carambola*	1.9	3.6	0.9	2.5	1.1	0.1	1.68	1.25
6	*Syzygium cuminii*	4.6	0.1	1.0	1.0	1.3	1.1	1.52	1.57
7	*Litchi chinensis*	0.7	2.8	1.35	2.8	1.1	0.1	1.48	1.11
8	*Annona muricata*	0.1	1.4	2.0	1.3	1.0	1.4	1.20	0.63
9	*Aegle marmelos*	3.0	0.4	1.0	0.1	1.0	0.5	1.00	1.04
10	*Dillenia indica*	0.1	0.5	0.8	0.1	0.1	0.4	0.33	0.29

* The term «mean» was found as the average of the number of individuals of the mentioned species.

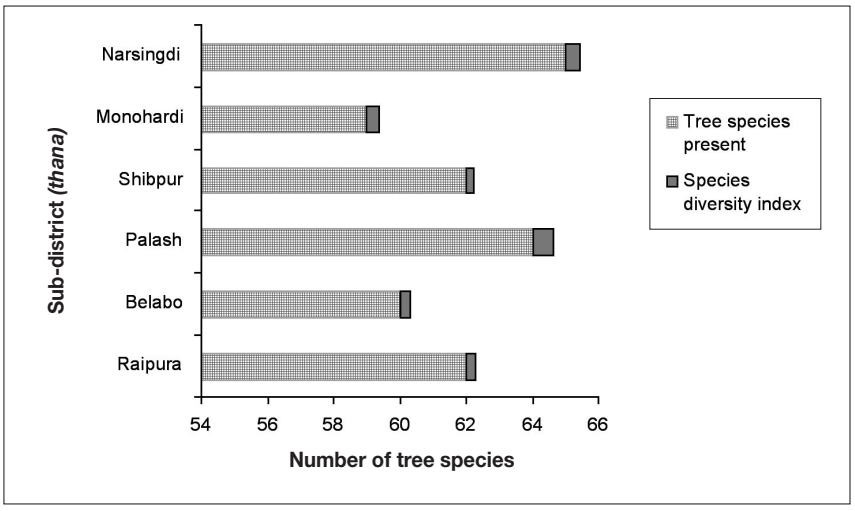

Figure 1: **Tree species diversity indices in the Narsingdi district, Bangladesh.**

Abbildung 1: Diversitätsindex der Baumarten im Distrikt von Narsingdi, Bangladesh.

waste/marginal lands varies with the availability of land for tree planting and the attitudes of the administration. In all cases, except college campus, *Swietenia mahagoni* was the dominant species with a mean number of 106 per campus in the institutions and 84 per kilometer in the waste/marginal lands *(tables 2 & 3).* Our findings confirm those of Islam & Ahmed (1987), Khaleque (1987), Akhtar *et al.* (1989), Alam *et al.* (1990) and Momin *et al.* (1990). However, Millat-e-Mustafa (1997) reported *Mangifera indica* as dominant followed by *Cocos nucifera* and *Areca catechu* in the tropical homegardens of Bangladesh. Akhter *et al.* (1997) also found a numerical dominance of *Mangifera indica* followed by *Samanea saman* and *Areca catechu* in the village homegardens of the Chittagong region, a forest rich area of Bangladesh. So, the present study has a different information on tree species dominance in the homesteads. The current dominance of certain tree species in the homesteads of the study area might be due to the good growth and fruiting ability, more economic return and multipurpose uses of the species. Uddin *et al.* (1998) also described that farmers of Narsingdi preferred fruit trees to fuel/timber species, naming *Artocarpus heterophyllus* as their first choice. The dominance of *Swietenia mahagoni* in institutions and on waste/marginal lands has perhaps come about because administrators of institutions and government and non-government organizations have become aware of the acute need for timber. Uddin *et al.* (1998) also identified this trend in the same study area. Those agents had the possibility of turning to long-term invest in timber.

3.4 Tree species diversity index

The tree species diversity indices for all six *thanas* are shown in *figure 1,* where Palash shows the highest and Shibpur the lowest value. Throughout the whole Narsingdi district, the tree species diversity index was enumerated as 0.379. This result is espoused by the investigation of Kumar *et al.* (1994). They pointed out that the species diversity of the small homesteads was significantly greater than the medium and large holdings. Christanty *et al.* (1986) found a diversity index of 2.79 for Javanese homesteads and 3.71 for Sudanese homesteads. Kumar *et al.* (1994) noted an equitability index of 0.542 for small, 0.368 for medium and 0.428 for large holdings of the Kerala homesteads. The present study was carried out over a larger area with a large number of samples. Since the diversity indices are not calculated using the same formula, comparisons are difficult to establish.

4. Conclusion

The present study recorded a rich composition of tree species in the floodplain areas of Bangladesh. Although the species are mainly categorized as timber, fuelwood and fruit trees, most have multipurpose uses. However, resources are dwindling day by day due to overexploitation and lack of consciousness and knowledge. A further reason for tree depletion in this area is the remoteness of the sampled floodplain areas from traditional government forests, and the dependency of the population on local tree resources. Properly managed homestead forests and other sources of wood can meet the food, fodder and fuelwood demands of the rural population, as well as supplying raw materials to rural industries, thereby increasing income and employment opportunities. By applying proper silvicultural treatments and scientific methods to the management of the forests, the requirements of the local people can be met. By planting all unused, barren and vacant land in the homesteads, institutions and waste/marginal lands with fast growing timber, fruit and fuelwood tree species, both indigenous and exotic, the diversity of tree species in the floodplain areas of Bangladesh can be conserved.

Summary

Tree species composition, uses, dominance and diversity in all six sub-districts *(thanas)* of Narsingdi district were studied. 125 homesteads, 30 schools, 8 colleges, 15 *madrashas,* 6 government and semi-government offices, 12 semi-government and private mill/factories, 10 km highways, 25 km feeder roads, 10 km canal banks and 22 km river banks were sampled with multistage random sampling technique. A total of 102 tree species were identified with the diversity index 0.379 throughout the whole district. Among the species 36, 31, 19 tree species were identified as timber, fruit and fuelwood species respectively. Out of 41 families identified, Leguminosae possessed the highest numbers of species (21). Artocarpus heterophyllus and Swietenia mahagoni was the dominant tree species in the homesteads and institutions, waste/marginal lands, respectively.

Résumé

Les arbres et leurs ressources dans les plaines inondables du district de Narsingdi (Bangladesh)

Le présent article étudie la répartition, les usages, la dominance et la diversité des essences dans les 6 sous-districts de Narsingdi. Une méthode d'échantillonnage aléatoire à plusieurs niveaux a permis d'effectuer l'inventaire de 125 fermes, 30 écoles, 8 collèges, 15 *madrashas,* 6 administrations gouvernementales ou semi-gouvernementales, 12 moulins ou usines semi-publics ou privés, 10 km de routes principales, 25 km de routes de raccordement, 10 km de rives de canaux et 22 km de bords de rivières. Au total, 102 essences ont été identifiées (indice de diversité 0,379), dont 36 fournissent du bois d'œuvre, 31 des fruits et 19 du bois de feu. Parmi les 41 familles recensées, celle des légumineuses comprend le plus grand nombre d'espèces, à savoir 21. *Artocarpus heterophyllus* est l'espèce dominante dans les fermes, alors que *Swietenia mahagoni* domine dans les institutions ainsi que dans les friches et sur les terres marginales.

Traduction: Claude Gassmann

Zusammenfassung

Baumressourcen in den Überschwemmungsgebieten des Distrikts Narsingdi, Bangladesh

Im vorliegenden Aufsatz wurden Verteilung, Nutzung, Vorherrschen und Diversität der Baumarten in allen sechs Unterbezirken *(thanas)* von Narsingdi in Bangladesh untersucht. Das Gelände von 125 Wohnstätten, 30 Schulen, 8 Hochschulen, 15 *madrashas,* 6 staatlichen und halbstaatlichen Amtssitzen, 12 halbstaatlichen und privaten Mühlen, 10 km Autobahnen, 25 km Zufahrtsstrassen, 10 km Kanal- und 22 km Flussufer wurde mittels einem mehrstufigen Zufallsstichproben-Verfahren erfasst. Im gesamten Untersuchungsgebiet wurden insgesamt 102 Baumarten mit dem Diversitätsindex 0,379 identifiziert. Unter den Arten wurden 36 als Nutzholz, 31 als Früchte und 19 als Brennholz liefernde Baumarten identifiziert. Von den 41 Pflanzenfamilien gehörte die höchste Baumartenzahl (21) zu den Leguminosen. Die vorherrschenden Baumarten im Gebiet der Wohnstätten und Institutionen, bzw. im Ödland waren *Artocarpus heterophyllus* und *Swietenia mahagoni.*

Übersetzung: Margrit Irniger

References

Abedin, M.Z., Quddus, M.A., 1990a: Household fuel situation, homegardens and agroforestry practices at six agroecologically different locations of Bangladesh. In: Abedin, M.Z., Lai, C.K. & Ali, M.O. (eds.): Homestead Plantation and Agroforestry in Bangladesh. Bangladesh Agricultural Research Institute. Joydebpur, Bangladesh. pp. 19–54.

Abedin, M.Z., Quddus, M.A., 1990b: Agroforestry systems in Bangladesh with particular reference to economic and tenurial issues. Expert Consultation on Agroforestry in the Asia-Pacific Region. FAO Regional Offices for Asia and the Pacific. Bangkok, Thailand.

ADB (Asian Development Bank), 1993: Forestry Master Plan. Main Plan-1993/2012. Volume I. Ministry of Environment and Forests. Dhaka. Bangladesh.

Ahmed, K.U., 1997: Minor fruits in Homestead agroforestry. In: Alam, M.K., Ahmed, F.U. & Amin, S.M.R. (eds.): Agroforestry: Bangladesh Perspective. Apan, NAWG, Barc, Dhaka, Bangladesh. pp. 165–169.

Akhtar, M.S., Abedin, M.Z., Quddus, M.A., 1989: Why farmer grow trees in agricultural fields: some thoughts, some results. Research report 1988-89. On farm Research Division, Bari, Jessore, Bangladesh. pp. 161–178.

Akhter, S., Nath, T.K., Mohiuddin, M., 1997: Village homegardens in Chittagong: Socio-economic aspects and tree species composition. Chittagong Univ. Stud. Part II: Sci. 21 (1): pp. 63–72.

Alam, M.S., Haque, M.F., Abedin, M.Z., Aktar, S., 1990: Homestead trees and household fuel uses in and around the FSR site, Jessore. In: Abedin, M.Z., Lai, C.K. & Ali, M.O. (eds.): Homestead Plantation and Agroforestry in Bangladesh. Bangladesh Agricultural Research Institute. Joydebpur, Bangladesh. pp.106–119.

Alam, M.K., Mohiuddin, M., Basak, S.K., 1996: Village trees of Bangladesh: Diversity and Economic aspects. Bangladesh Forest Research Institute, Chittagong, Bangladesh. pp. 21–36.

BBS (Bangladesh Bureau Of Statistics), 1995: Bangladesh Population Census, 1991. Zilla Series, Zilla: Narsingdi. Ministry of Planning, Bangladesh.

BBS (Bangladesh Bureau Of Statistics), 1999: Statistical Yearbook of Bangladesh, 1998. Ministry of Planning. Dhaka, Bangladesh. 668 pp.

Bhuiyan, M.K., Hoque, S.M.S., Hossain, M.M., Ali, M., 1995: Exploitation of Forest Produces from the Chittagong University Campus and its adjoining forest areas. Chittagong Univ. Stud., Part II: Sci. 19 (1): pp. 1–5.

Christanty, L., Abdoellah, O.S., Marten, G.G., Iskander, J., 1986: Traditional agroforestry in West Java: The Pekarangan (homegarden) and Kebun-Talun (Annual-Perennial rotation) cropping systems. In: Traditional Agriculture in Southeast Asia. Environment and Policy Institute, East-West centre, Honolulu, Hawaii, USA. pp. 132–158.

Fowler, J., Cohen, L., 1992: Practical Statistics for Field Biology. John Wiley and Sons, New York.

Haque, M.A., 1992: Homestead agroforestry in Bangladesh. In: Proceedings of the 6th National Horticulture Convention and Symposium. Held during 16–17 April 1992, Bangladesh. pp. 103–11.

Hossain, M.M., Rakibbu, M.G., 1993: Resource availability, training and tree plantation on private land- A case study in a Bangladesh village. Chittagong Univ. Stud. Part II: Sci. 17 (2): pp. 5–14.

Hossain, M.M., 1991: Energy consumption at household level: A case study in fuelwood consumption in two districts of Bangladesh. Chittagong Univ. Stud. Part II: Sci. 15 (2): pp. 161–173.

Islam, M.M., Ahmed, D., 1987: Analysis of Homestead Production and Utilization Systems at FSR Site, Kalikapur. Research report 1986-87. On farm Research Division, Bari, Pabna, Bangladesh.

Kemp, R.H., Chai, L., 1993: Conservation and implications of loss of biological diversity with particular reference to forest management. In: Thang Hooi Chiew *et al.* (eds.): People, the environment and forestry-conflict and harmony. Proceedings of the 14th Commonwealth Forestry Conference, Kuala Lumpur, Malaysia. pp. 247–254.

Khaleque, K., 1987: Homestead forestry production in Bangladesh. In: Khosla, P.K & Khurana, D.K. (eds.): Agroforestry for Rural Needs. Vol. I. Proceedings of International Workshop. Indian Scientist of Tree Scientists. Solan, India. pp. 1–12.

Kumar, B.M., George, S.J., Chinnamanis, S., 1994: Diversity, structure and standing stock of wood in the homegardens of Kerala in Peninsular India. Agrofor. Syst. 25: 243–262.

Leuschner, W.A., Khaleque, K., 1987: Homestead agroforestry in Bangladesh. Agrofor. Syst. 5: 139–152.

Miah, G., Abedin, M.Z., Khair, A.B.M.A., Shahidullah, M., Baki, A.J.M.A., 1990: Homestead plantation and household fuel situation in Ganges floodplain of Bangladesh. In: Abedin, M.Z., Lai, C.K. & Ali, M.O. (eds.): Homestead Plantation and Agroforestry in Bangladesh. Bangladesh Agricultural Research Institute, Joydebpur, Bangladesh. pp. 120–135.

Millat-e-Mustafa, M., 1997: Tropical homegardens: An Overview. In: Alam, M.K., Ahmed, F.U. & Amin, S.M.R. (eds.): Agroforestry: Bangladesh Perspective. Apan, NAWG, Barc, Dhaka, Bangladesh. pp. 18–33.

Millat-e-Mustafa, M., Hall, J.B., Teklehaimanot, K., 1996: Floristics and structure of Bangladesh homegardens. Agrofor. Syst. 33: 263–280.

Millat-e-Mustafa, M., Bhuiyan, M.K., Hossain, M., Ali, M., 1994: Species composition and management techniques in homestead woodlots - a case study in Comilla district. Chittagong Univ. Stud. Part II, Sci. 18 (1): 97–102.

Mill-Mustafa, M., Khan, N.A., Haruni, A.K.O., Shamim, M.S., 2000: Research on Homegardens in Bangladesh: Present Status and Priorities for the New Millennium. In: Khan, N.A. (ed.): Of Popular Wisdom: Indigenous Knowledge and Practices in Bangladesh. Barcik, Dhaka, Bangladesh. pp. 107–117.

Misbahuzzaman, K., Ahmed, M.R., 1993: Homestead land utilization for tree husbandry in a forest rich area of Bangladesh. Chittagong Univ. Stud., Part II: Sci. 17(1): 37–45.

Momin, M.A., Abedin, M.Z., Amin, M.R., Islam, Q.M.S., Haque, M.M., 1990: Existing homestead plantation and household fuel use pattern in the floodprone Tangail region of Bangladesh. In: Abedin, M.Z., Lai, C.K. & Ali, M.O. (eds.): Homestead Plantation and Agroforestry in Bangladesh. Bangladesh Agricultural Research Institute, Joydebpur, Bangladesh. pp. 136–148.

Prain, D., 1981: Bengal plants. Vol. I & II. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.

Shukla, R.S., Chandel, P.S., 1980: Plant Ecology. S. Chand & Company ltd. New Delhi, India. 197 pp.

Uddin, G.S., Miah, M.D., Akther, S., 1998: Social Attitude towards homestead forestry in Narsingdi district, Bangladesh. South Asian Anthropologist 19 (2): 99–106.

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