Zeitschrift: Schweizerische Zeitschrift für Forstwesen = Swiss foresty journal = Journal forestier suisse

Herausgeber: Schweizerischer Forstverein

Band: 153 (2002)

Heft: 12

Artikel: Vegetation characteristics of Bangladesh homegardens

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DOI: https://doi.org/10.5169/seals-1098262

Vegetation characteristics of Bangladesh homegardens

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Keywords: Plant form; richness; density; similarity; homegarden; agroforestry; Bangladesh. FDK 166 : 26 : 915 : (54)

Abstract: A total of 162 perennial species were recorded from the 100 homegardens surveyed in four regions of Bangladesh. The highest number of species was recorded from the deltaic region (91) followed by the plain (79), hilly (73) and the dryland (65) regions, respectively. Species density declined with increasing homegarden size in each region. Within each region food and fruit producing species dominated in the homegardens. Between any two regions more than 50% of the species was common. Nine general uses (food/fruit, timber, fuelwood, spice, fodder, medicine, fence, agricultural implement, others) of homegarden plants were identified.

Abstract: In vier verschiedenen Gebieten von Bangladesh konnten in hundert untersuchten Gärten insgesamt 162 mehrjährige Pflanzenarten erfasst werden. Die höchste Artenzahl fand sich im Deltagebiet (91), gefolgt vom Flachland (79), Hügelgebiet (73) und schliesslich dem Trockengebiet (65). In jedem Gebiet verringerte sich die Artenvielfalt mit zunehmender Gartengrösse. Innerhalb jedem Gebiet dominierten die Nahrung und Früchte liefernden Gartenpflanzen. Im Vergleich von jeweils zwei Regionen waren über 50 Prozent der Arten die gleichen. Eruiert werden konnten neun Hauptnutzungsformen der Gartenpflanzen (Nahrung/Früchte, Nutzholz, Brennholz, Gewürz, Futter, Heilmittel, Hecken, landwirtschaftliches Gerät, anderes).

Introduction

Homegardens in Bangladesh are usually cited as one of the best examples to show diversity and complexity of the structure and function of tropical homegardens (Millat-e-Mustafa 1996). The term «homegarden» has been used rather loosely to denote diverse practices, from growing vegetables behind the house to complex multi-storied systems. It could be defined 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 labor» (Fernandes & Nair 1986).

Homegarden cultivation in Bangladesh displays many agroforestry concepts: the intimate mixing of diverse agricultural crops, multipurpose trees, domestic animals and/or fish meets most of the fundamental needs of the local population. Multistoried configurations and high plant diversity avoid the environmental deterioration commonly associated with monoculture production systems. In 1992, the Forestry Master Plan team estimated the average annual rate of increment of homegardens to be 5 m^3 of wood per hectare, i.e., more than double that of government forests (Forestry Master Plan 1994). Davidson (1984) observed that over half of the fruit, vegetables and spices grown in homegardens are sold to meet family expenses. Income from homegardens covers from 26% to 47% of total family expenditure. Over recent decades the relative importance has shifted from traditional forestry (government forest) to homegardens to the extent that the major part of fuelwood (70%), timber (80%), bamboo (90%) and other forest product requirements of the country are currently met by homegarden production (Hammermaster 1981). This paper sheds light on the species composition, richness, density and similarity of homegardens of different physiographic regions in Bangladesh.

Methods and materials

Selection of the study area and respondent

On the basis of physiographic conditions, Bangladesh can be divided into four regions: deltaic, dry land, hilly and plain (Leuschner & Khaleque 1987). The climatological and pedological information for the regions is shown in *table 1* (Millat-e-Mustafa *et al.* 2002). One district was picked randomly from each region followed by the random selection of a sub-district within each. Finally, from a list of the villages of each selected sub-district, a representative village was selected at random. Thus there were altogether four villages, one from each region, selected for the study.

Table 1: Soil and climatic differences in different regions in Bangladesh.

Tabelle 1: Unterschiedliche Boden- und Klimafaktoren in verschiedenen Regionen von Bangladesh.

Regions	Typical soil	Typical climatic seasonality	Typical temperature ranges
Deltaic	Silty loam & clay	• Annual precipitation: 2037 mm, • Maximum precipitation: June (436 mm), • Dry season: November to March (10–42 mm)	18.8 to 28.9 °C
Dry land	Silty loam to silty clay loam	• Annual precipitation: 1695 mm, • Maximum precipitation: July (405 mm), • Dry season: November to April (0–54 mm)	17.8 to 29.2 °C
Hilly	Clay loamy & sand	• Annual precipitation: 4037 mm, • Maximum precipitation: July (1166 mm), • Dry season: December to March (7–19 mm)	20.3 to 28.2 °C
Plain	Clayey to clay loam & sandy loam	• Annual precipitation: 2295 mm, • Maximum precipitation: July (496 mm), • Dry season: November to March (5–48 mm)	19 to 28.9 °C

In each selected village a preliminary socio-economic survey was carried out by the means of a questionnaire. The whole village was surveyed at this stage. The objective of this survey was to ascertain the sizes of homegardens, on the basis of which farmers were put into one of following 5 categories: Landless = homestead area ≤0.02 ha, Marginal = >0.02–0.08 ha, Small = >0.08–0.14 ha, Medium = >0.14–0.20 ha, or Large = ≥0.20 ha. Five homegardens were then selected randomly from each category, thus giving 25 samples for each region and 100 for the whole country.

Vegetation survey

A vegetation survey was conducted at each selected homegarden to determine important vegetation characteristics. For every survey a north-south base line was established to divide the homegardens into two roughly equal parts. Sample centre points were demarcated on this line at 10 metre intervals until the boundary was reached. From the centre point additional lines perpendicular to the base line, were demarcated towards the east and west as far as the homegarden limit. By creating further points at 10 meter intervals on these east-west lines, 10 m x 10 m sample grids were generated. The individuals of all perennial species were recorded in each grid. In the case of banana and bamboo, each clump was counted as one individual. Having been measured each plant was marked with chalk to avoid double counting. Since it was not possible to carry out our studies in all regions simultaneously, we excluded seasonal crops including vegetables and weeds from the inventory.

Tree use matrix

Once the vegetation survey was completed for one homegarden, a list was made of the species present. A tree use matrix exercise was then conducted with the farmer and his or her family members to determine the uses of different species. To begin the exercise, leaves and twigs of all species present in the homegarden were placed on the ground to create rows in a table. Columns representing uses were then marked out. The farmer was asked to put beans in the relevant cells to represent the use of that category. Family members helped wherever necessary.

Data compilation and analysis

To ascertain the floristic composition, plants were first categorized into trees, herbs and shrubs. Species composition is also shown in terms of their functions, e.g. food and fruit producing species, timber and fuelwood species, spices, medicinal and others. Species that could not be grouped in the first four categories are subsumed under others. Species richness is calculated as the number of the total species present. Species density is calculated as the ratio of the total number of individuals of species present in a plot and the sample area. The final figure is converted into species per hectare. Using the Müller-Dombois & Ellenberg (1974) formula, Sörenson's coefficient of similarity (SI) is calculated as follows:

$$SI = \frac{2c}{a+b} \times 100$$

where
a = number of species present in community A,
b = number of species present in community B, and
c = number of species common to both communities.

Results

Plant form

The inventory data revealed that a great variety of plant species was managed in the homegardens of the study areas. From the 100 sample homegardens, a total of 162 perennial species were recorded within the four physiographical regions. Of these, 93 species were recorded as tree, 27 species as shrub and 42 species as herb. As vegetation inventory took place at different seasons in different regions, annual crops (vegetables, pulses etc.) were excluded from the inventory. Species recorded in the inventory with their local and botanical name, family and frequency distribution (number of homegardens from where it was recorded) is presented in *table 2.* It should be noted that 40 species could not be identified by scientific names. The regional distribution of plant form pattern also indicated a higher proportion of trees, followed by the herbs and shrubs, respectively *(figure 1).* Between regions, Chi-Squared tests did not show any significant differences in the occurrence of trees and shrubs, but for the herbs it showed a significant difference between regions at the 0.05 level. This is because the number of herbs in dry land regions is considerably lower than in other regions.

Species richness

Marked variation was found in species richness in the homegardens of different regions *(figure 2).* The highest numbers of species was recorded in the homegardens of the deltaic (91) regions. The corresponding total for the plain, hilly and dry land regions was 79, 73 and 65 respectively.

The percentage value of species richness of each farm category for each region was converted to Arc Sine form and Analysis of variance (Anova) was calculated. The Anova of the 100-homegarden set showed that significant interaction between region and homegarden size influences species richness. There were significant differences ($p < 0.001$) in species richness among the regions associated with farm size and within each homegarden size category there were significant differences ($p < 0.001$).

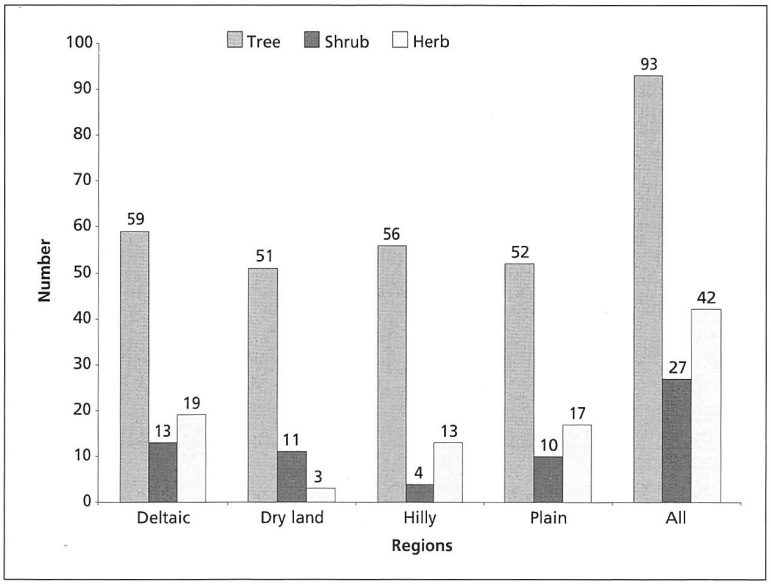

Figure 1: **Percentage distribution of plant form of the traditional homegardens of Bangladesh with respect to regions.**

Abbildung 1: Prozentuale Verteilung der Wuchsformen (Bäume, Sträucher, Kräuter) in den traditionellen Gärten in verschiedenen Regionen von Bangladesh.

Table 2: **Floristic composition of the traditional homegardens in Bangladesh by regions.**

Tabelle 2: Floristische Zusammensetzung nach Regionen in den traditionellen Gärten von Bangladesh.

No	Family	Scientific name	Common name	Plant Form*	Function*	Recorded from with frequency			
						Hilly	Plain	Dry	Deltaic
1.	Acanthaceae	*Andrographis paniculata* Nees	Kalomegh	S	M			16	8
2.	Acanthaceae	*Adhatoda vasica* Nees	Bashak	S	M	40		20	12
3.	Anacardiaceae	*Lannea coromandelica* (Houtt.) Merr.	Badhi	T	T	40	32	–	32
4.	Anacardiaceae	*Mangifera indica* L.	Mango	T	F	100	100	100	100
5.	Anacardiaceae	*Spondias pinnata* (L.f.) Kurz	Hog-plum	T	F	16	12	40	100
6.	Annonaceae	*Annona squamosa* L.	Sorifa	T	F	4	–	–	–
7.	Annonaceae	*Miliusa velutina* Hook. f. et Thomson	Gandhigajari	T	T	–	40	–	–
8.	Annonaceae	*Annona muricata* L.	Ata	T	F	12	12	24	12
9.	Apocynaceae	*Alstonia scholaris* (L.) R.Br.	Chatian	T	T	12	–	8	8
10.	Araceae	*Pothos scandens* L.	Sunnat-pata	H	M	16			
11.	Araceae	*Colocasia indica* (Lour.) Kunth	Aroid	H	F	56	–	–	–
12.	Asclepiadiaceae	*Calotropis gigantea* (L.) W.T. Aiton	Ahon / Akand	S	M		8		
13.	Bixaceae	*Bixa orellana* L.	Latkan	S	F		16		12
14.	Bombacaceae	*Bombax ceiba* L.	Silk cotton	T	T	12	80	60	60
15.	Bromeliaceae	*Ananas sativus* Schult. et Schult. f.	Pine apple	H	F	100	100	–	100
16.	Burseraceae	*Garuga pinnata* Roxb.	Jiga	T	T	–	–	16	
17.	Caricaceae	*Carica papaya* L.	Papaya	T	F	96	88	72	100
18.	Combretaceae	*Terminalia chebula* Retz.	Haritaki	T	F	–	–	4	–
19.	Combretaceae	*Terminalia arjuna* (Roxb.) Wight et Arn.	Arjun	T	M	4	8	–	24
20.	Combretaceae	*Terminalia catappa* L.	Katbadam	T	F	–	–	–	60
21.	Compositae	*Ageratum conyzoides* L.	Fulkhuri	S	M		16		
22.	Convolvulaceae	*Argyreia nervosa* (Burm.f.) Boj. *	Ghutuli	H	M		8		
23.	Cucurbitaceae	*Coccinia cordifolia* (L.) Cogn.	Mamakola	H	M				20
24.	Cucurbitaceae	*Coccinia cordifolia* DC.	Kougola	T	F	48	–	–	92
25.	Cyperaceae	*Scirpus sqarrosus* L. *	Guri-kachu	H	M				36
26.	Dilleniaceae	*Dillenia indica* L.	Chalta	T	F	4	64	–	92
27.	Dipterocarpaceae	*Dipterocarpus turbinatus* Gaertn. f.	Garjon	T	T	–	8	–	–
28.	Dipterocarpaceae	*Shorea robusta*	Sal	T	T	–	100	24	–
29.	Ebenaceae	*Diospyros discolor* Willd.	Bilati Gab	T	F	–	–	–	48
30.	Ebenaceae	*Diospyros peregrina* Gurke.	Gab	T	F	4	4	–	100
31.	Elaeocarpaceae	*Elaeocarpus robustus* Roxb.	Olive	T	F	8	32	44	32
32.	Euphorbiaceae	*Jatropha gossypiifolia* L.	Erenda	H	M	16			
33.	Euphorbiaceae	*Cicca acida* (L.) Merr.	Arboroi	T	F	4	8	–	–
34.	Euphorbiaceae	*Trewia nudiflora* L.	Pitali	T	T	–	–	4	–
35.	Euphorbiaceae	*Excoecaria indica* Müll. Arg.	Uirom	T	M				4
36.	Euphorbiaceae	*Phyllanthus emblica* L.	Amoloki	T	F	16	–	–	20
37.	Gentianiaceae	*Swertia chirata* Ham.	Chirota	H	M		12		
38.	Poaceae	*Sclerostachya fusca* Roxb. *	Khuira-kata	H	M		8		
39.	Poaceae	*Schumannianthus dichotoma* Gagnep.	Patipata	S	O	72	–	–	–
40.	Poaceae	*Bambusa balcooa* Roxb.	Barak bans	T	T	16	–	32	–
41.	Poaceae	*Bambusa longispiculata* Gamble	Tolla bans	T	T	–	–	4	–
42.	Poaceae	*Bambusa burmanica* Gamble	Jai bans	T	T	16	–	4	–
43.	Poaceae	*Cynodon dactylon* Pers.	Dubba grass	H	M	76	52	44	32
44.	Poaceae	*Bambusa vulgaris* Schrad. ex Wendl	Baijja bans	T	T	32	72	24	72
45.	Guttiferae	*Calophyllum inophyllum* L.	Gulab	T	T				56
46.	Labiaceae	*Anisomeles indica* (L.) Kuntze *	Gobrasal	T	T			68	
47.	Labiaceae	*Hyptis suaveolens* Poit.	Tokhma	S	M		16		
48.	Labiaceae	*Ocimum americanum* L.	Tulshi	S	M			44	20
49.	Lauraceae	*Litsea monopetala* (Roxb.) Pers.	Kharajora	T	T	–	56	–	–
50.	Lauraceae	*Cinnamomum zeylanicum* Blume	Cinnamon	T	S	4	–	–	24
51.	Lauraceae	*Cinnamomum tamala* T. Nees et Eberm.	Bay leaf	T	S	4	8	4	28
52.	Leguminosae	*Cassia occidentalis* L.	Eski	H	M	28			
53.	Leguminosae	*Cassia siamea* Lam.	Mingiri	T	T	32			
54.	Leguminosae	*Cajanus cajan* (L.) Huth	Arhor	S	M		28		
55.	Leguminosae	*Caesalpinia crista* L.	Koromcha	T	F	4	–	–	–
56.	Leguminosae	*Acacia nilotica* (L.) Del.	Babla	T	T				8
57.	Leguminosae	*Cassia fistula* L.	Sonalu	T	T	44	–	20	8
58.	Leguminosae	*Mimosa pudica* L.	Lazzaboti	H	M	12			16
59.	Leguminosae	*Acacia auriculiformis* A. Cunn.	Acacia	T	T	–	100	16	16
60.	Leguminosae	*Leucaena leucocephala* (Lam.) de Wit	Ipilipil	T	T	–	20	–	20
61.	Leguminosae	*Dalbergia sissoo* Roxb. ex DC.	Sissoo	T	T	–	20	28	20
62.	Leguminosae	*Lawsonia inermis* L.	Mendi	S	O				40
63.	Leguminosae	*Tamarindus indica* L.	Tentul	T	F	–	40	28	44
64.	Leguminosae	*Erythrina variegata* L.	Pania-madar	T	T	96			72
65.	Leguminosae	*Albizia lebbeck* (L.) Benth.	Kala-koroi	T	T	20	40		84
66.	Leguminosae	*Albizia procera* (Roxb.) Benth.	Koroi	T	T	28	68	56	88
67.	Leguminosae	*Albizia richardiana* King & Prain	Chambol	T	T	–	–	–	100
68.	Leguminosae	*Samanea saman* (Jacq.) Merr.	Rain tree	T	T	100	60	20	100
69.	Leguminosae	*Erythrina variegata* L.	Madar	T	T	72	44	4	100
70.	Leguminosae	*Saraca indica* L.	Ashok	T	M	12	–	–	–
71.	Lythraceae	*Lagerstroemia speciosa* (L.) Pers.	Jarul	T	T	8	–	–	–

No	Family	Scientific name	Common name	Plant Form*	Function*	Recorded from with frequency Hilly	Plain	Dry	Deltaic
72.	Magnoliaceae	*Michelia champaca* L.	Champa ful	T	T	16	–	–	–
73.	Malvaceae	*Hibiscus rosa-sinensis* L.	China rose	S	O	20	–	–	–
74.	Malvaceae	*Abelmoschus esculentus* L.	Okhra	H	M				12
75.	Meliaceae	*Toona ciliata* Roem.	Rongi	T	T	–	8	–	–
76.	Meliaceae	*Azadirachta indica* Juss.	Neem	T	T	32	36	52	–
77.	Meliaceae	*Aphanamixis polystachya* (Wall.) Parker	Pitraj	T	T	4	100	28	44
78.	Meliaceae	*Swietenia macrophylla* King	Mahogony	T	T	76	100	100	76
79.	Menispermaceae	*Tinospora tomentosa* Miers	Padma guruj	H	M				8
80.	Menispermaceae	*Stephania japonica* (Thunb.) Miers	Moischani	H	M	24			
81.	Moraceae	*Streblus asper* Lour.	Shaora	T	T		16		
82.	Moraceae	*Ficus lacor* Buch.-Ham	Pakur	T	T			12	
83.	Moraceae	*Artocarpus lakoocha* Roxb.	Dewa / Barta	T	F	4	52	4	–
84.	Moraceae	*Ficus hispida* L. f.	Dumur	T	F	20	–	–	96
85.	Moraceae	*Artocarpus heterophyllus* Lam.	Jack fruit	T	F	92	100	96	100
86.	Moringaceae	*Moringa oleifera* Lam.	Sajna	T	F	28	16	56	–
87.	Musaceae	*Musa* spp. L.	Banana	T	F	100	100	100	100
88.	Myrtaceae	*Syzygium fruticosum* (Roxb.) DC.	Putijam	T	F	8	–	–	–
89.	Myrtaceae	*Eugenia javanica* Lam.	Jamrul	T	F	8	–	–	16
90.	Myrtaceae	*Eucalyptus camaldulensis* Dehn.	Eulcalyptus	T	T	8	100	76	20
91.	Myrtaceae	*Syzygium cumini* (L.) Skeels	Jam	T	F	32	84	16	68
92.	Myrtaceae	*Psidium guajava* L.	Guava	T	F	60	100	92	100
93.	Oleaceae	*Nyctanthes arbor-tristis* L.	Shefali	T	T				12
94.	Orchidaceae	*Vanda tessellata* (Roxb.) Hook.	Rashna	H	M	40			
95.	Oxalidaceae	*Averrhoa bilimbi* L.	Balemboo	T	F	8	–	–	–
96.	Oxalidaceae	*Averrhoa carambola* L.	Kamranga	T	F	–	36	40	24
97.	Palmae	*Phoenix sylvestris* Roxb.	Khejur	T	F	–	68	44	72
98.	Palmae	*Borassus flabellifer* L.	Tal	T	F	–	32	32	84
99.	Palmae	*Cocos nucifera* L.	Coconut	T	F	92	100	76	92
100.	Palmae	*Areca catechu* L.	Betel nut	T	F	64	100	16	100
101.	Piperaceae	*Piper betel* L.	Pan	H	F		28		
102.	Piperaceae	*Piper longum* L.	Pepul lata	H	M				12
103.	Plumbaginaceae	*Plumbago indica* L.	Lal-chita	S	M			40	
104.	Polygonaceae	*Polygonum orientale* L.	Bishkatali	S	M		24		
105.	Punicaceae	*Punica granatum* L.	Pomegranate	T	F	8	44	16	60
106.	Rhamnaceae	*Ziziphus jujuba* (L.) Gaertn.	Jujube	T	F	48	96	56	56
107.	Rubiaceae	*Paederia foetida* L.	Gandhabadhali	H	M				12
108.	Rubiaceae	*Vangueria spinosa* Roxb.	Moyna	H	M				8
109.	Rubiaceae	*Stephegyne parvifolia* Korth.	Kelikadam	T	T				12
110.	Rubiaceae	*Anthocephalus chinensis* Lam.	kadam	T	T	–	–	28	92
111.	Rutaceae	*Zanthoxylum rhetsa* (Roxb.) DC.	Bazna	T	T	–	40	–	–
112.	Rutaceae	*Glycosmis arborea* (Roxb.) DC.	Aidali	S	M				4
113.	Rutaceae	*Feronia limonia* (L.) Swingle	Cot bael	T	F	–	–	–	36
114.	Rutaceae	*Aegle marmelos* (L.) Correa	Wood apple	T	F	12	56	40	40
115.	Rutaceae	*Citrus grandis* (L.) Osbeck	Jambura	T	F	52	36	8	56
116.	Rutaceae	*Citrus reticulata* Blanco	Orange	T	F	4	–	–	60
117.	Rutaceae	*Citrus limon* (L.) Burm. f.	Lemon	S	F	84	88	40	88
118.	Sapindaceae	*Litchi chinensis* Sonn.	Litchi	T	F	12	32	72	52
119.	Sapotaceae	*Mimusops elengi* L.	Bakul	T	T				8
120.	Sapotaceae	*Achras zapota* L.	Sofeda	T	F	8	–	4	100
121.	Scropeaceae	*Cesia coromandeliana* Vahl.	Kurkurmota	S	M			52	
122.	Solanaceae	*Datura metel* L.	Dhutura	S	M				20
123.	Sterculiaceae	*Abroma augusta* L.	Ulatkombol	S	M		16	44	24
124.	Tiliaceae	*Corchorus capsularis* L. *	Nalita	T	T		52		
125.	Tiliaceae	*Corchorus olitorius* L. *	Tooshi-pata	H	M		20		
126.	Trapaceae	*Trapa bispinosa* Roxb.	Singara	H	M		12		
127.	Umbelliferae	*Centella asiatica* (L.) Urb.	Thankuni	H	M	92	84	80	76
128.	Verbenaceae	*Clerodendrum viscosum* Vent.	Ghetur	H	M				8
129.	Verbenaceae	*Vitex negundo* L.	Nishinda	S	M				8
130.	Verbenaceae	*Tectona grandis* L.	Teak	T	T	36	60	28	–
131.	Verbenaceae	*Gmelina arborea* Roxb.	Gamar	T	T	32	–	8	–
132.	Violaceae	*Viola odorata* L. *	Boinnacha	T	T			44	
133.			Farar-lo	H	M	12			
134.			Failla	H	O	24			
135.			Akhalmendi	H	M		4		
136.			Vomra	T	M		4		
137.			Padmakuronchi	H	M		8		
138.			Domkalash	H	M		12		
139.			Kastal	H	M		12		
140.			Pailla-lata	H	M		12		
141.			Titbohor	S	M		16		
142.			Arbaush	H	M		20		
143.			Kata-hija	H	M		20		
144.			Thatenga	T	T		28		
145.			Kalakuchi	H	M	20	32		
146.			Takamoti	H	M			20	

No	Family	Scientific name	Common name	Plant Form*	Function*	Recorded from with frequency Hilly	Plain	Dry	Deltaic
147.			Malibola	S	M			28	
148.			Lal-khori	T	T			36	
149.			Sada-keranda	S	M			60	
150.			Lal-keranda	S	M			64	
151.			Koriful	S	M		44	64	
152.			Kudraj	T	M				4
153.			Pidagora	S	M				4
154.			Kanai-lata	H	M				8
155.			Saich-pata	H	M				8
156.			Bagajoga	H	M				12
157.			Bishkoromja	S	M				12
158.			Aron	S	M				16
159.			Bhooter-chira	H	M				16
160.			Amguruj	H	M				24
161.			Takanandi	H	M				36
162.			Militarylata	H	M				64

*Plant Form: T = Tree, S = Shrub, H = Herbs.
*Function: F = Food/fruit producing species, T = Timber and fuelwood species, M = Medicinal, S = Spices and O = Other species.

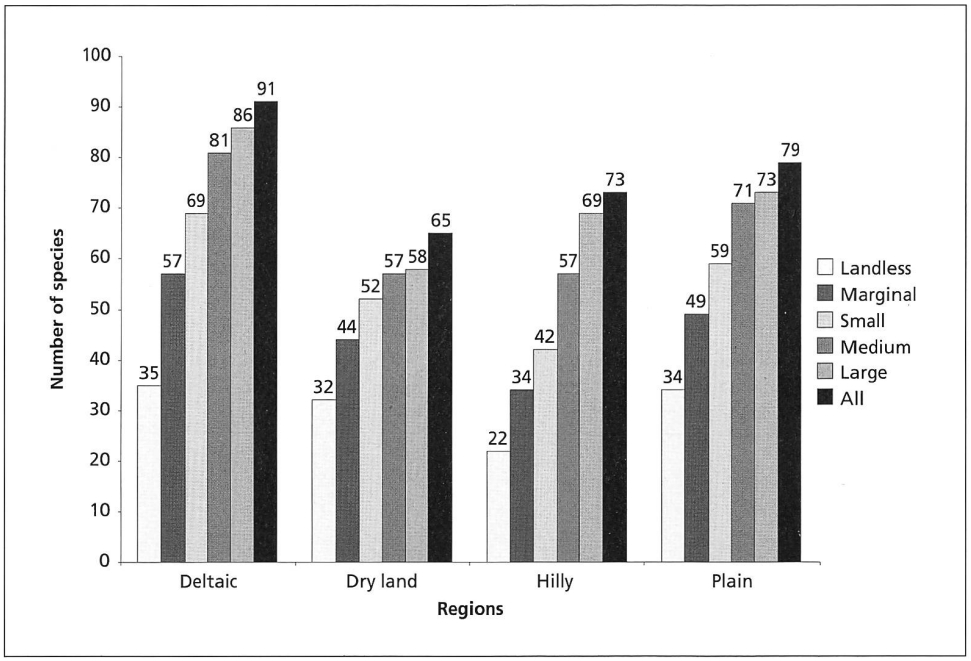

Figure 2: **Species richness of the traditional homegardens of Bangladesh by region and farm category.**

Abbildung 2: Artenvielfalt in den traditionellen Gärten von Bangladesh, aufgeteilt nach Regionen und Betriebsgrössen.

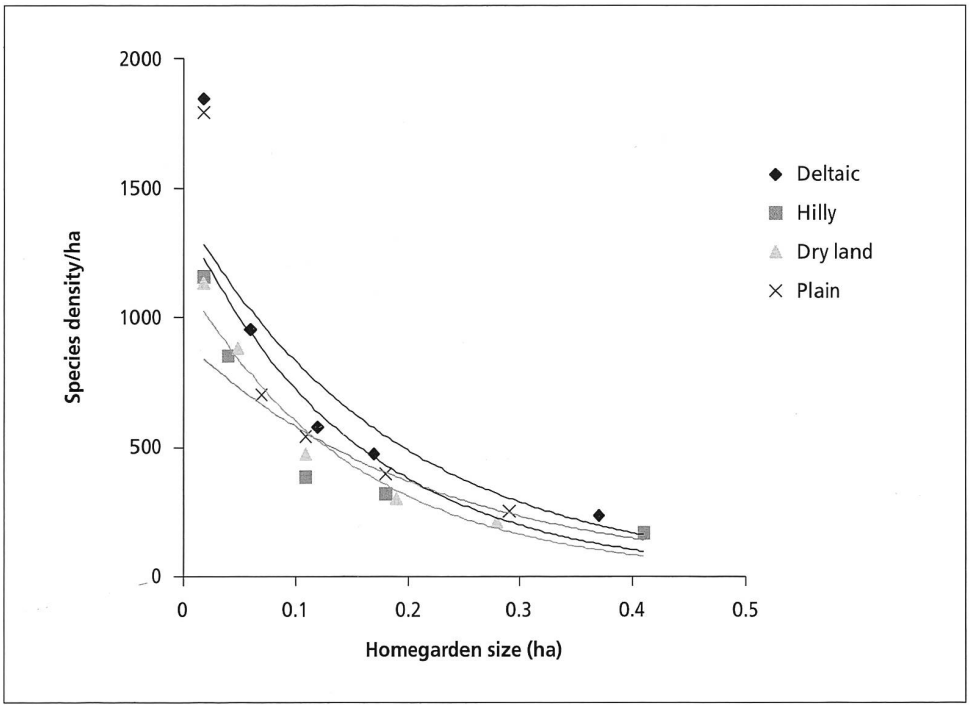

Figure 3: **Graph showing trend of decreasing species density with increasing homegarden size in the deltaic (R^2 = 0.63), dry land (R^2 = 0.64), hilly (R^2 = 0.66) and plain regions (R^2 = 0.63).**

Abbildung 3: Abnehmender Trend der Artenvielfalt bei zunehmender Grösse der Gärten im Deltagebiet, in trockenen, hügeligen und flachen Gebieten.

Species density

While density of species per hectare for each farm category was plotted against the mean size of the homegardens by region, a general trend of species density declining with increasing homegarden size was observed in every region. This is shown in *figure 3.* An exponential curve is shown in each figure fitting the resulting points. Statistical analysis (Regression) for homegarden size (independent variable) against species density per hectare (dependent variable) also showed a strong relationship in all the regions.

Functional grouping of species

When all 162 species are taken into consideration, overall functional grouping of species indicated the presence of a high proportion of medicinal species (40%) followed by timber (29%), food and fruit producing species (27%), others (3%) and spices (1%). Excluding medicinal plants timber species make up (49%) followed by food and fruit (45%), others (4%) and spices (2%). However, a general pattern of higher proportions of food and fruit producing species followed by the timber, medicinal, others and spices was observed in all regions *(figure 4).* The percentage value of each functional group was converted to Arc Sine form and Analysis of variance (Anova) was calculated. Within each functional group, Anova tests showed no significant difference among the regions.

Species similarity

Species peculiar to each region are shown in *table 2.* Floral similarity between regions ranged between 51–57% is presented in *table 3.* Looking at species similarity in three regions, the percentage is 42–45%, whereas only a third of species (about 36%) was common to all regions. In calculating the species similarity, each region was considered as a single unit and the species recorded from all farm categories of a region was therefore taken to be the total number of species for that region. Statistical analysis (Chi-Squared test) showed no significant difference of species similarity between or among regions. This means that vegetation is more or less homogeneous regarding species composition.

Table 3: Species similarity index of the traditional homegardens of Bangladesh between and among regions.

Tabelle 3: Ähnlichkeitsindex der Arten in den traditionellen Gärten in und zwischen Regionen von Bangladesh.

Region (s)	Region (s)			
	Deltaic	Dry land	Hilly	Plain
Deltaic &		53	55	51
Dry land &			57	57
Hilly &				53
Deltaic, Dry land &			42	45
Deltaic, Plain &		45	42	
Deltaic, Dry land, Hilly &				36

Uses of the species

The reasons for growing a variety of plants in the homegardens are complex. Although the functional grouping of species indicated only five categories of plants, in fact nine different types of use of the homegarden plants were recorded from the study areas. In order of preference these were fuelwood, timber, food and fruit, medicine, others, fodder, hedgerow, agricultural implements, and spices *(figure 5).* The category called others includes raw materials for cottage goods, herbal pesticide, ropes, water purifiers, rituals, ornaments, and even a live bridge. In fact, nothing was grown for exclusive use as fuelwood, fence, agricultural implements or others; these were obtained as by-products from other plants. Statistical analysis (Chi-squared test) showed no significant difference in each use category between regions.

Discussion

The information presented in this paper was the result of a vegetation inventory of the traditional homegardens of four regions in Bangladesh. The proportion of trees was higher than that of herbs and shrubs in the areas studied. This is an indication of the long-term perpetuity of the homegardens. Although authors researching homegardens in particular countries give lists of occurring species (e.g., Michon 1983; O'kting'ati *et al.* 1984; Mergen 1987; Padoch & de Jong 1987), no effort has so far been made to categorize homegarden plants based on their plant forms.

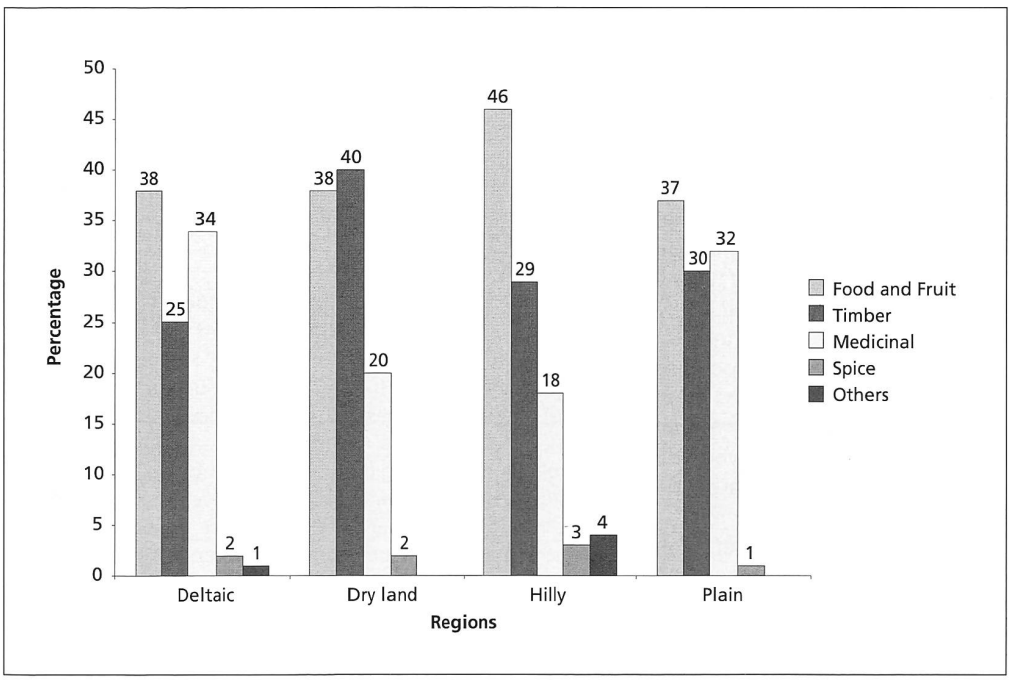

Figure 4: Functional grouping of species of the traditional homegardens of Bangladesh by regions.

Abbildung 4: Nutzungsformen der Arten in den traditionellen Gärten der verschiedenen Regionen von Bangladesh.

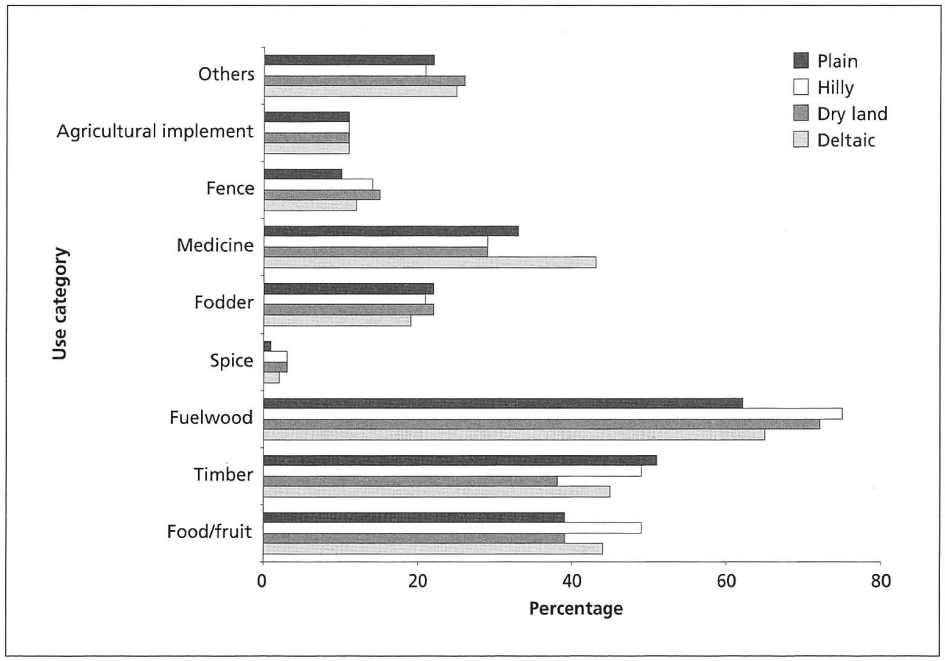

***Figure 5:* Uses of the homegarden plants by regions.**

Abbildung 5: Nutzungsformen der Gartenpflanzen nach Regionen.

A total of 162 perennial species was identified in the study areas. This is a higher figure than in earlier inventories done by Abedin & Quddus (1990), Leuschner & Khaleque (1987) and Millat-e-Mustafa *et al.* (1996) in different regions of Bangladesh. This might be because more homegardens were included in the present study than in earlier inventories, thus increasing the chances of including new species. Moreover, medicinal plants-excluded in previous surveys-were included here. Species richness was highest in the deltaic regions followed by the plain, hilly and dry land regions. This finding is consistent with those of Millat-e-Mustafa *et al.* (1996). Favorable environmental conditions and farmers' involvement in nursery business as a means of subsistence made the deltaic region richest in terms of species richness. At the other extreme, adverse environmental factors (e.g. intense heat, low rainfall) made these regions poorest in terms of species richness. As a result only a few herb species were recorded and this resulted in a significant difference in the herb category among regions.

Smaller homegardens had more species density than the larger ones. This might be due to farmers with smaller homegardens, who are also less well off, attempting to exploit the garden to the full in order to cover their domestic needs of tree products. Similar observations are made by Southern (1994) for the kandy homegardens of Sri Lanka.

Higher proportion of fruit and food producing species followed by timber, others and spices were recorded from the homegardens of the study areas. Although not a lot of quantitative information exists on species composition in homegardens, the studies of Barrau (1961) in the Pacific, McConnell & Dharmapala (1973) in Sri Lanka, Sommers (1978) in Philippines, Michon *et al.* (1983) in Java, Boonkird *et al.* (1984) in Thailand, Millat-e-Mustafa *et al.* (1996) in Bangladesh have acknowledged the predominance of fruit and food producing species in the homegardens of these countries.

In a comparison of two regions more than half of the species were common. This proportion fell to 40% when the homegardens of three regions were compared and around a third of species were common in all four regions.

Homegardens are fundamental to the farmers' life throughout the country. A wide range of products is available from homegardens. Multipurpose tree crops provide fuelwood, fruit, timber, poles, medicines, spices, shade, hedgerows, fodder, protection against pests, cash crops, fibres for ropes and mats or even simply for ornaments. The great diversity of species and their different phenological behaviour also ensures year-round production of different products, thus ensuring something for the daily harvest. Homegarden cultivation is therefore a socially, culturally and ecologically acceptable integrated form of a system of land use.

Summary

A vegetation survey of 100 randomly selected homegardens (five homegardens from each of the landless, marginal, small, medium and large farm categories) and from four physiographic regions (deltaic, dry land, hilly, and plain) of Bangladesh was carried out from July 1998 to June 1999. In all, a total of 162 perennial species were recorded with the highest number of species from deltaic regions (91) followed by the plains (79), the hilly regions (73) and (65) from dry land regions. Species density declined with increasing homegarden size in each region. Nine general uses of homegarden plants were identified (food/fruit, timber, fuelwood, spices, fodder, medicine, fences, agricultural implements, others) with a predominance of food and fruit producing species.

Zusammenfassung

Botanische Eigenschaften der (Haus-)Gärten in Bangladesh

Vom Juli 1998 bis Juni 1999 wurden sämtliche Pflanzen in hundert zufällig ausgewählten Gärten (je fünf von landlosen, landarmen, kleinen, mittleren und grossen Farmen) in vier verschiedenen Regionen (Delta-, Trocken-, Hügelgebiet und Flachland) untersucht. Insgesamt 162 mehrjährige Arten wurden erfasst, und die höchste Artenzahl konnte im Deltagebiet (91), gefolgt vom Flachland (79), dem Hügelgebiet (73) und schliesslich dem Trockengebiet (65) gefunden werden. Die Artenvielfalt war mit zunehmender Gartengrösse geringer. Neun verschiedene Hauptnutzungsformen konnten festgestellt werden (Nahrung/Früchte, Nutzholz, Brennholz, Gewürz, Futter, Heilmittel, Hecken, landwirtschaftliches Gerät, anderes), wobei die Nahrung und Früchte liefernden Pflanzen dominierten.

Übersetzung: Margrit Iniger

Résumé

Les caractéristiques botaniques de jardins de case au Bangladesh

De juillet 1998 à juin 1999, l'ensemble des plantes de cent jardins de case choisis au hasard (cinq jardins pour chacune des cinq catégories de fermes suivantes: sans terres, pauvres en terres, petites, moyennes et grandes) ont été étudiées dans quatre régions différentes du Bangladesh (Delta, régions arides, collines et plaines). Au total, 162 espèces vivaces ont été recensées. Le plus grand nombre a été enregistré dans le Delta (91), puis dans les plaines (79), les collines (73) et finalement les régions arides (65). La diversité des espèces est inversement proportionnelle à la taille des jardins. Neuf utilisations principales (nourriture/fruits, bois d'œuvre, bois de feu, épices, fourrage, médicaments, haies, outils agricoles, autres) ont été identifiées, avec prédominance des plantes nourricières et fruitières.

Traduction: Claude Gassmann

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