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# Structure and floristics of Bangladesh homegardens

M. D. MILLAT-E-MUSTAFA[1], JOHN B. HALL[2] and ZEWGE TEKLEHAIMANOT[2, *]

[1] *Institute of Forestry, Chittagong University, Chittagong, Bangladesh;* [2] *Department of Forestry, School of Agricultural and Forest Sciences, University of Wales, Bangor, Gwynedd LL57 2UW, UK;* * *Author for correspondence*

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**Abstract.** A vegetation survey of traditional homegardens in four regions (South western, North western, Eastern and Central northern) in Bangladesh was conducted with reference to marginal (> 0.02–0.08 ha), small (> 0.08–0.14 ha), medium (> 0.14–0.20 ha) and large (> 0.20 ha) farm categories. Eighty homegardens (five from each farm category in each of the four regions) were assessed in terms of perennial species. The floristic data were ordinated (DECORANA) with respect to homegarden categories based on size and region.

Most species were planted in the border of the homegardens irrespective of farm size and region. Food and fruit producing species dominated near the living quarter and working areas and small plots of annual vegetables and crops separated this part of the garden from the more distant parts favoured for timber species. Six vertical strata were recognised with higher plant density and species richness recorded in the lower three. In total ninety two perennial species were recorded for the set of 80 homegardens surveyed. From gardens in the South western region 67 species were recorded. Corresponding figures were 56 for the Central northern region, 54 for the Eastern region and 46 for the North western region. Within regions there were significant differences in species richness associated with farm size, and within each homegarden size category there were significant differences among regions. Diversity was highest among food and fruit producing species, followed by the timber species. The ordination showed a distinction between the North western and the other regions due to a combination of lower species richness in the North western region homegardens and several species exclusive to the region. Floristic differences led to less marked but nevertheless important differences among the other regions, also.

## Introduction

Homegardens are well-established and vitally important traditional land use systems throughout Bangladesh. They cover about 0.27 million hectares [Forestry Master Plan, 1992] and account for 26–47% of total family income. Over half of the fruit, vegetables and spices grown in homegardens are sold [Davidson, 1984]. In addition, about 55% of the country's requirements for timber, fuelwood and bamboo are met from this source [Forestry Master Plan, 1992]. Nevertheless, despite their importance, homegardens in Bangladesh have not been thoroughly studied. Most studies have been carried out on an ad-hoc basis and are fragmentary in nature, providing only limited insight into the systems [Abedin and Quddus, 1990; Hossain et al., 1988; Leuchner and Khaleque, 1987]. The present study provides a framework of information on

homegarden structure, species composition and diversity as a basis for understanding the nature and organization of their management.

## Materials and methods

### *Study sites*

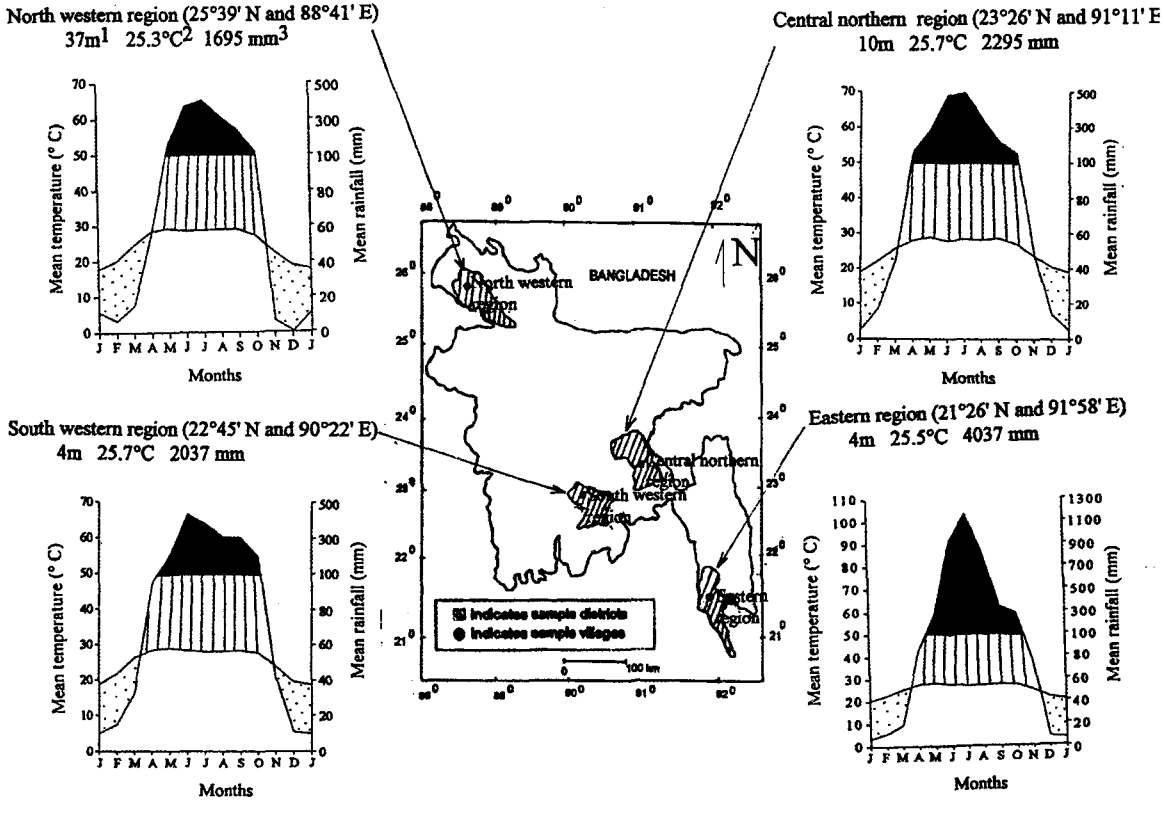
The study was carried out from July 1992 to April 1993 in villages representing each of the four regions of Bangladesh (Fig. 1): the South western, the North western, the Eastern and Central northern regions. These correspond, respectively, to the Deltaic region, Dry region, Hilly region and Plain region of Leuchner and Khaleque [1987].

Multistage random sampling identified representative areas and households for the study. A representative district was taken randomly from each region followed by the random sampling of a representative sub-district within it. Finally a village was taken at random from each of the four sub-districts. Thus, in all, four villages, one from each region, were considered. At village level, the homegardens to be surveyed were identified through a preliminary socio-economic survey.

The farmers in each sample village were categorised into: landless (homestead areas $\leq$ 0.02 ha); marginal (homestead areas > 0.02–0.08 ha); small (homestead areas > 0.08–0.14 ha); medium (homestead areas > 0.14–0.20 ha) and large (homestead areas > 0.20 ha). Since the landless farmers do not practise agroforestry in their homesteads due to land scarcity, their homesteads being totally occupied by the houses, they were excluded from further consideration. Five homegardens were sampled randomly from each of the remaining homestead size categories, giving 80 as the total number of homegardens surveyed.

### *Vegetation survey*

For surveying the vegetation in a homegarden, a north-south base line was established, dividing it into two roughly equal parts. Points were marked on this line at 10 m intervals until the boundary was reached. From the marked points additional lines perpendicular to the base line, ran east and west to the homegarden limit. By creating points at 10 m intervals on these east-west lines, a 10 m $\times$ 10 m sample grid was generated. In each grid unit, the location co-ordinates, total height, crown diameter and crown height of all individuals of perennial species were recorded. In the case of banana and bamboo, clumps were treated as individuals. Since it was not possible to conduct the study during the same season in all regions, seasonal crops including vegetables and weeds grown in the homegardens were excluded.




Note: [1] = Altitude, [2] = Mean annual temperature, [3] = Total annual rainfall

*Fig. 1.* Locations and climatic diagrams of sample districts and village locations.

*Homegarden floristic composition*

All perennial plant species in each homegardens were listed. Specimens of plants that could not be identified in the field were later identified at the Bangladesh Forest Research Institute. To structure the data set, most plants were functionally grouped into food and fruit producing species, timber species and spices. The remaining species were classified as "miscellaneous".

*Horizontal structure*

The horizontal structure of the vegetation was assessed in terms of species locations within the homegardens, in relation to distance from the living quarter. Moving away from the homestead, four quadrants were distinguished. The quadrant containing the living quarter was taken as the first quadrant (Fig. 2). The species present, grouped according to function, were recorded by quadrant. The importance of each function group was also expressed as the percentage of the number of species assessed in each quadrant. Species location within the homegardens was noted in relation to the homegarden boundary as "restricted to the border"; "restricted to the interior part"; or "in both border and interior".

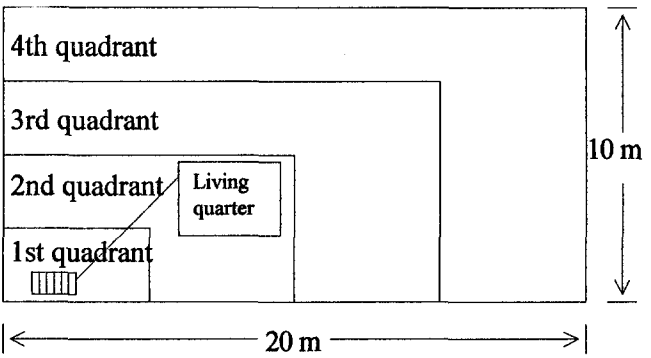



*Fig. 2.* Location of different quadrants within the homegarden.

*Vertical structure*

The vertical structure of the homegardens was summarised by stratifying the individual plants into six strata: $S_0$, plants ≤ 1 m high; $S_1$, plants 1–3 m high; $S_2$, plants 3–5 m high; $S_3$, plants 5–7 m high; $S_4$, plants 7–9 m high; $S_5$, plants > 9 m high.

A profile diagram for a belt of 20 m × 10 m was sketched for each homegarden and density and species richness were recorded. The series of profile diagrams presented (Figs. 4 a–d) is from the marginal homegarden class size,

the class accounting for the majority of homegardens. In every case the 20 m × 10 m belt includes sections from each of the four quadrants.

*Data processing and analysis*

For comparing homegarden categories, data were expressed on a per hectare basis. Differences in species richness among homegardens were examined by a conventional two-way analysis of variance. Within regions, correlations of species number with homegarden area were sought.

The highly diverse nature of homegarden floristics invites analysis with multivariate methods. Broad floristic trends within and among regions were therefore examined through Detrended Correspondence Analysis, DECORANA [Hill and Gauch, 1980]. The standard (default) version was used, on presence/absence data, for all perennial species in each homegarden.

## Results

*Homegarden structure*

*Horizontal structure*

Farmers plant most species, including all timber trees and selected tall fruit trees such as *Syzygium* spp., *Cocos nucifera* and *Tamarindus indica*, only at the borders of the homegardens (Table 1). About half as many species, including *Citrus limon*, *Punica granatum*, *Carica papaya*, *Ziziphus jujuba* and *Cinnamomum tamala*, are planted only in the homegarden interior. Many medium- and small-crowned fruit trees (such as *Mangifera indica*, *Artocarpus heterophyllus* and *Areca catechu*), *Musa* spp. and herbaceous (non-seasonal) perennials such as *Curcuma longa* and *Zingiber officinale* are grown both in the border and the interior parts.

In all quadrants, food and fruit producing species contributed more than other functional groups to species richness, particularly in the 1st quadrant (Fig. 3). Timber species ranked second in terms of species richness in all

*Table 1.* Species arrangement with respect to major locations within homegardens by region in Bangladesh.

| Region | Total species | Planting locations | | |
|---|---|---|---|---|
| | | Only border | Only interior | Both border & interior |
| South western | 67 | 38 (57) | 19 (28) | 10 (15) |
| North western | 46 | 25 (54) | 11 (24) | 10 (22) |
| Eastern | 54 | 30 (56) | 13 (24) | 11 (20) |
| Central northern | 56 | 34 (61) | 13 (23) | 9 (16) |

Figures in parenthesis indicate percentage values.

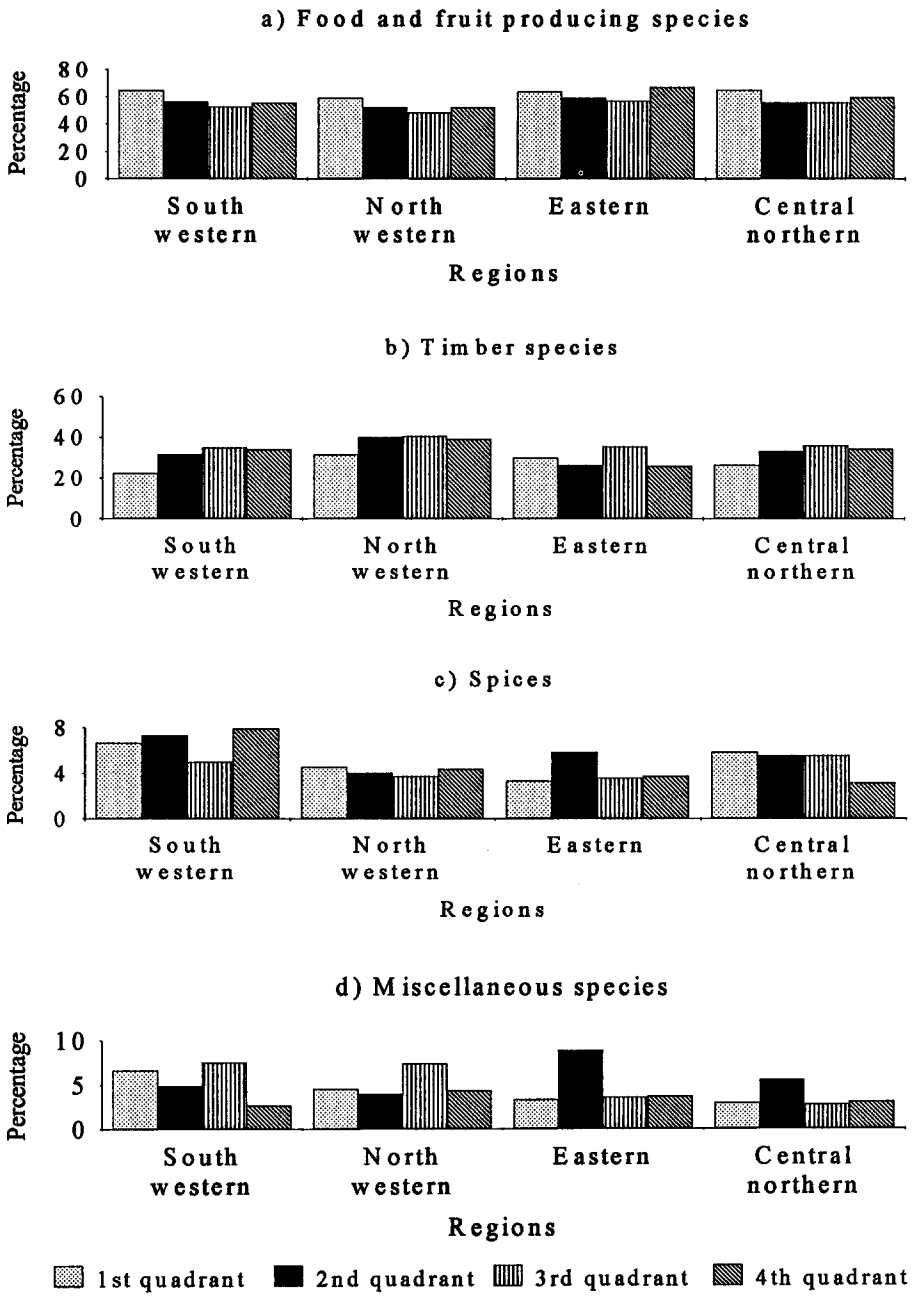
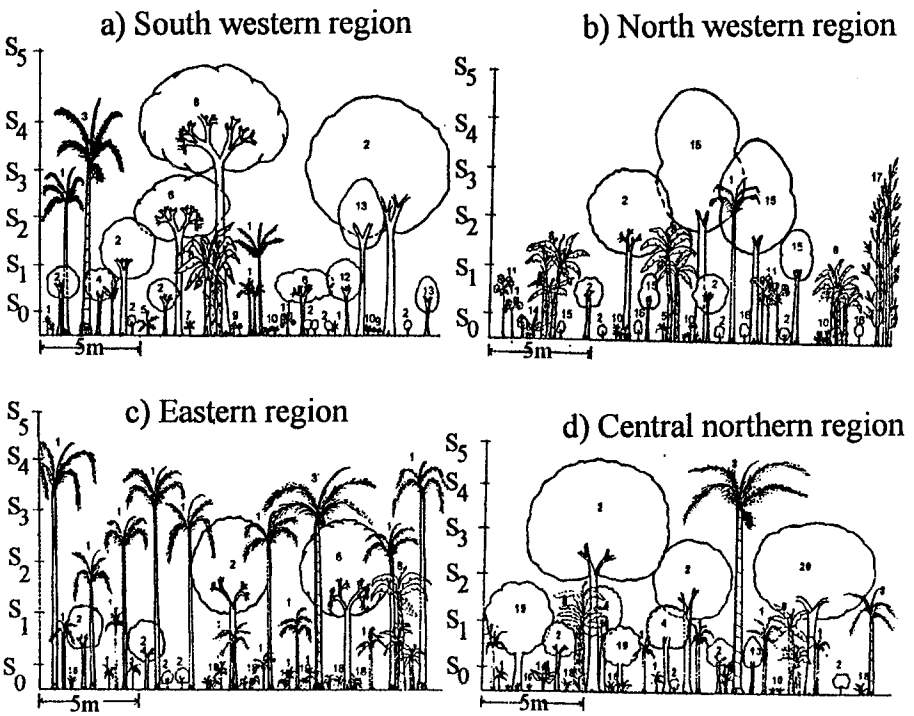



*Fig. 3.* Species distribution by quadrants in traditional homegardens of different regions in Bangladesh.

quadrants and were consistently the best represented group in the 3rd quadrant. No pattern was apparent in the location of spices and miscellaneous species within the homegardens: the use of these was very variable.

*Vertical structure*

Homegardens display a broadly consistent vertical structure throughout the country (Fig. 4) and many important species are typical of every region. Stratum, $S_0$ (< 1 m), consists mainly of herbaceous perennials, such as *Curcuma longa* and *Ananus sativus*, and seedlings of woody perennials. This stratum receives little direct sunlight as there are five strata above. Stratum $S_1$ (1–3 m) consists of a mixture of *Musa* spp., *Carica papaya,* shrubs such as *Citrus limon,* and large seedlings of such upper layer species as *Areca catechu*, *Artocarpus heterophyllus*, *Mangifera indica*, *Samanea saman* and *Swietenia macrophylla.* This stratum too, is heavily shaded by the strata above.




*Note:* 1 = *Areca catechu*; 2 = *Mangifera indica*; 3 = *Cocos nucifera*; 4 = *Swietenia macrophylla*; 5 = *Phoenix sylvestris*; 6 = *Samanea saman*; 7 = *Ocimum sanctum*; 8 = *Musa* spp.; 9 = *Glycine max*; 10 = *Curcuma longa*; 11 = *Carica papaya*; 12 = *Spondias pinnata*; 13 = *Diospyros embryopteris*; 14 = *Colocacia indica*; 15 = *Melia azedarach*; 16 = *Azadirachta indica*; 17 = *Bambusa* spp.; 18 = *Ananus sativus*; 19 = *Artocrpus heterophyllus*; 20 = *Albizia* spp.
*Strata:* $S_0$ = ≤ 1 m; $S_1$ = 1–3 m; $S_2$ = 3–5 m; $S_3$ = 5–7 m; $S_4$ = 7–9 m; $S_5$ = > 9m.

*Fig. 4.* Profile diagrams of traditional homegardens in Bangladesh.

Stratum $S_2$ (3–5 m) consists mainly of larger individuals of *Musa* spp., and *Carica papaya,* together with mature individuals of food and fruit trees (e.g. *Artocarpus lakoocha*, *Annona reticulata*, *Annona squamosa*, *Caesalpinia crista*, *Citrus grandis*, *Dillenia indica*, *Moringa oleifera*, *Phyllanthus emblica*) and saplings of timber species (e.g. *Albizia* spp., *Azadirachta indica*, *Samanea saman*, *Swietenia macrophylla*, *Aphanamixis polystachya*). This stratum receives partial sunshine, the amount depending on the continuity and canopy character in the three higher strata. Stratum $S_3$ (5–7 m) usually consists of numerous trees with their crowns at least partly exposed. Most productive individuals of food and fruit producing species are in this stratum, which includes individuals with fully exposed crowns (e.g. *Artocarpus heterophyllus*, *Diospyros embryopteris*, *Elaeocarpus robustus*, *Mangifera indic*a, *Psidium guajav*a, *Spondias pinnata*). Stratum $S_4$ (7–9 m) is of tall trees with generally good crown exposure to sunlight – most are fully exposed. Almost all mature individuals of the timber species and those of some fruit producing species belong to this stratum. Stratum $S_5$ (> 9 m) is of individuals with crowns raised above those of the surrounding trees: bamboos and trees of relatively tall homegarden species such as *Cocos nucifera*, *Areca catechu*, *Mangifera indica* and *Samanea saman*, all with fully exposed crowns. Per hectare densities of individual plants are much higher in the lower three strata, than in the other (Table 2).

*Table 2.* Vertical distribution of plants (range of values) and species richness (range of values) in traditional homegardens in Bangladesh (all farm categories combined).

| Region | Total individuals $ha^{-1}$ | Vertical strata | | | | | |
|---|---|---|---|---|---|---|---|
| | | $S_0$ | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ |
| South western | 1909–2462 | 424–704[a] | 368–693 | 337–719 | 158–265 | 38–225 | 17–136 |
| | | 20–37[b] | 19–33 | 18–34 | 7–12 | 2–11 | 1–7 |
| | | 35–46[c] | 54–78 | 62–81 | 33–51 | 21–32 | 10–18 |
| North western | 1189–2078 | 139–614 | 325–742 | 86–230 | 52–225 | 150–426 | 81–128 |
| | | 9–30 | 27–37 | 6–15 | 3–19 | 13–28 | 5–9 |
| | | 46–66 | 62–75 | 54–68 | 36–46 | 23–36 | 4–13 |
| Eastern | 1389–2380 | 271–583 | 435–742 | 233–384 | 163–231 | 69–471 | 12–150 |
| | | 20–29 | 29–31 | 12–24 | 9–14 | 4–20 | 1–8 |
| | | 30–48 | 55–67 | 55–67 | 41–52 | 20–30 | 10–21 |
| Central northern | 1754–2314 | 325–478 | 377–793 | 337–756 | 91–323 | 145–231 | 35–355 |
| | | 14–23 | 21–34 | 19–33 | 5–16 | 8–11 | 2–20 |
| | | 32–41 | 55–62 | 67–83 | 45–62 | 21–34 | 20–21 |

[a] Indicates minimum to maximum values of plant density for farm categories.
[b] Indicates minimum to maximum percentage values of plant density for farm categories.
[c] Indicates minimum to maximum percentage values of species richness for farm categories.

*Species richness*

In total, ninety two perennial species were recorded from the set of 80 homegardens surveyed (Appendix 1). Regional mean numbers of species are shown in Table 3. The analysis of variance of the 80-homegarden set showed a significant interaction of region with homegarden size influencing species richness (Table 4). The influence of region and homegarden size were therefore considered further in separate one-way analyses of variance. Within regions there was a direct relationship between ($P < 0.001$) species richness and farm size, indicating a greater diversity of resources at the disposal of larger farmers (South western, $r = 0.86$; North western, $r = 0.77$; Eastern = 0.85; Central northern, $r = 0.77$). Within each homegarden size category there were significant differences ($P < 0.001$) among regions indicating differences in species richness in the regions.

Food and fruit producing species accounted for more of the species present irrespective of homegarden size categories and regions than any other functional group, followed by the timber species, the miscellaneous group and the spices, respectively (Fig. 5).

In terms of vertical strata, species richness varied with region (Table 2). In the North western region the highest species richness was recorded from the lower three strata ($S_0$, $S_1$, $S_2$) of the homegardens regardless of homegarden size category and in the marginal and small homegardens of the South western and Eastern regions. However, in the medium and large homegardens of the South western and Eastern regions stratum $S_3$ was richer in species than

*Table 3.* Mean number of species in the homegardens of different regions in Bangladesh.

| Regions | Mean | SD | SE |
|---|---|---|---|
| North western | 16.4 | 3.89 | 0.87 |
| Central northern | 25.25 | 6.21 | 1.39 |
| South western | 30.05 | 7.02 | 1.57 |
| Eastern | 18.5 | 4.09 | 0.91 |

*Table 4.* Results of ANOVA test for the differences in number of species in different regions and farm categories.

| Sources of variation | df | SS | MS | F | *P* |
|---|---|---|---|---|---|
| Region (R) | 3 | 2355.30 | 785.10 | 108.29 | *** |
| Farm (F) | 3 | 1622.90 | 540.97 | 74.62 | *** |
| (R × F) | 9 | 187.60 | 20.84 | 2.88 | ** |
| Error | 64 | 464.00 | 7.25 | | |
| Total | 79 | 4629.80 | | | |

*** ($P < 0.001$); ** ($P < 0.01$).

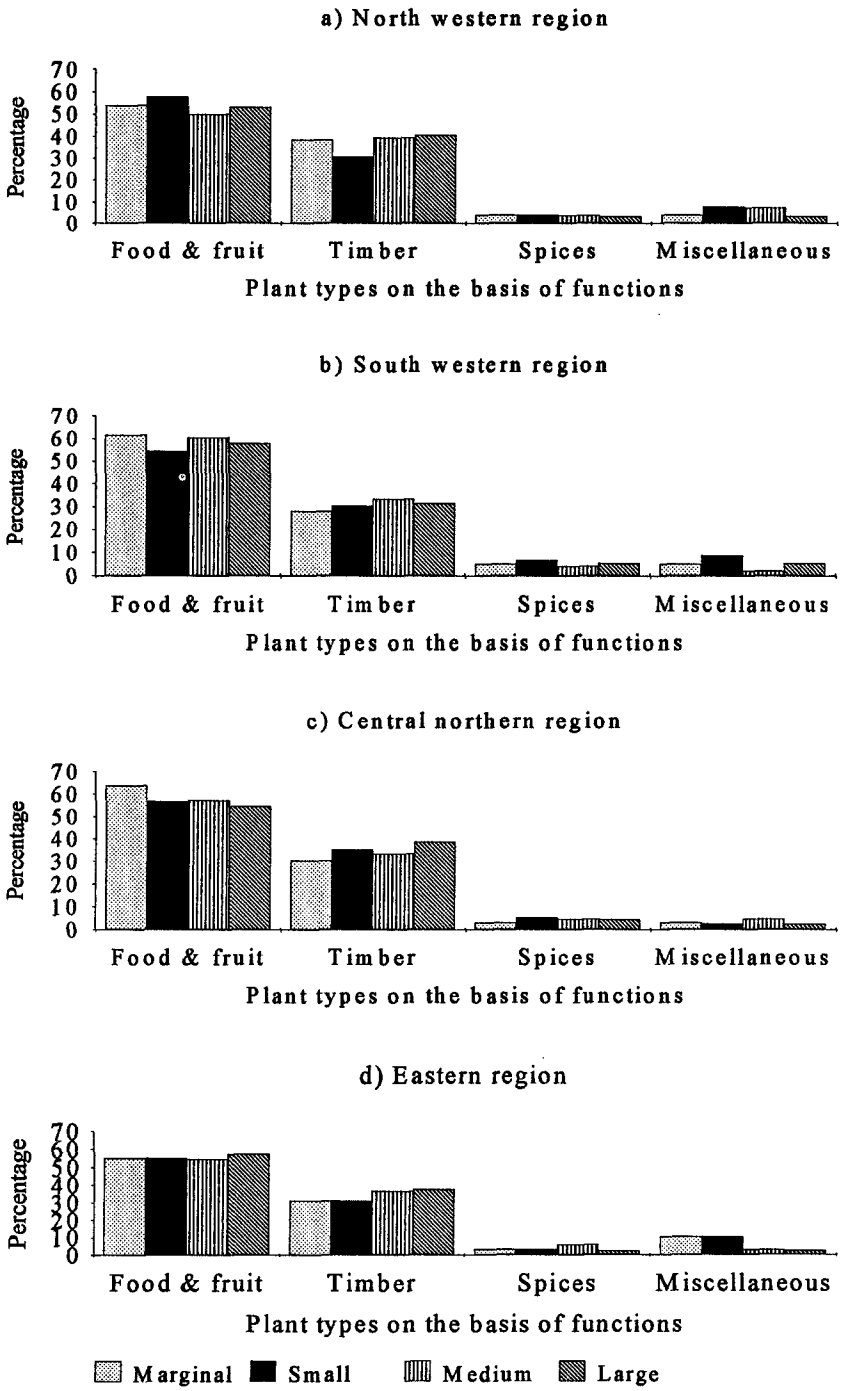



*Fig. 5.* Functional species groups of traditional homegardens in Bangladesh by regions.

stratum $S_0$ and this was the case for all homegardens in the Central northern region.

*Overall homegarden floristics*

The ordination using DECORANA revealed groups related to different villages. When all four regions were included, homegardens in the North western region village were separated as a group with high loadings on Axis 1 (Fig. 6a). This effect reflected partly the generally lower species richness of the North western region homegardens and partly the lower floristic similarity between the North western region and the other regions. The highest numbers of species per farm were in the South western region followed in turn by the Central northern, the Eastern region and the North western region.

The North western region group was readily divisible into two subgroups: a subgroup composed of marginal and small sized farms had high Axis 2 loadings, while the subgroup of medium and large sized farms, had low Axis 2 loadings. A corresponding effect reflecting farm size was also present in other regions but much less sharply displayed. The South western, Central northern and Eastern group homegardens all received comparatively low Axis

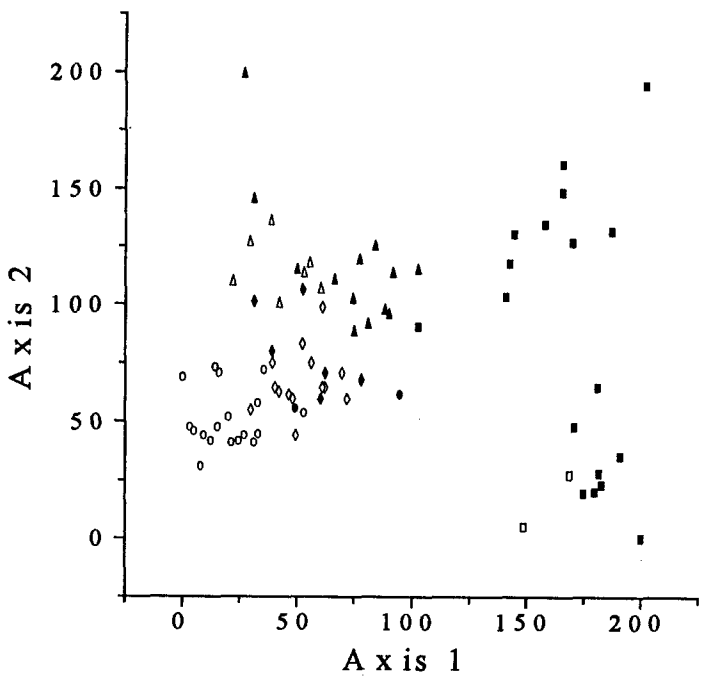



*Fig. 6a.* DECORANA ordination of eighty homegardens of Bangladesh: Squares* (North western region), Circles* (South western region), Triangles* (Eastern region), Diamonds (Central northern region).

*Note:* * Solid symbols represent homegardens with species richness ≤ 20; open symbols represent homegardens with species richness > 20.

1 loadings but on Axis 2 the Eastern farms had high loadings and the South western farms low loadings. On this axis, the Central northern farms were intermediate but there was continuity through the three groups. A breakdown analysis was carried out to examine relations among the South western, Eastern and the Central northern farms in more detail without the influence of North western region homegardens (Fig. 6b). This breakdown analysis revealed differences between the Eastern homegardens (high loadings on Axis 1) and the others (low loadings on Axis 1). The effect of farm size was more obvious in the breakdown analysis for the Eastern and Central northern regions but not for the South western region which received the lowest loadings on both Axis 1 and Axis 2.

The presence of species characteristic (species grown in one region only) for different regions also contributed to the separation of regions in the ordinations (Appendix 1). *Musa* and *Mangifera indica* were present in every homegarden in every region. Another 23 species were present in at least one homegarden in each region. The highest numbers of species overall were recorded in the homegardens of the South western (67) and Central northern (56) regions. Corresponding totals were 54 for the Eastern region and 46 for the North western region.

The difference between the North western region subgroups arises from differences in the number of species present in individual homegardens, larger

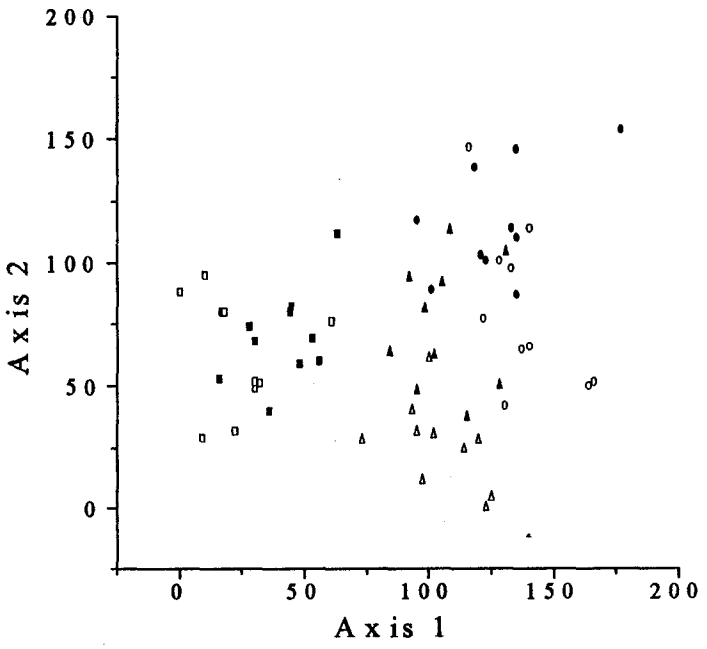



*Fig. 6b.* DECORANA ordination of sixty homegardens of Bangladesh: Circles* (Eastern region), Triangles* (Central northern region), Squares* (South western region).
*Note:* * Solid symbols represent marginal and small homegardens; open symbols represent medium and large homegardens.

farms having more species. Fruit trees such as *Moringa oleifera*, *Citrus acida*, *Borassus flabellifer* and *Aegle marmelos* and timber trees such as *Dalbergia sissoo*, *Anthocephalus chinensis* and *Bombax ceiba* were not found in the smaller farm categories. The inclination of farmers with large holdings to collect many species, the availability to them of more space, their better socio-economic conditions and higher education are possible contributory factors.

## Discussion

The farmers of Bangladesh have inherited complex homegarden farming systems. Farmers consciously enact spatial arrangement patterns for species in their homegardens and they mostly plant in mixture at the border, ensuring multiple utility of the homegarden edges. This intimacy of mixing of species presumably reduces the spread of pests or diseases through the system in a part of the garden allocated to species not needing management attention on a daily basis [Batra, 1962]. Kumar et al. [1994] reported such mixing in homegardens in Kerala, India. The plants of the homegarden edge serve the multipurpose needs of the farmers not only by providing products but by also acting as a live fence and as boundary demarcation. The central area (mostly a part of quadrants 2 and 3) of the homegardens accommodates yards, cattle and poultry sheds, ponds and the vegetable gardens and other small, pure stands of annual crops which require regular tending. Food and fruit producing species dominate the part of the homegarden near the living quarters. Here fruits are safest from theft. Wickramasinghe [1992] observed a similar distribution pattern of food and fruit producing species in the homegardens of Sri Lanka. To avoid damage to the living quarters during pruning and final felling, farmers prefer remote parts of their homegardens for growing large species for timber, as do their counterparts elsewhere in humid Asia [Sommers, 1978; Christanty et al., 1986].

The multilayered canopy configuration of the homegardens, with less plant density and species richness in the upper two strata (> 7 m height), generates gradients of light intensity and quality through the lower strata. In these strata, different species flourish where the light regime suits them better then their associates. Higher plant density and species richness in strata up to 7 m in height simplifies the harvesting of products by women and the children: many products are taken off the plants at heights < 2 m.

The numbers of perennial species recorded from the homegardens of each region (26–57) are high but consistent with those reported for earlier inventories (20–52) carried out by the Bangladesh Agricultural Research Institute at different farming systems research sites [Abedin and Quddus, 1990]. The number of species has been shown here to vary significantly from region to region. The types of plants grown are influenced by a combination of socio-cultural background, availability of forest resources and environmental factors. Higher numbers of species were recorded from the south western region (67 species in 20 homegardens surveyed) where the agricultural land remains

under water most of the year and farmers have developed a homestead based subsistence system where they raise nurseries of valuable species. The geographic isolation of this region and the need to be self reliant with locally available resources are likely causes for people to grow such a diversity of plant species. At the other extreme, in the north western region, adverse environmental conditions (such as low rainfall, intense heat and low soil fertility) restrict the variety of species that are rewarding to grow [FAO-UNESCO, 1977]. Thus, the north western region is, the poorest in terms of species richness (46 species in 20 homegardens surveyed).

Although species composition varies greatly from region to region, a basic set of species is common to all regions. For example *Musa* spp. and *Mangifera indica* were recorded from all 80 homegardens surveyed. Early fruiting behaviour, a function as famine food during food shortages, ease of growing and managing, availability of vegetative propagules, multiple uses and high income from sales of fruits have made *Musa* spp. one of the most common components in the homegardens of Bangladesh. Similarly, *Mangifera indica* is a useful cash crop which is regarded as a multipurpose tree species by farmers – and its wood can burn green, which is seen as an especially valuable characteristic. The growing of plants in the homegarden is primarily with home consumption in mind. Thus food and fruit producing species predominate. The homegardens nevertheless supply also timber, fuelwood, fodder and medicine. Although no quantitative figure is available for species composition patterns in homegardens across the world, the studies of Michon et al. [1983] in Java; Sommers [1978] in Philippines; McConnell and Dharmapala [1973] in Sri Lanka; Boonkird et al. [1984] in Thailand, Nair and Sreedharan [1986], Salam and Sreekumar [1991] in India and Khaleque [1987] in Bangladesh acknowledge the predominance of fruit and food producing species in Asian homegardens.

In conclusion, the horizontal and vertical structure of the homegardens in Bangladesh are carefully maintained by the farmers which ensures maximum utilisation of available water, nutrients, light and space. Regional differences, however, show that environmental factors operating on a large scale remain strong influences. They reduce diversity significantly in the north western region and, at the other extreme, promote diversity in the south western region, in combination with socio-economic adaptation to needs to cope with periods of isolation by flood water. Extending investigations to cover the annual components will provide insight into the homegarden production system in its entirety and is a research priority. Integrated research, including management aspects of homegarden components (e.g. animal, fish) excluded from this study and interactions among them is also needed. There are prospects for practical advances based on their high diversities of fruit and other functional group species in the homegardens and roles as *in situ* germ plasm conservation sites. Identifying fruit plants in the homegardens with special characteristics invites special attention to establishing an *in situ* gene bank network in homegardens, managed by collaboration between farmer and resource specialists.

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## Appendix: Plant species of the traditional homegardens in Bangladesh.

| No. | Family | Scientific name | Common name | Plant form | Function | Reported from | Uses |
|---|---|---|---|---|---|---|---|
| 1 | Amaranthaceae | *Achyranthes aspera* (Wall.) Hook | Apang | S | O | SW | 3, 6 |
| 2 | Anacardiaceae | *Odina wodier* Roxb. | Jiga | T | T | NW | 2, 3 |
| 3 | Anacardiaceae | *Lannea coromandelica* (Houtt.) Merr. | Badhi | T | T | All regions | 2, 3, 5, 7, 8 |
| 4 | Anacardiaceae | *Mangifera Indica* Linn. | Mango | T | F | All regions | 1, 2, 3, 5 |
| 5 | Anacardiaceae | *Spondias Pinnata* (L.f.) Kurz | Hog-plum | T | F | All regions | 1, 2, 3 |
| 6 | Annonaceae | *Annona reticulata* Linn. | Custard apple | T | F | SW, E & CN | 1, 3 |
| 7 | Annonaceae | *Annona squamosa* Linn. | Sorifa | T | F | SW | 1, 3 |
| 8 | Annonaceae | *Polyalthia longifolia* (Sonnerat) Thwaite | Debdaru | T | T | SW | 2, 3, 8 |
| 9 | Apocynaceae | *Alstonia scholaris* (Linn.) R. Br. | Chatim | T | T | SW & CN | 2, 3, 8 |
| 10 | Araceae | *Colocasia indica* (Lour.) Spach | Aroid | H | F | All regions | 1 |
| 11 | Bombacaceae | *Bombax ceiba* Linn. | Silk cotton | T | T | All regions | 2, 3, 8 |
| 12 | Bromeliaceae | *Ananas sativus* (Lindley) Schultes f. | Pine apple | H | F | All regions | 1 |
| 13 | Burseraceae | *Bursera serrata* Colebr. | Gutgutia | T | T | SW & CN | 2, 3 |
| 14 | Caricaceae | *Carica papaya* Linn. | Papaya | T | F | All regions | 1 |
| 15 | Casuarinaceae | *Casuarina equisetifolia* Linn. | Yew tree | T | T | E | 2, 3 |
| 16 | Combretaceae | *Terminalia arjuna* W & A | Arjun | T | T | CN | 2, 3, 6 |
| 17 | Combretaceae | *Terminalia catappa* Linn. | Kat badam | T | T | SW, E & CN | 2, 3 |
| 18 | Cucurbitaceae | *Coccinia cordifolia* Dc. | Kougola | T | F | SW & E | 1, 2, 3 |
| 19 | Dilleniaceae | *Dillenia indica* Linn. | Chalta | T | F | SW & CN | 1, 3 |
| 20 | Dipterocarpaceae | *Dipterocarpus turbinatus* Gaertner f. | Gorjon | T | T | E | 2, 3 |
| 21 | Ebenaceae | *Diospyros embryopteris* Pers. | Gab | T | F | SW, E & CN | 1, 2, 3 |
| 22 | Elaeocarpaceae | *Elaeocarpus robustus* Roxb. | Olive | T | F | E & CN | 1, 2, 3 |
| 23 | Euphorbiaceae | *Phyllanthus emblica* Linn. | Amoloki | T | F | SW & E | 1, 3, 6 |
| 24 | Euphorbiaceae | *Ricinus communis* Linn. | Verenda | S | O | NW & CN | 6 |
| 25 | Gramineae | *Bambusa balcooa* Roxb. | Barak bans | T | T | NW, E & CN | 2, 3, 5, 7, 8 |
| 26 | Gramineae | *Bambusa burmanica* Gamble | Jai bans | T | T | SW, E & CN | 2, 3, 5, 7, 8 |
| 27 | Gramineae | *Bambusa longispiculata* Gamble | Tolla bans | T | T | SW & NW | 2, 3, 5, 7, 8 |
| 28 | Gramineae | *Bambusa vulgaris* Schrad. ex Wends | Baijja bans | T | T | E & CN | 2, 3, 5, 7, 8 |
| 29 | Gramineae | *Melocanna bambusoides* Trin. | Muli bans | T | T | SW & CN | 2, 3, 5, 7, 8 |
| 30 | Gramineae | *Schumannianthus dichotoma* Gagnep. | Patipata | S | O | E & CN | 8 |
| 31 | Labiatae | *Ocimum sanctum* Linn. | Tulsi | S | O | SW, NW & CN | 6, 8 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 32 | Lauraceae | *Cinnamomum tamala* Fr. Nees | Bay leaf | T | S | SW, E & CN | 3, 4 |
| 33 | Lauraceae | *Cinnamomum zeylanicum*Blume | Cinnamon | T | S | SW | 3, 4 |
| 34 | Lecythidaceae | *Barringtonia acutangula* (Linn.) Gaertn. | Hijol | T | T | SW & E | 2, 3 |
| 35 | Leguminosae | *Acacia auriculiformis* Cunn. ex Benth. | Acacia | T | T | E & CN | 2, 3 |
| 36 | Leguminosae | *Albizia falcataria* (Linn.) Fosberg | Malocanna | T | T | SW & NW | 2, 3 |
| 37 | Leguminosae | *Albizia procera* (Roxb.) Benth. | Koroi | T | T | All regions | 2, 3 |
| 38 | Leguminosae | *Caesalpinia crista* Linn. | Koromcha | T | F | SW | 1, 3 |
| 39 | Leguminosae | *Cajanus cajan* Linn. | Pigeon pea | S | F | SW, NW & E | 1, 3, 5, 7 |
| 40 | Leguminosae | *Cassia fistula* Linn. | Sonalu | T | T | SW & E | 2, 3, 8 |
| 41 | Leguminosae | *Cassia siamea* Lamk. | Minjiri | T | T | SW | 2, 3 |
| 42 | Leguminosae | *Delonix regia* (Bojer ex Hook.) Rafin. | Krisnochura | T | T | E | 2, 3, 8 |
| 43 | Leguminosae | *Erythrina variegata* Linn. | Madar | T | T | All regions | 2, 3, 5, 7, 8 |
| 44 | Leguminosae | *Glycine max* Linn. | Soyabean | H | F | SW | 1 |
| 45 | Leguminosae | *Leucaena leucocephala* (Lamk) deWit. | Ipilipil | T | T | NW | 3, 5 |
| 46 | Leguminosae | *Pongamia glabra* Vent Jard. | Karung | S | O | SW | 6 |
| 47 | Leguminosae | *Samanea saman* (Jacq.) Merr. | Rain tree | T | T | All regions | 2, 3 |
| 48 | Leguminosae | *Sesbania sesban* (Cav.) | Doincha | T | T | SW | 3 |
| 49 | Leguminosae | *Dalbergia sissoo* Roxb. ex DC. | Sissum | T | T | NW | 2, 3 |
| 50 | Leguminosae | *Tamarindus indica* Linn. | Tamarind | T | F | SW & CN | 1, 2, 3 |
| 51 | Lythraceae | *Lagerstroemia speciosa* (Linn.) Pers. | Jarul | T | T | SW & CN | 2, 3 |
| 52 | Lythraceae | *Lawsonia inermis* Linn. | Mendi | T | O | SW, NW & E | 3, 8 |
| 53 | Magnoliaceae | *Michelia champaca* Linn. | Champa ful | T | T | E | 2, 3, 8 |
| 54 | Malvaceae | *Gossypium herbaceum* Linn. | Cotton plant | S | O | NW | 3, 8 |
| 55 | Malvaceae | *Hibiscus rosa-sinensis* Linn. | China rose | S | O | E | 3, 7, 8 |
| 56 | Meliaceae | *Aphanamixis polystachya* (Wall.) Parker | Roina | T | T | SW & CN | 2, 3 |
| 57 | Meliaceae | *Azadirachta indica* A. Juss. | Neem | T | T | NW | 2, 3, 6 |
| 58 | Meliaceae | *Melia azedarach* Linn. | Ghora Neem | T | T | NW | 2, 3 |
| 59 | Meliaceae | *Swietenia macrophylla* King. | Mahogony | T | T | All regions | 2, 3 |
| 60 | Meliaceae | *Toona ciliata* M.J. Roemer | Poma | T | T | NW & CN | 2, 3 |
| 61 | Moraceae | *Artocarpus lakoocha* Roxb. | Dewa | T | F | SW, E & CN | 1, 3 |
| 62 | Moraceae | *Artocarpus heterophyllus* Lamk. | Jack fruit | T | F | All regions | 1, 2, 3, 5 |
| 63 | Moraceae | *Ficus racemosa* Linn. | Fig | T | T | SW & CN | 3, 5 |
| 64 | Moraceae | *Morus alba* Linn. | Mulberry | T | O | NW | 3 |
| 65 | Moringaceae | *Moringa oleifera* Lamk. | Sajna | T | F | NW | 1, 3 |
| 66 | Musaceae | *Musa* spp. Linn. | Banana | T | F | All regions | 1, 3, 5, 7 |

*Appendix (Continued).*

| No. | Family | Scientific name | Common name | Plant form | Function | Reported from | Uses |
|---|---|---|---|---|---|---|---|
| 67 | Myrtaceae | *Eucalyptus camaldulensis* Dehn. | Eucalyptus | T | T | NW & E | 2, 3 |
| 68 | Myrtaceae | *Eugenia javanica* Lamk. | Star apple | T | F | SW, NW & CN | 1, 2, 3 |
| 69 | Myrtaceae | *Psidium guajava* Linn. | Guava | T | F | All regions | 1, 2, 3 |
| 70 | Myrtaceae | *Syzygium cumuni* (Linn.) Skeels | Jam | T | F | All regions | 1, 2, 3 |
| 71 | Oxalidaceae | *Averrhoa bilimbi* Linn. | Balemboo | T | F | E | 1, 3 |
| 72 | Oxalidaceae | *Averrhoa carambola* Linn. | Star fruit | T | F | All regions | 1, 3 |
| 73 | Palmae | *Areca catechu* Linn. | Betel nut | T | F | All regions | 1, 2, 3, 7, 8 |
| 74 | Palmae | *Borassus flabellifer* Linn. | Palmyra Palm | T | F | SW, NW & CN | 1, 2, 3, 7, 8 |
| 75 | Palmae | *Cocos nucifera* Linn. | Coconut | T | F | All regions | 1, 2, 3, 7, 8 |
| 76 | Palmae | *Phoenix sylvestris* (Linn.) Roxb. | Date palm | T | F | SW, NW & CN | 1, 3, 8 |
| 77 | Piperaceae | *Piper longum* Linn. | Pipul | S | O | SW | 3, 6 |
| 78 | Punicaceae | *Punica granatum* Linn. | Pomegranate | T | F | All regions | 1, 3 |
| 79 | Rhamnaceae | *Ziziphus jujuba* (Linn.) Gaertn. | Jujube | T | F | All regions | 1, 2, 3, 6 |
| 80 | Rubiaceae | *Anthocephallus chinensis* (Lamk.) A.Rick ex Walp | Kadam | T | T | SW, NW & CN | 2, 3, 8 |
| 81 | Rutaceae | *Aegle marmelos* (Linn.) Correa | Wood apple | T | F | All regions | 1, 2, 3, 6 |
| 82 | Rutaceae | *Citrus acida* (Linn.) | Jambura | T | F | All regions | 1, 3 |
| 83 | Rutaceae | *Citrus grandis* (Linn.) Osbeck | Pomelo | T | F | E | 1, 3 |
| 84 | Rutaceae | *Citrus limon* (Linn.) Burm. f. | Lemon | S | F | SW, E & CN | 1, 6 |
| 85 | Rutaceae | *Citrus reticulata* Blanco | Orange | T | F | SW & CN | 1, 3 |
| 86 | Rutaceae | *Feronia limonia* (Linn.) Swingle | Kath bael | T | F | SW | 1, 2, 3 |
| 87 | Sapindaceae | *Litchi chinensis* Sonn. | Litchi | T | F | All regions | 1, 2, 3 |
| 88 | Tiliaceae | *Grewia microcos* Linn. | Asar | T | T | All regions | 2, 3 |
| 89 | Verbenaceae | *Gmelina arborea* Roxb. | Gamar | T | T | E | 2, 3 |
| 90 | Verbenaceae | *Tectona grandis* L.f. | Teak | T | T | SW, E & CN | 2, 3 |
| 91 | Zingiberaceae | *Curcuma longa* Linn. | Turmeric | H | S | All regions | 4, 6 |
| 92 | Zingiberaceae | *Zingiber officinale* Roscoe | Ginger | H | S | SW | 4, 6 |

Regions: NW = North western, SW = South western, E = Eastern, CN = Central northern.
Plant Form: T= Tree, S= Shrub, H= Herb.
Function: F= Food/fruit producing species, T = Timber and fuelwood species, S = Spices and O = Other species.
Uses: 1 = Food/fruit, 2 = Timber, 3 = Fuelwood, 4 = Spice, 5 = Fodder, 6 = Medicine, 7 = Fence and 8 = Others.