Defining Tree-Breeding Objectives fo Multipurpose Tree Species: A Case Study in Sri Lanka

Report Number 16

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Part of

a Regional Study on Farmers' Tree-Breeding Objectives

conducted by scientists in the

Multipurpose Tree Species Research Network

Forestry/Fuelwood Research and Development (F/FRED) Project
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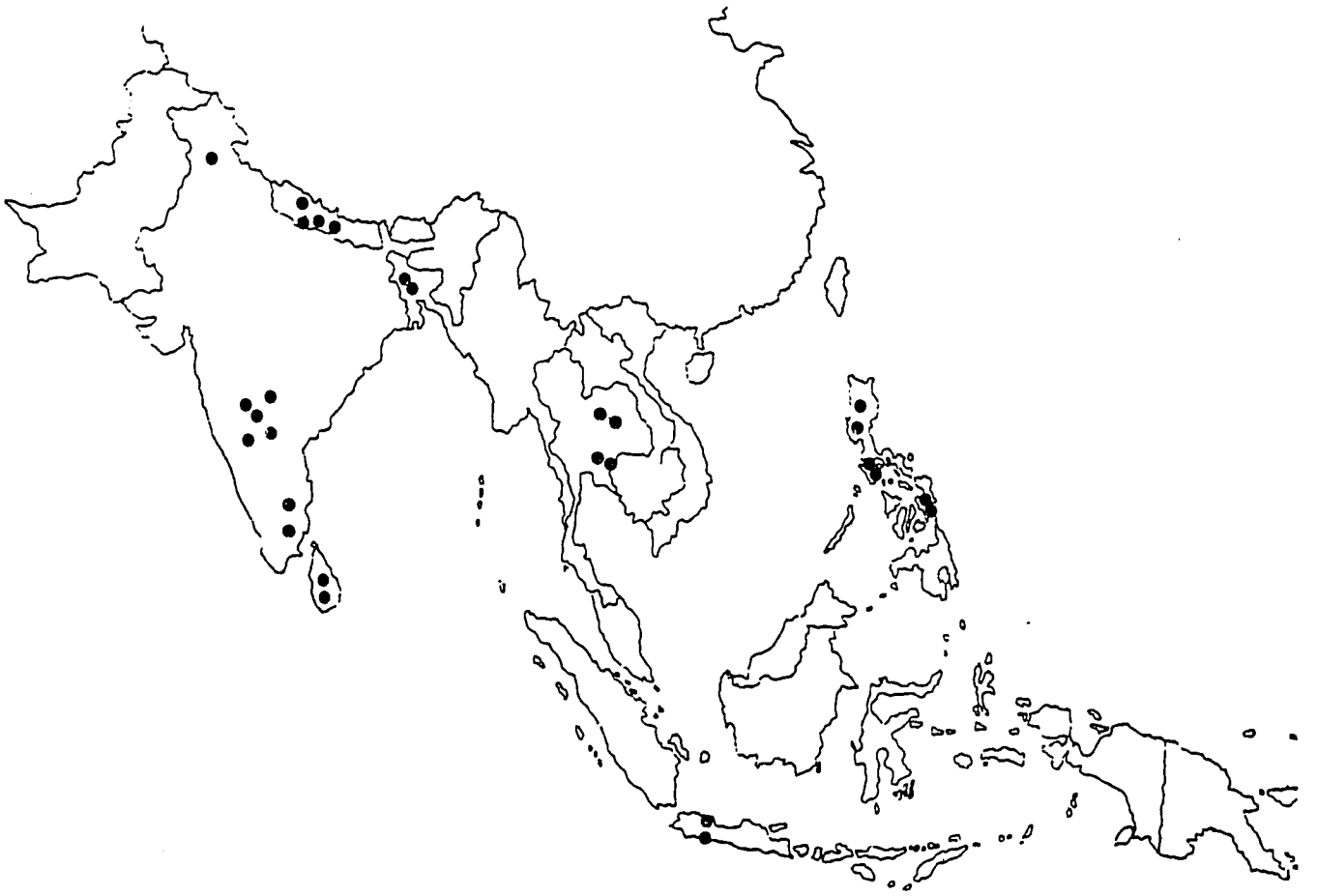
In 1989, scientists in the Multipurpose Tree Species Research Network conducted a regional, interdisciplinary study on Farmers' Tree-Breeding Objectives. The study set out to identify farmers' preferences for individual tree characteristics from interviews in 28 villages in Bangladesh, India, Indonesia, Nepal, the Philippines, Sri Lanka, and Thailand. Once assembled, these preferences describe ideotypes, or "ideal trees," that provide a basis for genetic improvement of multipurpose tree species (MPTS) appropriate to farmers' perceived needs.

The study used a series of line drawings of tree "types" to help farmers compare and suggest preferred characteristics in discussions with the researchers. Discussions covered current uses of trees and ideas for improvement. Separate group discussions were held with men and women, and with other distinct ethnic or social groups in the village. The researchers summarized their initial findings and discussed them with the villagers in an attempt to obtain consensus on the ideotypes described.

Each participating researcher provided summaries of up to 6 composite ideotypes for the regional analysis. Report number 10 in the MPTS Research Series, *Defining Tree-Breeding Objectives for Multipurpose Tree Species in Asia*, by Lert Chunanaparb and Radha Ranganathan, provides the regional perspective on the resulting ideotypes. This case study from Sri Lanka was prepared in December 1989.



Map of villages included in the regional study.

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1. Background

Most farmers have considerable experience in growing trees in their agricultural fields, homegardens, field margins, and as hedges. Traditionally for centuries they have maintained trees on common land and have collected the produce from the forests. The early tribes living in the wilderness depended on the produce obtained from trees growing wild, and so they protected trees for future use as an important constituent of their environment. Food, fuel, shade, and protection were the primary concern of these tribes for thousands of years.

The change from tribal living to a more methodical, cultivation-based system forced them to select a few most desirable species to maintain, while allotting part of their land to the production of short-duration grain, legumes, and other food crops. Their experience in maintaining trees enabled them to select those trees they knew best for domestication. The traditional knowledge of plant traits, uses, management, and the ecological niches in which different species flourished, helped them to domesticate the most desirable species for multiple use.

However, just as in many other countries, in Sri Lanka the introduction of plantation crops like tea, rubber, coffee, and coconut and of high-yielding, short-duration agricultural crops, caused the farmers' concern for tree crops to be neglected. The advantages of growing agricultural crops for mass processing, and thereby obtaining a cash income and a sure market, are the major causes for a tremendous retreat of tree crops from the farmyards. This retreat is not merely due to an inability of the trees to meet the needs of the farmers' but also due to the bias in crop-improving technologies toward short-duration crops. Rather than improving tree species for mass processing, agricultural innovations have focussed attention on developing high-yielding crop varieties to meet the increasing need for food. As a consequence, changes in farm technology since 1960 are associated with the development of legumes, grains, and a range of cereals for the farmers. Agrarian and related extension services have also placed greater emphasis on popularizing the new, short-duration crop varieties, thus overlooking the role of trees in domestic food production and environmental protection. Traditional management practices have been almost completely neglected.

Furthermore, agricultural development has seldom considered the prospects for growing trees for food, timber, fodder, organic residues, and for producing raw materials for employment-generating wood industries. Due to marketing predictions, substantial national attention has been devoted to minor export crops, including tree species like *Zeylania* (nutmeg), *Trifotum* (cloves), *Coffea arabica* (coffee), *Theobroma cacas* (cocoa) and *Piper nigrum* (black pepper). In this effort, substantial subsidies have been given to farmers to grow these species in their farmlands and homegardens. The emphasis on greater production and immediate cash, along with easy marketing, have influenced

farmers to grow these crops. But in this process, too, no attention had been paid to identify or understand the traditional practices of tree management or farmers' desire for integrating trees into farm operations. Agricultural extension services aimed at popularizing a selected number of species and were obligated to meet an annual quota.

With realization of the advantages of growing trees, particularly their effectiveness in environmental conservation and rehabilitation, propagation of tree crops amid other farm operations is receiving more attention in Sri Lanka. Initially, this was mainly to rehabilitate the deteriorated environment of the dry zone and highlands, not to diversify the tree produce-based activities. It is difficult to determine accurately the area currently under tree-crop production, particularly for small-scale farm operations, because they are often in isolation in farmyards, along hedges, or in field margins.

In this context, homegardens are exceptional because of their boundary limits, multi-story structure, and crop composition. According to agricultural statistics, this category covers nearly 26% of the total area cultivated by the small-holding agricultural sector. In terms of species composition, there is a marked diversity, mainly due to the ecological diversity of the country. Still, greater prospects exist across the country to popularize and propagate tree species among small-scale farm operators, whose operations occupy almost 70% of the cultivated land in Sri Lanka. However, if tree crops are to be effectively popularized, farmers' needs, desires, and their ability to adopt them must be identified. Unless agriculturists, plant-breeders, and other experts draw on farmers' skills and identify their needs, extensionists will not be able to interest farmers in new technologies. More contributions by farmers means advantages for the whole system.

Technological innovations in agriculture must account for farmers' wishes. Here, as in many technological processes, genetic improvement of tree species is constrained by a severe lack of information on traditional tree-use practices, types of trees preferred by farmers, and their desired traits. To bridge this gap, scientists who deal with tree improvements must collaborate with social scientists who deal with communities. The primary objectives of this present study are to define and describe tree characteristics desired by small-scale farmers in Sri Lanka. It is hoped that this information will be helpful to scientists working in genetic improvement, and will provide others with a basis for species selection and propagation.

2. The Study Area

This study was conducted simultaneously with the study of 'Farm and Village Forest and Land Use Practices' in two villages. The two villages, Bambarabedda and Madugalla, are located on opposite sides of the Ma-Oya River, which feeds into the Mahaweli River. The Bambarabedda area is in the midslope of the ridge to the east of Ma-Oya, while Madugalla is in the mid-slope of the western ridge (Figure 1).

Both villages are on hilly and rugged terrain, most of the slopes being 20-35 degrees. In both areas, the altitude rises to about 600 meters from the 200-meter elevation of the river valley. Climatically, the area is located in Sri Lanka's Intermediate Zone and its annual rainfall is about 100 cm. The monthly average temperature varies between 24° and 26° C, with a minimum of 17° and a maximum of 33° C.

The area extent of Bambarabedda is 349 ha; for Madugalla, it is 1,466 ha. Bambarabedda has a total of 398 households, Madugalla has 334 households. The area under forest is about 28% in Bambarabedda. Madugalla has a marginally higher level, 33% forest cover. Both villages have some distinguishing features regarding spatial distribution of tree-based systems. In terms of species, however, the two villages share some similarities; to some extent this is due to their physiographic and climatic similarities. Farmers' knowledge of tree species and their management practices were also found to be similar.

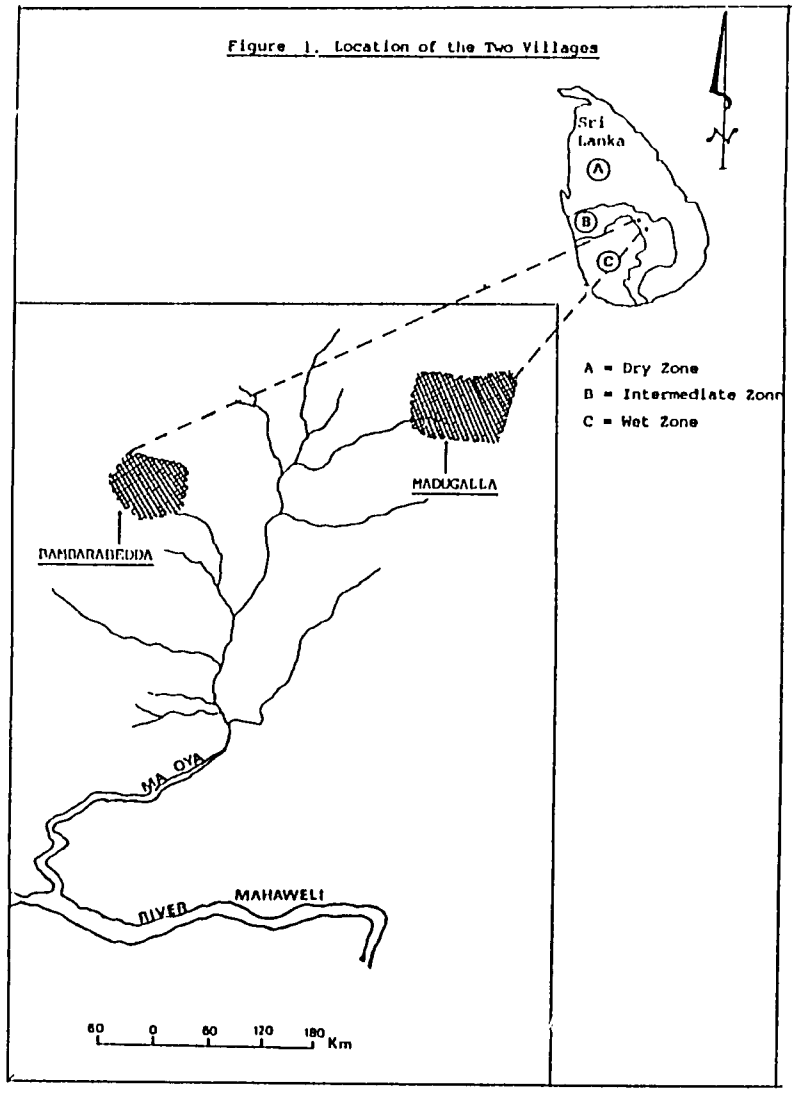


Figure 1. Map showing location of the two villages.

3. Distribution of Trees and Tree-Based Systems in the Two Villages

Traditionally, farmers grow trees in their homegardens and not in their farm fields, for several reasons. They usually plant upland fields to seasonal crops. The large area covered by tree canopies deters farmers from growing trees in their fields. Trees are grown in the following areas, listed in descending priority order.

1) Homegardens
2) Live fences
3) Hedges
4) Common land
5) Upland farms

Most well-managed trees are found in homegardens, along hedges or growing as fences. Trees grown on common land germinate naturally and are not protected or managed properly. This is mainly due to the lack of individual ownership of these trees. However, the tree species grown in similar locations share some characteristics of canopy shape, stem form, and branching habit. Figure 2 shows two common models of tree distribution noted in the two villages.

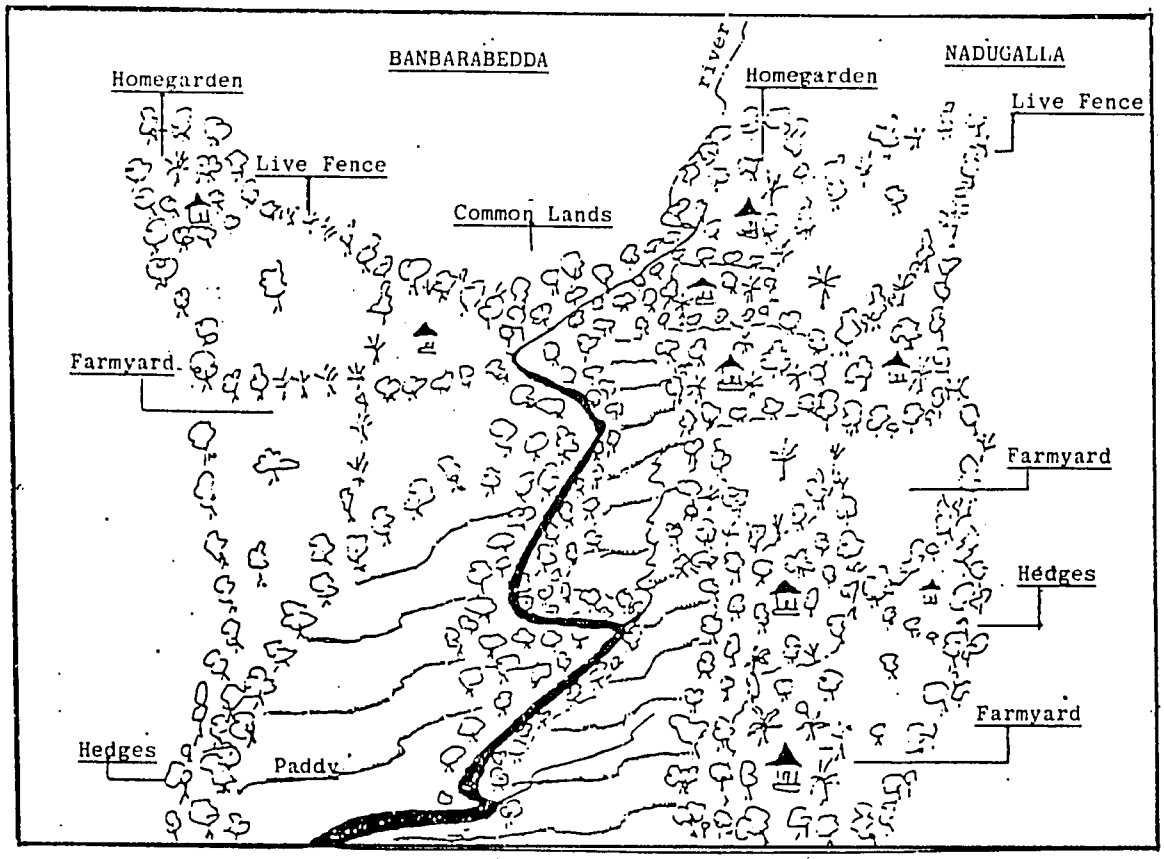


Figure 2. Common models of tree distribution in the study villages.

4. Tree Species Grown by Farmers

All 25 households surveyed grow and manage at least a few trees in their homegardens. The number of trees and species grown by a household is determined by the extent of land owned by the family. Table 1 presents the data on species grown and the priority given by farmers for each species.

The two villages present quite a contrast, as evident from the table. First, there is a difference in species composition. A wide variety of species is grown in Madugalla while the range is narrower in Bambarabedda. The greater diversity of species in Madugalla owes something to the wider range of micro-environmental conditions there. Bambarabedda's settlement is clustered in the steep mid-slopes; the riverine area below does not belong to the community. In Madugalla, on the other hand, most houses are found in the riverine areas where stream banks and the hedges of paddy fields contain trees. A range of species grows in this more humid micro-environment in addition to the species found in homegardens.

In addition, most species observed in Bambarabedda have been known traditionally and commonly grown in the homegardens. In Madugalla, trees are not limited to homegardens. A substantial range of species is found along the hedges which demarcate the lowland stretches of paddy from the adjoining highlands.

Table 1. The tree species grown by farmers and their ranking by the households that grow them.

Species	Bambarabedda					Madugalla				
	Priority				Occur-rence	Priority				Occur-rence
	1	2	3	4		1	2	3	4	
Artocarpus heterophyllus	14 (56)	10 (40)	-	-	24	5 (26)	6 (24)	-	-	11
Cocus nucifera	11 (44)	8 (32)	-	-	19	7 (28)	1 (4)	-	-	8
Mangifera indica	-	3 (12)	1 (4)	-	4	3 (12)	-	1 (4)	-	4
Gliricidia sp.	-	2 (8)	4 (16)	-	6	1 (4)	2 (8)	3 (12)	-	6
Coffea arabica	-	1 (4)	1 (4)	1 (4)	3	-	-	-	-	0
Artocarpus altillis	-	1 (4)	2 (8)		3	-	-	-	-	0
Psidium guajava	-	-	1 (4)	-	1	1 (4)	4 (16)	-	-	5
Tamarindus indica	-	-	-	1 (4)	1	-	-	-	-	0
Maduca longifolia	-	-	-	-	0	5 (20)	3 (12)	1 (4)	-	9
Persea gratissima	-	-	-	-	0	2 (8)	-	-	-	2
Acacia caesia	-	-	-	-	0	1 (4)	-	-	-	1
Croton laccifer	-	-	-	-	0	-	-	-	1 (4)	1
Pongamia pinnata	-	-	-	-	0	-	3 (12)	1 (4)	-	4
Musa acuminate colla	-	-	-	-	0	-	1 (4)	1 (4)	-	2
Eugenia faranica	-	-	-	-	0	-	1 (4)	1 (4)	-	2
Careya arporea	-	-	-	-	0	-	1 (4)	-	-	1
Not reported	-	-	16 (64)	23 (92)		-	3 (12)	17 (68)	24 (96)	

Figures in parentheses are percentages represented by the adjacent number of households.

5. The Priority Species and Their Products

Table 2 presents the information gathered regarding tree species, according to their ranking by farmers. In both areas, the most common species is *Artocarpus heterophyllus*. Its prominence among species is most clear at Bambarabedda, where it is grown by 96% of the households. In Madugalla, it is grown by only 44% of the households. For the other species, farmers give varying priorities.

Table 2. The priority ranking of the species in the two villages.

Species	Bambarabedda		Madugalla	
	No.of Hh Growing	Rank	No.of Hh Growing	Rank
Artocarpus heterophyllus	24	01	11	01
Cocus nucifera	19	02	08	03
Mangifera indica	04	04	04	06
Artocarpus altillis	03	05	-	-
Gliricidia sp.	06	03	06	04
Coffea arabica	03	05	-	-
Psidium guajava	01	06	-	-
Tamarindus indica	01	06	-	-
Maduca longifolia	-	-	09	02
Persea gratissima	-	-	02	07
Acacia caesia	-	-	01	08
Croton laccifer	-	-	01	08
Pongamia pinnata	-	-	04	06
Musa acuminate colla	-	-	02	07
Eugenia faranica	-	-	02	07
Careya arporea	-	-	01	08

Hh = Households

Tree produce obtained and used by farmers gives an indication of what farmers obtain from the trees growing on their own land. Except for *Gliricidia*, which is grown in homegardens to support pepper vines and as a living hedge, the ability to produce food is the clear priority factor. Here the community's dietary habits are an important factor. In Bambarabedda (Table 3A), where farmers' land is limited, food production is their major concern. Other products such as fuelwood, fodder and timber are secondary. But

in Madugalla, where farmers have enough land to produce a range of food stuffs, their concern for food production is less prominent, although it remains their priority (Table 3B). Here, a considerable number of households grow species like *Maduca longifolia* for fruit from which they extract oil, and for its high-value timber. In Bambarabedda, *Artocarpus heterophyllus* and *Cocus nucifera* contribute a substantial portion of the diet, and are thus tended by households even on small parcels of land. In this situation, farmers' priority for food-producing species is clear, although their interest in obtaining timber and fuel can also be stressed. As revealed here, the multiplicity of the produce often enable the farmers to select species.

6. Planting Niches, Sources of Materials and Characteristics Disliked by Households

To some extent, farmers' preference for a tree species is site specific. It is largely determined by the physiographic characteristics and the tree's uses. In most cases, food-producing species have a prominent place in the homegardens, whereas timber and fuelwood priority species are more likely to be scattered. Multiple use, starting with use as food, is the villagers' main concern.

Planting niches for some of the major species villages are shown in Table 4A (Bambarabedda) and 4B (Madugalla). As mentioned earlier, if a wide range of site conditions are not available for farmers to grow trees, then planting niches are limited to homegardens, hedges and live fences. Within these limited opportunities, farmers prefer to grow multipurpose species known to them, giving priority for food, but followed by other uses too. If common land or reserve land is located within village premises, whether on stream banks or along the boundaries of paddy stretches, then farmers grow trees for food, or for timber and fuel. In these cases, although specific locations for particular species are noticeable and known, farmers prefer to plant the same species that they grow in their farm fields, if land is available or less area is needed to grow them.

Table 3A. Listing of Priority Species and Tree Products by Households (Hh) in Bambarabedda.

Hh	Products	Species			
		A	B	C	D
01	Product 1	*Cocus nucifera* Nut	*Artocarpus heterophyllus* Fruit	*Mangifera indica* Fruit	
	Product 2	Bole	Branches	Branches	
	Product 3	Cadjan	Bole	Bole	
02	Product 1	*Artocarpus heterophyllus* Fruit	*Gliricidia* Stem (for pepper vines)		
	Product 2	Branches	Poles		
	Product 3	Bole	Leaves (mulch)		
03	Product 1	*Artocarpus heterophyllus* Fruit	*Cocus nucifera* Nut	*Gliricidia* Stem (for pepper vines)	
	Product 2	Branches	Cadjan	Poles	
	Product 3	Bole	Bole	Leaves (mulch)	
04	Product 1	*Artocarpus heterophyllus* Fruit	*Mangifera indica* Fruit	*Psidium guajawa* Fruit	
	Product 2	Branches	Branches	Branches	
	Product 3	Bole	Bole	---	
05	Product 1	*Cocus nucifera* Nut	*Gliricidia* Stem (for pepper vines)		
	Product 2	Cadjan	Poles		
	Product 3	Bole	Leaves (mulch)		
06	Product 1	*Artocarpus heterophyllus* Fruit	*Cocus nucifera* Nut	*Coffea arabica* Fruit	*Tamarindus indica* Fruit
	Product 2	Branches	Cadjan	Branches	Branches
	Product 3	Bole	Bole	---	Bole
07	Product 1	*Artocarpus heterophyllus* Fruit	*Cocus nucifera* Nut	*Artocarpus altillis* Fruit	*Coffea arabica* Fruit
	Product 2	Branches	Trunks	Branches	Branches
	Product 3	Bole	Bole	Bole	---

Table 3A. (Continued)

Hh No.	Products	Species		
		A	B	C
08	Product 1 Product 2 Product 3	*Artocarpus heterophyllus* Fruit Branches Bole	*Coffea arabica* Fruit Branches ---	
09	Product 1 Product 2 Product 3	*Artocarpus heterophyllus* Fruit Branches Bole	*Artocarpus altillis* Fruit Branches Bole	
10	Product 1 Product 2 Product 3	*Artocarpus heterophyllus* Fruit Branches Bole	*Cocus nucifera* Nut Cadjan Bole	*Gliricidia* Stem (for pepper vines) Poles Leaves (mulch)
11	Product 1 Product 2 Product 3	*Artocarpus heterophyllus* Fruit Branches Bole	*Cocus nucifera* Nut Cadjan Bole	
12	Product 1 Product 2 Product 3	*Cocus nucifera* Nut Cadjan Bole	*Artocarpus heterophyllus* Fruit Branches Bole	
13	Product 1 Product 2 Product 3	*Cocus nucifera* Nut Cadjan Bole	*Artocarpus heterophyllus* Fruit Branches Bole	
14	Product 1 Product 2 Product 3	*Cocus nucifera* Nut Cadjan Bole	*Artocarpus heterophyllus* Fruit Branches Bole	

Table 3A. (Continued)

Hh No.	Products	Species		
		A	B	C
15	Product 1 Product 2 Product 3	*Cocus nucifera* Nut Cadjan Bole	*Artocarpus heterophyllus* Fruit Branches Bole	
16	Product 1 Product 2 Product 3	*Artocarpus heterophyllus* Fruit Branches Bole	*Cocus nucifera* Nut Cadjan Bole	*Gliricidia* Stem (for pepper vines) Poles Leaves (mulch)
17	Product 1 Product 2 Product 3	*Cocus nucifera* Nut Cadjan Bole	*Artocarpus heterophyllus* Fruit Branches Bole	*Artocarpus altillis* Fruit Branches Bole
18	Product 1 Product 2 Product 3	*Artocarpus heterophyllus* Fruit Branches Bole	*Mangifera indica* Fruit Branches Bole	*Gliricidia* Stem (for pepper vines) Poles Leaves (mulch)
19	Product 1 Product 2 Product 3	*Artocarpus heterophyllus* Fruit Branches Bole	*Mangifera indica* Fruit Branches Bole	
20	Product 1 Product 2 Product 3	*Artocarpus heterophyllus* Fruit Branches Bole	*Cocus nucifera* Nut Cadjan Bole	
21	Product 1 Product 2 Product 3	*Cocus nucifera* Nut Cadjan Bole	*Artocarpus heterophyllus* Fruit Branches Bole	

Table 3A. (Continued)

Hh No.	Products	Species		
		A	B	C
		Cocus nucifera	*Artocarpus heterophyllus*	
22	Product 1	Nut	Fruit	
	Product 2	Cadjan	Branches	
	Product 3	Bole	Bole	
		Cocus nucifera	*Artocarpus heterophyllus*	
23	Product 1	Nut	Fruit	
	Product 2	Cadjan	Branches	
	Product 3	Bole	Bole	
		Artocarpus heterophyllus	*Cocus nucifera*	
24	Product 1	Fruit	Nut	
	Product 2	Branches	Cadjan	
	Product 3	Bole	Bole	
		Cocus nucifera	*Artocarpus heterophyllus*	
25	Product 1	Nut	Fruit	
	Product 2	Cadjan	Branches	
	Product 3	Bole	Bole	

Source: Field information

One of the most outstanding features noted is that planting materials are purchased for only a few selected species like *Cocus nucifera*, *Artocarpus heterophyllus*, *Mangifera indica*, and *Artocarpus altillis*. Only 18% of households purchased planting materials in Babarabedda; in Madugalla only 11%. In these cases, also, farmers purchased a few improved varieties to grow in homegardens. Naturally germinated and locally propagated varieties are most widespread, prominent on common lands, along hedges, and as live fences.

Characteristics disliked by farmers are broad canopies and lateral roots. Both characteristics tend to minimize the possibility of growing other plants nearby. On a small farmholding, a narrow tree canopy can mean either more trees or more space for other crops.

7. Ideotype Specification for Agroforestry

The ideotypes preferred by the farmers are determined not only by these characteristics but also by environmental conditions. In discussions, farmers noted that it is difficult to raise tall-growing species due to the strong wind that sweeps through the area during the dry season. Species planted by farmers for tall single stems grow crooked starting at about 2-3 meters above the ground. This was encountered by the Ceylon Tobacco Company on its *Eucalyptus* plantation established on steeply sloping terrain in Madugalla. In such a situation, plant breeders should try to introduce species capable of withstanding wind.

The other important features which should be considered are the soil and moisture conditions. In both areas the soil is shallow, heavily degraded, and infertile. Due to these conditions and the steep slope of the land, water percolation into the soil and moisture retention are low. Genetically improved varieties developed for these areas must tolerate shallow, infertile, stony and degraded soils, seasonal droughts, and generally low moisture.

As shown in Table 5, farmers are also concerned about trees' sturdiness, resistance to pests and disease, ease of propagation, potential for pruning, and ability to provide continuous vegetal cover.

Table 3B. Listing of Priority Species and Tree Products by Households (Hh) in Madugalla.

Hh	Products	Species			
		A	B	C	D
01	Product 1	*Cocus nucifera*	*Artocarpus heterophyllus*		
	Product 2	Nut	Fruit		
	Product 3	Cadjan	Branches		
		Bole	Bole		
02	Product 1	*Gliricidia*			
	Product 2	Stem (for pepper vines)			
	Product 3	Poles			
		Leaves (Mulch)			
03	Product 1	*Artocarpus heterophyllus*			
	Product 2	Fruit			
	Product 3	Branches			
		Bole			
04	Product 1	*Persea gratissima*			
	Product 2	Fruit			
	Product 3	Branches			
		Stem			
05	Product 1	*Mangifera indica*	*Psidium guajawa*	*Eugenia faranicca*	*Croton laccifer*
	Product 2	Fruit	Fruit	Fruit	Leaves
	Product 3	Branches	Branches	Branches	Branches
		Bole	---	---	---
06	Product 1	*Cocus nucifera*	*Artocarpus heterophyllus*		
	Product 2	Nut	Fruit		
	Product 3	Cadjan	Branches		
		Bole	Bole		
07	Product 1	*Cocus nucifera*	*Careya arborea*		
	Product 2	Nut	Fruit		
	Product 3	Cadjan	---		
		Bole	---		

Table 3B. (Continued)

Hh	Products	Species			
		A	B	C	D
08	Product 1	*Cocus nucifera*	*Gliricidia*		
	Product 2	Nut	Stem (for pepper vines)		
	Product 3	Cadjan	Poles		
		Bole	Leaves (mulch)		
09	Product 1	*Cocus nucifera*	*Artocarpus heterophyllus*		
	Product 2	Nut	Fruit		
	Product 3	Cadjan	Branches		
		Bole	Bole		
10	Product 1	*Cocus nucifera*	*Artocarpus heterophyllus*		
	Product 2	Nut	Fruit		
	Product 3	Cadjan	Branches		
		Bole	Bole		
11	Product 1	*Psidium guajawa*	*Artocarpus heterophyllus*		
	Product 2	Fruit	Fruit		
	Product 3	Branches	Branches		
		---	Bole		
12	Product 1	*Mangifera indica*	*Cocus nucifera*	*Gliricidia*	
	Product 2	Fruit	Nut	Stem(for pepper vines)	
	Product 3	Branches	Cadjan	Poles	
		Bole	Bole	Leaves (mulch)	
13	Product 1	*Acacia caesia*	*Gliricidia*	*Mangifera indica*	
	Product 2	Branches	Stem (for pepper vines)	Fruit	
	Product 3	---	Poles	Branches	
		---	Leaves	Bole	
14	Product 1	*Maduca longifolia*	*Artocarpus heterphyllus*	*Musa acuminata*	
	Product 2	Fruit	Fruit	Branches	
	Product 3	Branches	Branches	Bole	
		Bole	Bole	---	

Table 3B. (Continued)

Hh	Products	Species			
		A	B	C	D
15	Product 1	*Maduca longifolia* Fruit	*Psidium guajawa* Fruit		
	Product 2	Branches	Branches		
	Product 3	Bole	---		
16	Product 1	*Artocarpus heterophyllus* Fruit	*Psidium guajawa* Fruit		
	Product 2	Branches	Branches		
	Product 3	Bole	---		
17	Product 1	*Cocus nucifera* Nut	*Gliricidia* Stem(for pepper vine)		
	Product 2	Cadjan	Poles		
	Product 3	Bole	Leaves (mulch)		
18	Product 1	*Mangifera indica* Fruit	*Maduca longifolia* Fruit		
	Product 2	Branches	Branches		
	Product 3	Bole	Bole		
19	Product 1	*Artocarpus heterophyllus* Fruit	*Psidium guajawa* Fruit	*Maduca longifolia* Fruit	
	Product 2	Branches	Branches	Branches	
	Product 3	Bole	---	Bole	
20	Product 1	*Maduca longifolia* Fruit	*Gareya arborea* Fruit	*Gliricidia* Stem(for pepper vines)	
	Product 2	Branches	Branches	Poles	
	Product 3	Bole	Bole	Leaves (mulch)	

Table 3B. (Continued)

Hh	Products	Species			
		A	B	C	D
21	Product 1	*Maduca longifolia*	*Pongamia pinnata*		
	Product 2	Fruit	Bark		
	Product 3	Branches	Branches		
		Bole	Bole		
22	Product 1	*Persea gratissima*	*Pongamia pinnata*	*Gliricidia*	
	Product 2	Fruit	Bark	Stem (for pepper vines)	
	Product 3	Branches	Branches	Poles	
		----	Bole	Leaves (mulch)	
23	Product 1	*Maduca longifolia*	*Pongamia pinnata*		
	Product 2	Fruit	Bark		
	Product 3	Branches	Branches		
		Bole	Bole		
24	Product 1	*Artocarpus heterophyllus*	*Maduca longifolia*		
	Product 2	Fruit	Fruit		
	Product 3	Branches	Branches		
		Bole	Bole		
25	Product 1	*Artocarpus heterophyllus*	*Maduca longifolia*	*Pongamia pinnata*	
	Product 2	Fruit	Fruit	Bark	
	Product 3	Branches	Branches	Branches	
		Bole	Bole	Bole	

Source: Field information

Table 4A. Tree Products, Planting Niches, Source of Planting Materials and the Characteristics that the households dislike in Bambarabedda.

		S P E C I E S					
		(A)	(B)	(C)	(D)	(E)	(F)
		A.heterophyllus/Priority	C.nucifera/Priority	M.indica/Priority	Gliricidia/Priority	A.altillis/Priority	T.indicus/Priority
Product	1	Fruit 1	Nut 1	Fruit 1	Stem 1	Fruit 1	Fruit 1
Product	2	Branches 2	Cadjan 2	Branches 2	Poles 2	Branches 2	Branches 2
Product	3	Timber 3	Wood 3	Timber 3	Leaves 3	Timber 3	Timber 3
Product	4						
Planting niches	1	Homegardens	Homegardens	Homegardens	Intercropped with annual	Homegardens	Homegardens
	2	Field margins	Intercropped with annual crops	Field margins	Field margins	Field margins	Field margins
	3	—	—	Intercropped with annual crops	Homegardens	—	—
	4	—	—	—	—	—	—
Source of planting materials	1	Naturally germinated	Purchased	Purchased	Prcpagate form	Purchased	Naturally germinated
	2	Neighbor	Germinated	Naturally germinated	Neighbor	Neighbor	Neighbor
	3	Purchased	—	—	—	—	—
Characteristics that they dislike	1	Height	Lateral roots	Broad canopy	—	Broad canopy	Broad canopy
	2	Widespread lateral	—	Lateral roots	—	Lateral roots	Lateral roots

Source: Field information

Table 4B. Tree Products, Planting Niches, Source of Planting Materials and the Characteristics that the households dislike in Madugalla.

	S P E C I E S						
	(A)	(B)	(C)	(D)	(E)	(F)	(G)
	C.nucifera/Priority	A.heterophyllus/Priority	M.longifolia/Priority	P.guajawa/Priority	P.pinnata/Priority	Gliricidia/Priority	M.indica/Priority
Product 1 Product 2 Product 3	Nut 1 Cadjan 2 Bole 3	Fruit 1 Branches 2 Bole 3	Fruit 1 Branches 2 Bole 3	Fruit 1 Branches 2 — -	Bark 1 Branches 2 Bole 3	Stem 1 Poles 2 Leaves 3	Fruit 1 Branches 2 Bole 3
Plant niches 1	Homegardens	Homegardens	Common land	Homegardens	Common land	Field margin	Homegarden
2	Intercropped with annual crops	Field margin	Field margin	Common land	Field margin	Homegardens	Common land
3	—	Intercropped with annual crops	—	Field margin	—	Intercropped with annual crops	Field margin
Source of planting materials 1	Purchased	Naturally germinated	Naturally germinated	Naturally germinated	Naturally germinated	Propagated	Naturally germinated
2	Germinated —	Purchased —	— —	— —	— —	Neighbor —	Purchased Neighbor
Characteristics that they dislike 1	Lateral roots	Widespread lateral roots	Broad canopy	—	Broad canopy	—	Broad canopy
2	Height	Broad canopy	—	—	Lateral roots	—	Lateral roots

Source: Field information

Table 5. Ideotype specification for agroforestry.

Products and services required	Selection Criteria	Ancillary Information	Crown	Stem	Roots	Response to management	Deciduousness
Food, Erosion control, Wind-break, Fuelwood, Timber, Mulch, Fodder	Vigor, Pest and disease free, Easy propagation/ germination	Tolerates dry season, Tolerates low fertility soils, Tolerates low soil moisture	Dense, Narrow Round, Bole ratio = 15-20	Straight/multi-stem (varies according to conditions)	Geotropic Angled	Pollarding, Branch pruning	Continucus vegetal cover

Source: Field information

8. Site-Specific Ideotypes for Agroforestry

In describing the ideotypes that farmers desire, one must first identify the potential areas where farmers are willing to grow trees. In both villages, varying numbers of farmers are able to grow trees in the following sites:

1) Homegardens
2) Farmyards
3) Hedges
4) Fences
5) Common land

The ideotypes preferred for these niches are largely determined by the stem form, roots, and characteristics of the canopy. In genetically improved tree species, farmers would prefer to reduce the canopy width and the extensive spreading of lateral roots that seriously disrupt neighboring plants. Their preferences varied regarding straight and tall single stems vs. multi-stemmed trees with short boles. Again, this is determined by the area available for tree planting. The ideal tree characteristics identified by the farmers are shown in the line drawings of Figure 3.

Still, the characteristics preferred by farmers are location specific.

Even preferred rooting systems were found to vary. Although the priority was for a species with a deep tap root, a lateral rooting system was preferred for sloping terrain. The branch height and the canopy diameter are both site specific. The field examples shown by farmers were very useful in demonstrating what they desired for specific locations. Species with low branch height are needed for the homegardens, while straight, single-stemmed species with upper level branching are preferred along fences and hedges. An important point to stress is the farmers' concern over the space requirement.

9. Conclusions

The following points from this study should be highlighted:

1. Farmers give priority to food-producing trees. In determining the physiographic arrangement of the species, breeders should consider a desirable form for producing a greater quantity of fruits. For example, in improving *Mangifera indica*, which produces bunches of fruits from twigs, a multiple branching habit must be promoted. For *Artocarpus heterophyllus*, on the other hand, it is important to produce more fruit in the lower portion of the stems, the goal being greater fruit quantity within easy reach.

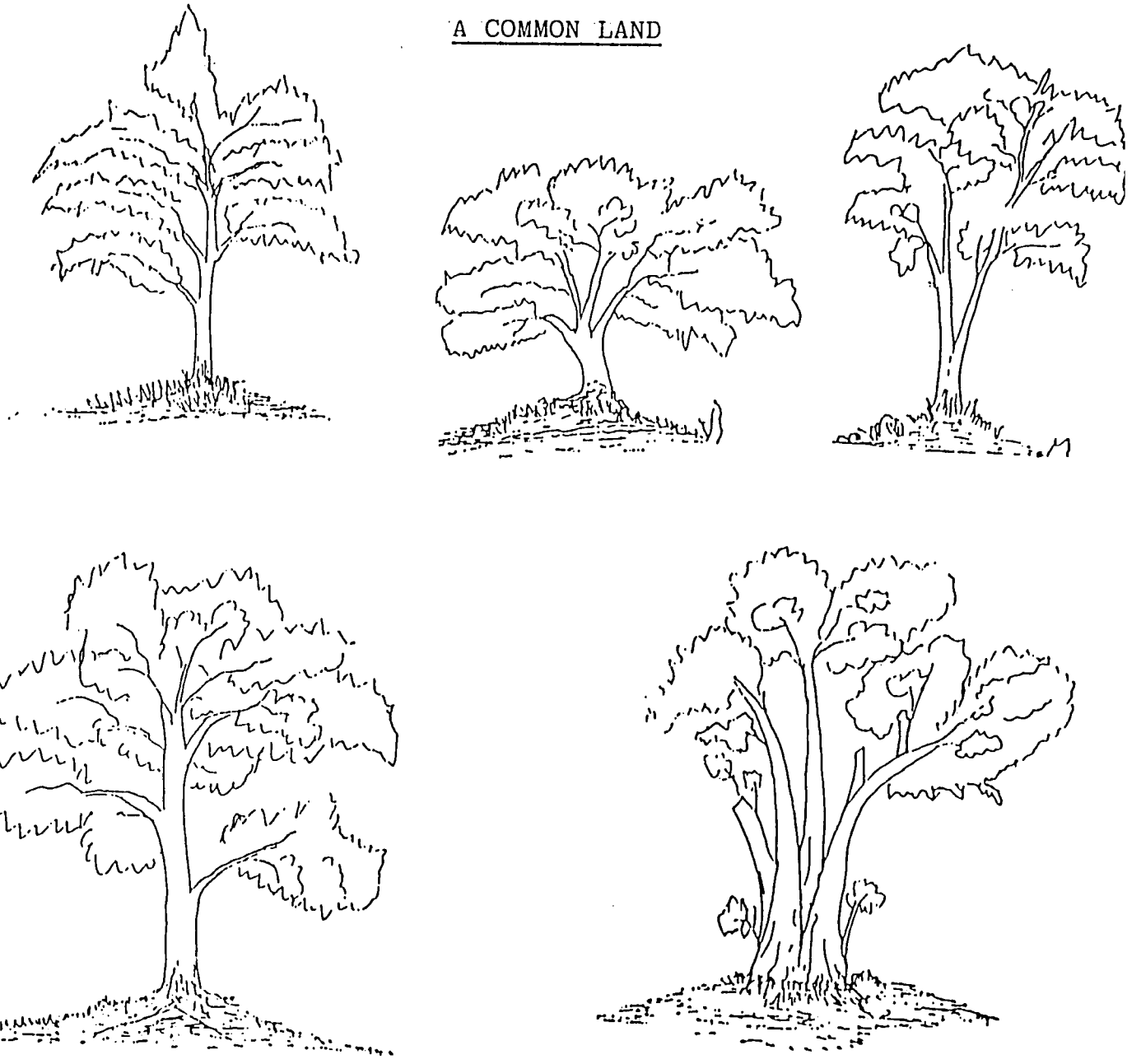
This is also true with regard to fodder and fuelwood. Easy harvest and the greater production are the qualities that farmers often prefer.

2. In identifying ideal tree characteristics, it is important to consider the locations where farmers are able to plant tree species. The expected service may vary from one location to another. For example, shade and a dense canopy, which are often tolerated in homegardens, are not features that farmers want in their fences or in farm fields. In these sites, farmers generally prefer to grow narrow-canopied, single-stemmed species that can be grown along a fence or in an alley. In addition in these areas, farmers like to establish trees where they can obtain mulch and control erosion, unlike in homegardens.

3. Genetically improved varieties must be able to flourish under the conditions set by the environment. If farmers are expected to practice special environment amelioration, the tree's potential will be limited in practical terms.

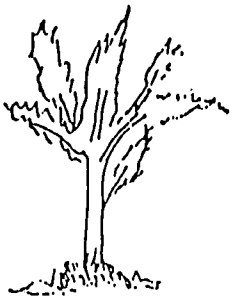
4. Another important point relates to space requirements. Both communities cited the need to reduce the space required for trees. Canopy width and rooting systems are the two features that need to be controlled. Plant improvements must have as a target more produce from a small parcel of land. However, further investigations should be conducted to examine whether farmers' tree ideotypes vary with farm size and household requirements.

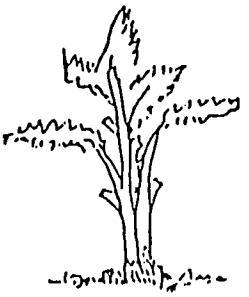
Figure 3. Ideotypes Identified by Farmers for Specific Sites

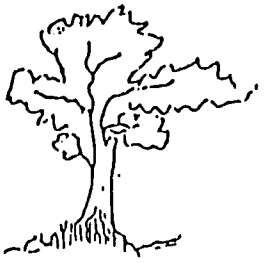


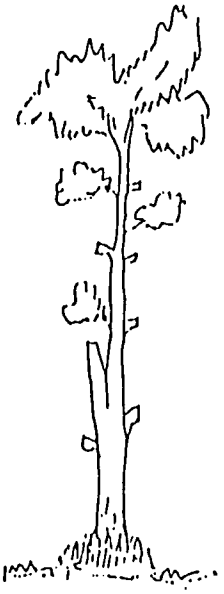
Canopy	Stem	Roots
Broad, and dense. Diameter(6-8m)	Multiple strong timber.	Deep top root with lateral.

B FARM LAND



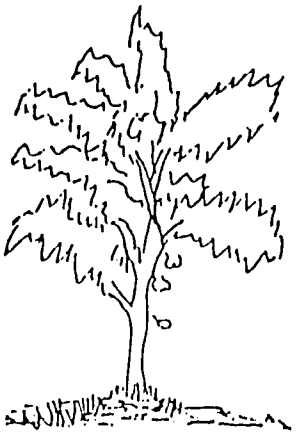


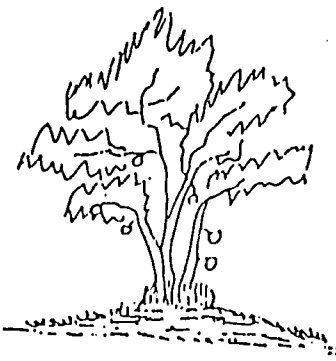


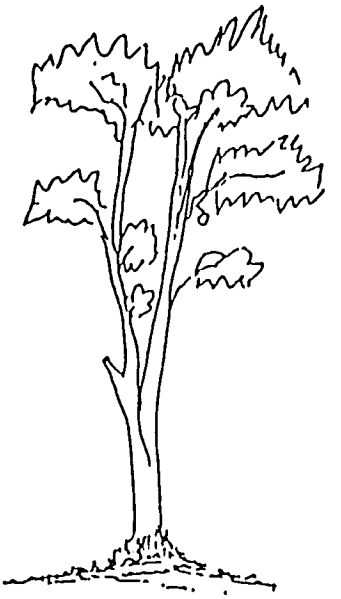


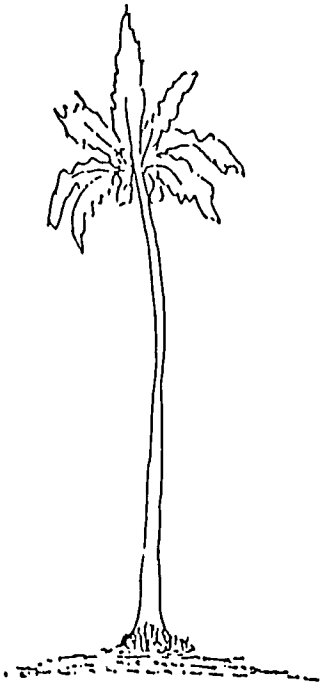
Canopy	Stem	Roots
Narrow diameter (1 - 2m)	Short/tall easy prunned.	Deep top root.

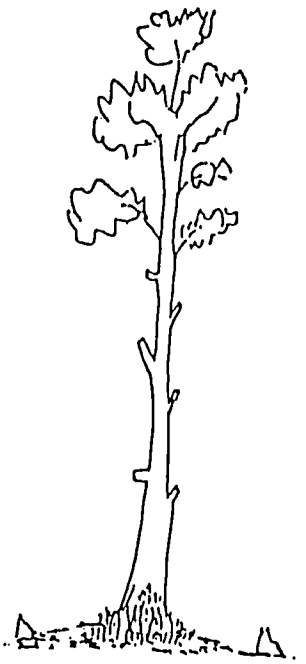
C HOMEGARDEN

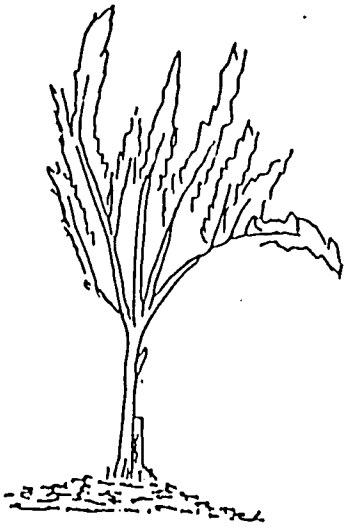












Canopy	Stem	Roots
Broad/Narrow diameter (2 - 6 m).	Multiple or single stem.	Deep top root.