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**DEFINING TREE BREEDING OBJECTIVES
FOR
MULTIPURPOSE TREE SPECIES IN ASIA**

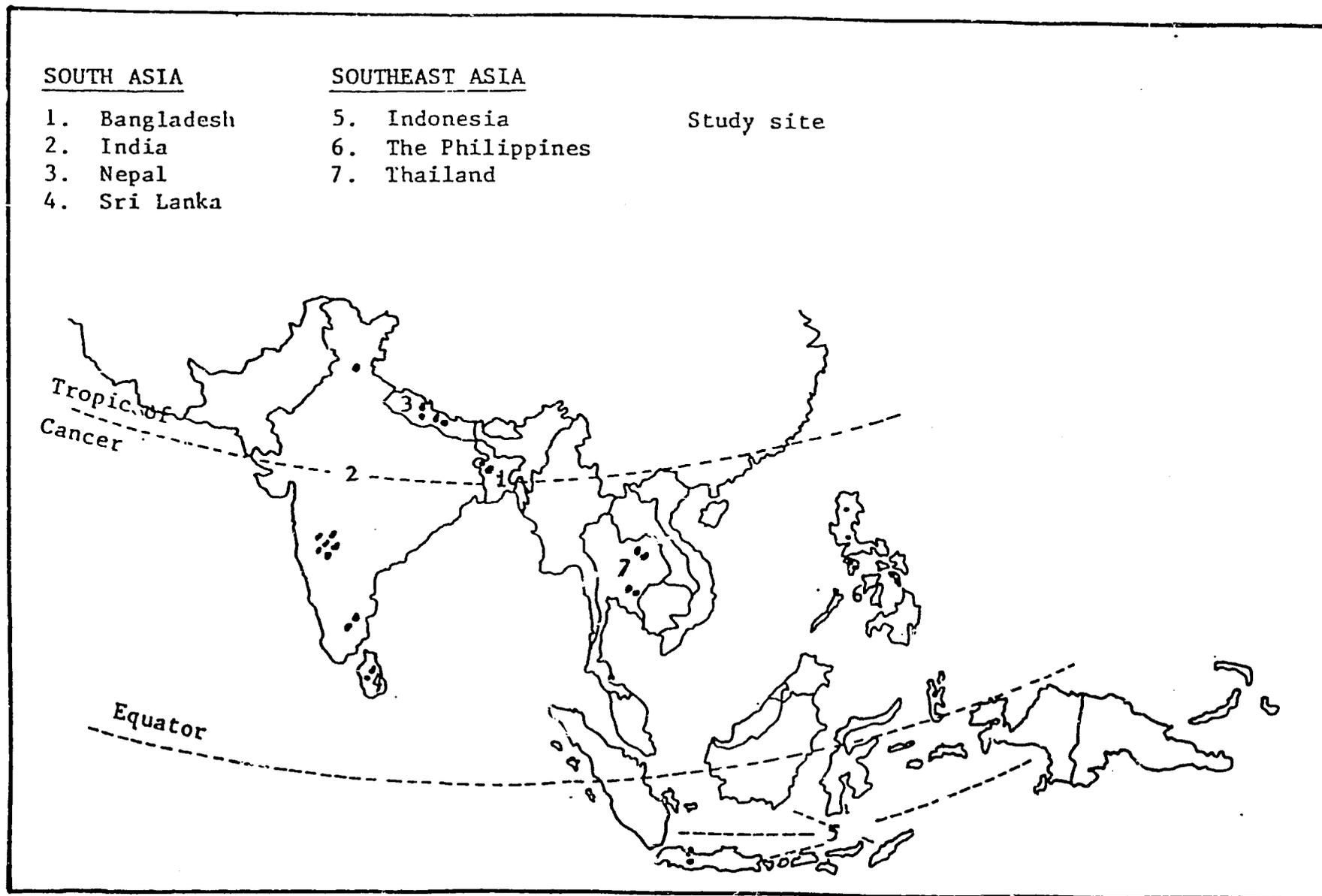
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by

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Study sites in the seven participating countries in Asia



Map modified from FAO, 1981.

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Preface

Tree improvement workers often use traditional timber definitions such as straight, clear bole to select and breed multipurpose tree species (MPTS). Given the unique environments and MPTS management practices used by farmers, it follows that the ideotypes desired by farmers differ from those desired by industrial producers and users. Until early 1989, no one had explored the idea of the farmer-selected ideotypes for MPTS, so the traditional industrial plantation ideotypes developed by and for the timber industry have by default been used for most MPTS.

In early 1989, a group of dedicated scientists from 7 countries in South and Southeast Asia undertook the task of exploring how households in some 31 villages defined the "ideal" MPTS for a variety of purposes. The task was not an easy one! A basic methodology was initially defined to help start the description of ideotypes for MPTS. Household interviews, line drawings and group meetings were used to describe desired tree characteristics for different purposes.

This report summarizes the ideotypes described through this study. The scientists who conducted the study and the authors of this report must be commended for their diligent work under conditions of very limited financial support and significant time constraints.

It is hoped that the methods used and the ideotypes described herein will encourage tree improvement workers to focus on the improvement of species and/or varieties which most closely match farmer needs and objectives.

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INTRODUCTION

The importance of woody perennials (trees, shrubs and lianas) in today's farming systems is becoming increasingly recognized as a result of the rapid depletion of forest resources and the increasing demand for fuelwood and other essential tree products. Indeed, the need to satisfy human needs for food, shelter, fuel, and fodder from small units of land calls for the exploration of multipurpose species of trees and other plants for their potential role in meeting these needs (Burley 1985). It is not surprising, therefore, that research and development efforts in forestry today are focused on the production and use of trees in multipurpose land-use systems to improve the productivity and sustainability of these tropical systems and to meet the wood needs of small farmers (Burley and Von Carlowitz 1984). Scientists in Asian countries are now involved in research and development programs on multipurpose tree species (MPTS), especially fast growing hardwood species (National Academy of Sciences 1984).

State of Tree Improvement in Asia

Information on existing tree improvement programs is essential in attempts to introduce or improve MPTS for smallholders. In Asian countries such information is scattered, diverse and generally lacks detail, with few efforts to record and compile data on tree improvement at the local and national levels (Chuntanaparb and MacDicken 1989).

There are about 30 economically important tree species used in active plantation programs in tropical Asia. However, tree improvement programs are only established and carried out for the most important industrial species (ie. *Tectona grandis*, *Pinus caribaea* and *Pinus merkusii*), and for important high-yielding hardwood species such as *Paraserianthes falcataria*, *Eucalyptus* spp., *Gmelina arborea*, and *Leucaena leucocephala*.

Only two of these species, *Leucaena leucocephala* and *Paraserianthes falcataria* have been planted extensively on farm lands, and have been improved for use in agroforestry systems.

There has been great interest, but little action, in improving other MPTS for small farms. There are likely to be few success stories as dramatic as that for the self-pollinated *Leucaena leucocephala*, but there is considerable scope for great improvement in many species which are presently underexploited. Research to produce such results is lacking. There is much to be done to fill gaps in our knowledge of species requirements, criteria for selection, proper combination of trees and crops, management, and harvesting of MPTS at the farm level.

Approaches for Tree Improvement for Small Farm Planting

The principles and practices of plant breeding are well established for trees (Wright 1975; Zobel and Talbert 1984) and apply equally to industrial plantations and to

small holder agroforestry and community plantings. Within the best populations, superior phenotypes are selected and their breeding value evaluated in clonal or progeny tests on typical sites and with typical management practices. Superior genotypes of cross-pollinated species are then propagated clonally or by seed into special seed production areas or orchards where open or controlled pollination provide seed for planting, and if needed, for further selection, testing and breeding (Burley 1980). Zobel and Talbert (1984) identify five attributes common to all tree improvement programs:

- a determination of the species, or geographic sources within a species that should be used in a given area;
- a determination of the amount, kind and causes of variability within the species;
- a packaging of the desired qualities into improved individuals so as to develop trees with combinations of desired characteristics;
- mass producing improved individuals for reforestation purposes; and
- developing and maintaining a genetic base population broad enough for needs in advanced generations.

However, even though the principles of tree improvement remain the same, regardless of the objectives of the program, tree improvement for small farm use is unique in several ways, particularly with respect to breeding objectives, choice of species and selection criteria.

Selection Criteria for MPTS for Small Farm Use

Existing tree improvement programs generally use industrial plantation requirements to guide selection and breeding. For example, a major plantation breeding objective for *Acacia auriculiformis* might be to produce single stemmed trees with long clear boles. Farmers growing *A. auriculiformis* on farms in fuelwood deficit areas might be more interested in trees with a low branching habit, with multiple stems and high coppicing ability. The selection of relevant criteria is a critical step in the improvement of MPTS.

Choosing and improving species for small farm growing is complicated because the tree is expected to fulfil many poorly-defined functions and because the desired traits for MPTS are seldom evaluated. The methods of securing, improving, conserving and managing MPTS require considerable long-term efforts and inputs. Therefore, it is crucial to carefully define selection criteria for appropriate species and clearly identify breeding objectives before MPTS improvement programs begin. Well-defined breeding objectives will allow researchers to select species and/or varieties which most closely match farmers' needs.

This study asked two major questions: (1) Are traditional tree breeding objectives a suitable definition for improved MPTS for small farmers? and (2) Can a more relevant set of ideotypes for MPTS breeding programs be defined?

Terms of Reference

The terms of reference state that the authors should:

- identify institutions and individuals in South and Southeast Asia who would conduct field studies to assess farmer-perceived tree breeding objectives for MPTS;
- assist in developing a methodology for a field study conducted by 15-18 researchers in Asia. The goal of the study is to determine characteristics which farmers would prefer for new and improved MPTS, and to describe ideal trees (ideotypes) based on those characteristics. Researchers identified in the first task above are to conduct the study in South and Southeast Asia;
- coordinate field studies by cooperating researchers in South and Southeast Asia using methods developed for this study;
- assist cooperating researchers to summarize and interpret the results of their studies; and
- prepare a report summarizing the results of the studies in Asia, in which several important MPTS ideotypes appropriate to conditions in Asia are described.

Objective:

To define and describe ideotypes of MPTS desired by small farmers in Asia. This description will provide a basis for genetic improvement of MPTS by researchers in Asia and will provide research and development institutions with information for species selection and breeding.

The Approach

The household surveys were conducted in 31 selected villages in seven countries (see map). The studies were initiated in May of 1989 with the goal of listing tree species used and preferred by subsistence level farmers and landless households.

Researchers working in the field of forestry or interested in forestry issues were contacted for this study. Their backgrounds were varied, ranging from economists and

sociologists working in Universities and research institutions to non-governmental organizations. They were given the task of gathering information on tree use practices in a village or villages of their choice (Table 1). Investigators recruited by the researchers carried out the data collection with the joint cooperation of the network specialists and the authors of this report. Background information relating to each of the villages, as supplied by the researchers, is presented in Appendix 1.

THE STUDY REGION

The seven countries grouped as tropical Asia in this study are Bangladesh, India, Indonesia, Nepal, the Philippines, Sri Lanka, and Thailand. For the presentation of results these countries have been arranged into two subregions as indicated in Table 1.

The total surface area of these countries is close to 6.4 million km². They extend between latitudes 37°N and 12°S and longitudes 61°E and 156°E. The greater part of the study area (56 percent) is accounted for by the south Asian countries. The three largest countries studied are India, Indonesia, and Thailand with 3.29, 1.92, and 0.51 million km² respectively.

South Asia has a large variety of land forms ranging from high mountains to plateaus of various kinds, alluvial plains and sandy deserts. The Himalayas are the most outstanding features of the region, extending over a distance of some 3,750 km between the Indus and Brahmaputra rivers. The main range with Everest (8,848 m), Kanchenjunga (8,597 m), Dhaulagiri (8,137 m), and many other giant peaks, forms the core of the system, to which the trans-Himalayas to the north, the outer Himalayas to the south, and lesser subsidiary ranges give width and body. The Himalayas have profoundly affected the climate, geology and the formation of vegetation types in India and Nepal. The North Indian Plains are a great alluvial tract formed by the basins of the three major rivers, Indus, Ganges and Brahmaputra, which originate in the Himalayas.

The peninsular plateau bounded by the Eastern and Western Ghats, where hill ranges rise generally from 900 to 1,200 m (in places to over 2,500 m), is a marked feature of the Indian subcontinent below the Vindhya mountains. The narrow coastal strips between the Western Ghats and the Arabian Sea, and between the Eastern Ghats and the Bay of Bengal are a distinct physiographical feature of India. The delta formed by the confluence of the Ganges and Brahmaputra rivers and the series of parallel ridges on the eastern border (Chittagong Hill Tracts) are the conspicuous features of Bangladesh. In Sri Lanka there are highlands in the central and southwestern areas rising to elevations higher than 2,000 m, lowland plains in the northern half of the country, and narrow coastal strips all around the island. The Mahaweli Ganga River is a prominent feature of the landscape.

Geologically the Indian land mass is part of Gondwanaland. It has a basement of archean rocks, probably formed by solidification of the earth's original crust. The more

important rock formations are archean gneiss, granite, quartzite, slate and schist (Himalayan ranges); sandstone, clay and conglomerate (Siwalik system); sandstone, shale, slate limestone (the Cuddapah and Vindhyan systems); and basalt (Deccan trap). A unique feature of this subregion is the Thar desert (mainly in India but extending into Pakistan) which is a vast expanse of sand deposits with a few outcrops of old basement rocks (FAO 1981). In Thailand the northern region consists of a series of parallel and longitudinal fold mountains extending through peninsular Thailand into Malaysia. The average height of the peaks is 1,600 m with some above 2,000 m. The Chao Phraya River drains the major part of the country while the Mekong River forms the eastern boundary.

Indonesia is an archipelago with some 13,600 islands, of which only 6,000 are inhabited. General topography of the three large islands (Sumatra, Kalimantan and Irian Jaya) is characterized by extensive coastal plains and inland mountainous areas up to or exceeding 3,000 m in elevation. The important mountain ranges are in western Sumatra, central Kalimantan, central Irian Jaya and in Sulawesi. Java has a series of fifteen volcanoes with fertile plains between them, and a broad northern coastal plain.

The Philippines consist of 10 large islands and about 7,000 small ones -- nearly all the islands have rugged interior uplands rising to between 1,250 and 2,500 m. The highest mountain, Mt. Apo in Mindanao, reaches 2,954 m while Mt. Pulong in Luzon is 2,929 m high. Lowlands are uncommon -- the most important lowland areas are in Luzon, in Mindanao (Agusan and Cotabato plains), and in western Negros and eastern Panay.

Geologically, two major morphostructural regions can be distinguished in southeast Asia (after FAO/Unesco in *Soil Map of the World*, Vol IX). The Sunda Shelf area includes the Malay Peninsula, Thailand, Indochina and the island of Borneo. In western Thailand the rock formations are carboniferous (Kanchanaburi series), while sandstone, conglomerate, limestone and locally metamorphosed quartz-phyllite and slate (Korat series) are found in the east. The Korat series also predominate throughout Indochina. The Mekong and Chao Phraya river basins consist of recent and older alluvial deposits of silt and clay which are sometimes interbedded with sandy layers. The circum-Sunda orogenic system includes the Philippines in the northeast and merges south-westward into the great Sunda mountain system -- the Moluccas (Maluku), Celebes (Sulawesi), lesser Sunda Islands (Nusa Tenggara), Java, Madura and Sumatra of Indonesia. The Philippines are characterized by high tectonic instability and volcanic activity. The basement consists chiefly of pre-jurassic igneous rocks which outcrop in extensive areas of Mindanao, Palawan, Mindoro and Leyte. Granites are widely represented. In Indonesia volcanic deposits are extensive in Java and Madura, while metamorphic crystalline schists and tertiary rock formations abound in Sumatra.

Soils in tropical Asia are enormously varied. Nineteen soil regions are recognized in the countries of tropical Asia by the FAO/Unesco study *Soil Map of the World* (Volumes VII and IX). Only a few broad features of the soils in the region are highlighted in this report.

The northwestern part of south Asia (Indus plain of Pakistan and parts of India) is predominantly arid and semi-arid with mainly calcic and haptic xerosol soils (brown to dark brown, silty clay loam, moderately calcareous, pH>8.0). In the Thar and Thai desert area the dominant soils are cambic arenosols (pale brown loamy sand). Very deep black soils (vertisols), somewhat poorly drained and clayey, are found in extensive areas in western India. In the Indo-Gangetic plains (northern India) and the Ganges-Brahmaputra delta (Bangladesh and adjoining parts of India) fluvisols or alluvial soils predominate. In the soil region which extends over the eastern and southern parts of peninsular India and all of Sri Lanka the soils are mainly reddish brown and loamy (fluvisols/nitosols). Cambisols (very dark grayish brown, sandy loam, pH>6.0) predominate in the mountainous humid tropical areas of Burma, Bangladesh and India.

In southeast Asia Acrisols are the most widespread and cover nearly half the area. These soils form an acid to moderately basic parent material. They are fine to medium textured, dark grayish brown, clay to sandy loam with a pH range of 5.0 to 6.0. Acrisols are very poor in nutrients and highly susceptible to erosion. They occur over vast tracts of the principal mountain systems of Vietnam, Laos, Cambodia, Thailand, Peninsular Malaysia, and the islands of Sumatra, Borneo, Sulawesi and Papua New Guinea. The plains of the Chao Phraya and Mekong rivers are predominantly alluvial (fluvisols). Acrisols are found in association with nitosols (fine textured, deep, well drained, sandy clay loam, pH:6.5) in parts of Java and the Philippines. Nitosols, *per se*, are restricted to local basalt plateaus -- two main occurrences are found in the central highlands of Thailand and the Plateau des Bolovens in Laos. Podzols (dark reddish brown with decomposed humus) occur in southern Kalimantan (Borneo) and the eastern coast of Sumatra.

Pronounced climatic contrasts are characteristic of the south Asia subregion. The mercury may rise above 50°C at Jacobabad (Pakistan) and fall below -10°C in the snowy regions of Kashmir and Nepal. A climb of only a few kilometers changes the temperature from hot (40°C) at the foothills (Terai) of the Himalayas to near arctic cold above the snowline on the Himalayan peaks. In the Indian subcontinent three seasons are generally distinguished -- winter (November-February), summer (March-June) and the rainy season (July-October). The North Indian Plains are characterized by extremely hot and oppressive weather in summer with cool to cold winters.

The contrasts in rainfall are even greater and have a profound effect on the vegetation -- the extremes range from an annual mean of 75 mm in upper Sind (Pakistan) and Rajasthan to 12,000 mm at Chirrapunji (Indian state of Assam). The bulk of the rainfall in the subcontinent is brought by the southwest monsoon during the four months from July to October. One great current of the monsoon bursts against the western Ghats and flows over the Deccan, another sweeps up the Bay of Bengal and combined, they wash the sub-continent. In winter (November-January) the northeast monsoon brings rain to some parts of India. The high rainfall areas lie in the northeast and on the west coasts of India and Sri Lanka. A narrow strip along the Himalayas also receives considerable rainfall. The general decrease in rainfall is from east to west and north to south, so that the northwestern part of India and most of Pakistan receive very

little rainfall. In India and Pakistan the variability of the monsoon summer rain is considerable, ranging from about 20 percent in areas receiving more than 1,000 mm normal rain to about 50 percent in areas having less than 500 mm rainfall. Such variations result in frequent floods and droughts. During April to June, and October to December, severe cyclones form in the Bay of Bengal and the Arabian Sea and severely affect the coastal areas of Bangladesh and India's east coast. The northeasterly winds bring considerable rain to Sri Lanka as well.

The mean annual rainfall varies widely from one country to another. In the continental countries it ranges from 1,000 to 1,800 mm, and in several parts of insular southeast Asia from 1,800 to 3,000 mm. The continental countries are influenced by the northeast monsoon from October to February-March and by the southwest monsoon from May to September -- almost 80% of the annual rainfall occurs from May to September. Indonesia experiences the west monsoon from November to March and the east monsoon from June to September. With the exception of the eastern areas, the Philippines receive most of their annual rainfall from May to October.

In southeast Asia average temperatures remain relatively uniform throughout the year, at around 27°C, in most of the region lying south of 17°N. Further north the mean range of temperature increases slightly with latitude in coastal regions, but shows high variation in inland areas. In Thailand the highest temperatures of the year are registered during March-April, when day temperatures rarely fall below 32°C. Indonesia, lying between 10°N and 10°S and surrounded by warm tropical seas, experiences a hot, humid climate in all seasons.

Table 1. Sites studied in Tropical Asia.

Subregions/Countries	Study sites¹
South Asia	
Bangladesh	1. Belpukur, Rajshahi, NW Bangladesh 2. Samsadipur, Rajshahi, NW Bangladesh
India	1. Thennalur, Pudukottai, Tamil Nadu 2. Vadapalanji, Madurai, Tamil Nadu 3. Sukhomajri, Ambala, Haryana 4. Sahajpur, Pune, Maharashtra 5. Yavat, Pune, Maharashtra 6. Shiradhon, Pune, Maharashtra 7. Kadus, Pune, Maharashtra 8. Satara, Aurangabad, Maharashtra 9. Shindwane, Pune, Maharashtra
Nepal	1. Kankre, Ugrachandi, Kavre 2. Tusal, Ugrachandi, Kavre 3. Rakhi, Rakhi Panehayat, Kaski 4. Lekhnath, Lekhnath, Kaski
Sri Lanka	1. Madugalla, Udadumbara, Kandy 2. Bambarabedda, Udadumbara, Kandy
Southeast Asia	
Indonesia	1. Payungagung, Panumbangan, Ciamis, West Java 2. Karang Sari, Padaherang, Ciamis, West Java
Philippines	1. San Isidro, Baybay, Leyte 2. San Miguel, San Isidro, Leyte 3. Barangay Bila, Bauko 4. Barangay Guizadon, Bauko 5. Barangay Paiton, Nanjan, Oriental Mindoro 6. Sitio Banilad Barangay, Dulangan 3, Oriental Mindoro 7. Jose P. Laurel, Laguna 8. Juan Santiago, Laguna
Thailand	1. Ban Non Si Sawat, Nong Kung Si, Kalasin 2. Ban Kam Kham, Nong Kung Si, Kalasin 3. KM 7, Sanamchaikhet, Chachoengsao

4. Nongyang, Sanamchaikhet, Chachoengsao

¹ Selected features of the study sites are presented in Appendix 1. More information can be obtained from the contributors listed in the Acknowledgements, and from F/FRED (forthcoming).

METHODOLOGY

Tree improvement for forestry builds on the principles of traditional tree breeding, but differences in the objectives of MPTS improvement programs require a modified approach. Such differences include the need to define selection criteria to meet the needs of the end users and the planting system into which the tree will be placed. In order to identify appropriate ideotypes a ten-step method was developed and used in this collaborative regional study to ensure that the initial stages of MPTS improvement will result in trees that meet the needs of both grower and consumer.

Approach

This study built upon the existing effort in a well established regional study on farm and village forest and land use practices, an on-going study in all the countries contributing to this study but India. Two site visits were made for the regional study -- this study added one additional visit to the same sites.

Step one was carried out using data from the regional study on farm and village land and forest use practices. Researchers from India used the same format as the others to collect this data.

1) A listing of priority species and tree products was extracted from the existing social science network study and summarized in the following format by household:

	Species A	Species B	Species X
Product 1	_____	_____	_____
Product 2	_____	_____	_____
Product 3	_____	_____	_____

Products were defined in the regional study as leaves, branches, flowers, etc. The tabulation of this data took place after the first field data collection from the regional study.

Steps two through five were conducted with the cooperation of five men and five women from households participating in the regional study during a second visit to the study sites.

2) This list of products was prioritized using the following format:

	Species A	Priority ranking	Species B	Priority ranking
Product 1	_____	_____	_____	_____
Product 2	_____	_____	_____	_____
Product 3	_____	_____	_____	_____

- 3) Respondents were asked to describe the planting niches they would like to use for these priority species. This was to define the areas in which the trees are likely to be planted, ie. homegardens, field margins, intercropped with annual staple crops, etc.
- 4) Respondents were asked to describe which characteristics they dislike about the priority species identified above.
- 5) Respondents were asked to identify the top three individual trees for each of the priority species and asked why these trees are superior or preferred. Clearly labelled photographs were taken of each tree. Respondents were also asked the source of the planting materials for these trees, ie. neighbor, forestry department, private nursery, natural forest, etc.
- 6) Respondents were asked to identify tree species which are used to provide the priority products listed in Step 1, but which are not as desirable and the reasons they are not preferred.
- 7) A series of line drawings of the following tree parts were used to help informants describe the ideotypes they would like for each priority species:
 - branching habit -- many or few large branches, arrangement of branches (phylotaxy);
 - stem form -- single stem, multiple stemmed, straight, crooked, etc.;
 - rooting habit -- strong taproot with little lateral branching, fibrous rooting system with strong lateral branching; and
 - foliage characteristics -- palatability, leaf size, etc.
- 8) The information collected in steps two through seven were summarized by the researcher after the second field visit. This synopsis provided the basis for the presentation to be made in step nine.

- 9) The summary was presented and discussed in group meetings with villagers. At least one meeting was held with a women's group. These meetings were conducted to obtain a consensus on the ideotypes described by the sampled households. The line drawings used in step seven were used in the group meetings as a basis for discussions. This step was performed on the third site visit.
- 10) Researchers provided the Coordinating Unit with summaries of up to six composite ideotypes which were agreed to in step nine.

USES OF TREES AND GENERAL IDEOTYPE SPECIFICATIONS

Species used and preferred by small farmers in the Asian countries being studied have been broadly divided into three categories -- fruit and food tree species, fast growing MPTS on farms, and forest tree species. The general ideotype, if any, for each of these categories is discussed briefly in this section. Table 2 lists the species, their uses and the countries in which they are used.

Fruit and Food Tree Species

Fruit trees and other woody perennials are important sources of nutrition and income to rural households. The importance of coconut (*Cocos nucifera*) and mango (*Mangifera indica*) in rural economics is well documented. Small farmers generally plant fruit trees singly or in groups of two in their homegardens but this is gradually changing as farmers find fruit trees more remunerative than subsistence farming. In response to expanding market opportunities, some farmers are planting more fruit trees.

A total of 16 multipurpose fruit/food species are being used by the farmers in the study region. In addition to fruit/food which is the major end use, all of the species have other end uses such as fodder, fuelwood, timber and/or medicinal uses. A comparison of the farmers' ideotype descriptions for these species reveals that some generalizations can be made across Asia. The major selection criteria for breeding are vigor, improved fruit yield and quality (size, taste), early fruit set and resistance to pests and diseases. In addition, woody biomass is an important characteristic. Over 75% of these species are used as fuelwood, some even while fruit yield is substantial (*Mangifera indica*, *Zizyphus mauritiana*, *Artocarpus heterophyllus*, *Coffea arabica*). Others are used as fuelwood when fruit yield is on the decline. Over 50% of these species are used for timber when the tree no longer yields adequate quantities of fruit.

Farmers in general want the above fruit species to have the following traits: a medium to large crown with many branches high on the stem; a single, straight, clear bole with no branches low on the stem; a deep taproot to withstand strong winds, bind the soil and improve the infiltration capacity of the soil; and respond to management (pruning/lopping of branches for fodder and fuelwood) through quick and profuse regrowth of branches/leaves without any reduction in fruit yield. Thus with fruit as the

major priority, the selection criteria for breeding should follow traditional fruit tree improvement methods with consideration of fuelwood and timber characteristics. Stem form will be an important objective for selection/breeding.

Fast Growing MPTS

Some may argue that all species in this category are not fast growing. The classification is only arbitrary for ease in discussing the different requirements of trees on small farm holdings. Of the 27 species grouped under this category, only eight have fuelwood as the major end use -- fuelwood is only one of the many end uses for the others.

The ideotype description for these species is generally a tree with a large crown and many branches, with single or multiple but straight stem(s), and having no branches up to a specified height. A single straight long stem is preferred if one of the other end uses is timber. As most of these trees are generally planted on field margins or farm boundaries, the shape of the crown and stem form is influenced by the amount of shade the annuals can tolerate or the value of the tree product to the farmer. For instance, in the case of a tree whose branches are very valuable or in short supply, farmers will accept a lower yield from the annual in favor of the tree product. However in most instances, farmers would like to optimize their yields from both the perennials and annuals.

Regenerative power or the capacity of the tree to regenerate quickly without any loss of vigor after being lopped is another attribute important to farmers.

Two-thirds of the species in this category are used for fodder. However, *Leucaena leucocephala*, *Sesbania sesban*, and *Prunus cerasoides* are the only three species for which fodder is a major end use. The extent of its usage varies by country and sometimes from village to village within the same region. For the species from India, farmers report that 13 of the 17 can be used as fodder, but only 5 (*Sesbania sesban*, *Prosopis juliflora*, *Leucaena leucocephala*, *Acacia nilotica* var. *indica* and *cupressiformis*) are used as fodder with any regularity. Leaves have a competing use as mulch. *Prosopis* and *Acacia* pods are popular fodder but only in a few cases did farmers report that they harvested the pods regularly as fodder. The villages in Sri Lanka use *Gliricidia sepium* as fodder, but it is not a major end use of the tree. Some of the sites in Thailand and the Philippines reported fodder as the major use of *Leucaena*.

The ideotype description for fodder species is quite similar to that of the fuelwood species. A large canopy with many branches and dense foliage is one of the requirements. Farmers want single or multiple stem(s) depending on the other end uses of the tree. Quick and prolific regrowth on lopping and modifications to the deciduous nature of the tree are other ideotype specifications expressed as desirable. Shorter periods of leaflessness and sometimes evergreen trees are preferred. For species with edible pods, farmers want trees to produce more of the longer and fleshier pods than the trees produce now.

An increase in productivity through the use of tree mulches is generally obtained from alley or hedgerow cropping of trees with annual or seasonal crops. Soil fertility is maintained through nutrient cycling and mulch incorporation. Nitrogen fixing trees have the ability to fix atmospheric nitrogen in a form usable by plants. The use of tree leaves as mulch in the study region has been observed to be mainly for high value crops like paddy and vegetables. Farmers in Thailand and the Philippines use *Leucaena* as a green manure. *Gliricidia sepium* is used in Sri Lanka and Thailand.

The use of tree leaves as mulch was the highest in one of the two villages studied in Tamil Nadu, India. *Delonix elata*, *Thespesia populnea*, *Albizia lebbek* and *Ailanthus excelsa* are very popular mulch species. *Azadirachta indica* leaves are used for their insecticidal properties. *Gliricidia sepium* has just been introduced as a mulch species by the Department of Agriculture. Only a few farmers are currently using it, but it is rapidly becoming one of the favored mulch species. Ideotype specifications for mulch species are similar to those of fodder species.

Timber is the most important end use. Of the 27 species in this category, close to 80% have timber as an end use. Some types of wood used as timber have very specific uses and farmers will only substitute another species if the desired one is unavailable. Farmers have used stem form as a selection criterion over the years to modify the species to their requirements. The most important characteristic for timber species is a long straight bole with no branches up to a minimum height of 3 m. Wood quality is another important characteristic. The wood should be durable, light, capable of taking high cross loads, have minimum spirality to avoid opening up when in use, and be resistant to termites and other wood borers or be capable of taking preservatives easily.

Natural Forest Tree Species

Farmers in the Philippines, Thailand, Nepal and India who live in or near remaining natural forests still use forest trees, particularly for timber and fuel. The general selection criteria are for vigor, stem form, branching, crown characteristics and wood properties to increase woody production.

There are several general ideotype requirements common to all species irrespective of their uses or the order of importance:

- roots should be deep and geotropically angled to allow the tree to withstand strong monsoon winds (Thailand, Indonesia, India), cyclonic storms (Sri Lanka, India, Bangladesh), and typhoons (Philippines). They should be able to bind the soil to prevent erosion on slopes and increase infiltration rates;
- thorns are not preferred. Farmers would like a reduction in the number of thorns or their complete removal. Some species have thorns which are reported to be poisonous, others have curved thorns which are even more disliked than the straight ones;

- this aspect is redundant, but farmers want trees to grow faster. In some cases it is because the need to protect trees from grazing animals will no longer be necessary. In most cases it is because small farmers need to realize rapid returns from the trees; and
- vigor and resistance to insects and diseases are universal requirements.

MULTIPURPOSE TREE SPECIES IDEOTYPES

Priority lists of potentially useful tree species in small villages in Asia have been described for specific and multipurpose uses. The simple and systematic methodology developed for rapid appraisal of MPTS which focuses on the evaluation of uses in the context of farmer interest has been very efficient. This method reduces the subjectiveness and personal biases of the researcher and makes the list of species more comprehensive. In addition, when farmer preferences were included the definition of selection criteria for appropriate species were clearly identified. By understanding the desired value to the end user of products from MPTS, the breeder can breed MPTS with traits to meet these expressed needs more precisely.

The farmers are generally more interested in specific or multiple uses of individual trees than in volume or biomass production. They grow trees on homelots and fields for a wide range of uses, such as windbreaks, fuelwood, shade, food, green manure and fodder. These intended uses help define the concept of the "ideal tree," or ideotype, for small farm growing. Donald (1968) defined ideotype as "a biological model which is expected to perform predictably, leading to greater quantities and qualities of crop yield under defined environmental conditions." To fulfil the designated farming system's objectives and to maximize land-use in time and limited space the associative or non-competitive ideotypes are most desirable.

In principle the selection of the best ideotype for farming systems parallels the selection of plus trees for industrial tree improvement programs including specific products and services required for farm living.

Breeding

Breeding is the genetic adjustment of plants to the service of humans. Breeding capitalizes on the natural variability and packages the best traits. It is a long term and never-ending process with few shortcuts. For annual crops the process is more rapid than for trees or farm animals. Most trees take at least two to three years to reach sexual maturity, prolonging the time required for breeding. Additionally, selecting for specific traits can be time consuming if the traits can only be observed after maturity or at harvesting age (Zsuffa 1989).

Realistic Selection Criteria

Selection is a powerful tool in the arsenal of modern quantitative geneticists. It is the process in which individuals with certain traits are favored in reproduction. It can only act effectively on traits that vary because of differences in the genetic constitution of individuals. Selection cannot create variation, but rather operates on variation already in existence. If effective, it causes a change in gene frequencies which in turn alter genotypic frequencies. If genes affecting a trait act in an additive manner, both on the allele and locus level, selection will tend to increase the frequency of the alleles producing the desired genotype, operating on that portion of the genetic variance known as additive variance or variance of breeding values. Traits in which additive genetic variance make up a substantial portion of the total variation will respond readily to selection (Kellison and Sprague 1971).

If gene action is predominantly non-additive, selection can be used to choose individuals that when crossed in specific combinations produce offspring with desired traits.

Forest tree species display considerable variation in many traits among trees within populations. Thus selection will be effective in improving such traits, provided a large part of the variation is due to differences in genetic makeup and is of the additive type. Studies in a number of species have generated information on the magnitude of the additive genetic variance for important economic traits (Chuntanaparb 1973, 1975; Zobel and Talbert 1984).

Ideotype Breeding

Genetic improvement of MPTS for small farms is carried out for a variety of characteristics including productivity, suitability to sites and planting systems, tree qualities for special end uses, and pest resistance. In addition, this study has clearly established the traits needed for MPTS in particular environments in Asia with regard to using prescribed approaches of cultivation and having specific objectives for end uses. Consideration of these model trees, or ideotypes, should be the first step towards bioengineering improved tree species.

The ideotype tree is, in a broad sense, a biological model which is expected to perform in a predictable manner within a defined environment. More specifically, an ideotype tree is a plant model designed to yield an improved quality and quantity of useful products than a wild plant or a conventional cultivar (Dickman 1985).

The formulation of MPTS ideotypes presented in this study is a useful step in tree improvement because it provides a clear goal for breeding, a guide for the selection of potential breeding stock and for the manipulation of newly generated material, and provides an opportunity to devise and examine combinations of characteristics which may never occur otherwise.

Three major points concerning the concept of ideotype trees should be kept in mind. First, the ideotype is a model toward which the tree breeder should strive. Ideotype breeding differs from traditional breeding in that goals are specified for each trait. Second, this model is artificial and idealized for designing a combination of genetically controlled physiological and morphological characteristics to maximize the quality and quantity of yield. Third, studies of ideotype trees lead to a better understanding of the processes in trees, the trees as whole plants, and the trees as part of stands (Zsuffa 1989).

Ideotype breeding usually entails a three-step approach (Rasmusson 1987). First, decisions must be made about traits that are to be part of the ideotype breeding effort, and a phenotypic goal for each trait should be specified. Second, genetic diversity must be sufficient to justify a breeding effort. And third, the breeder must be willing to conduct several cycles of breeding and test the trait in question in different genetic backgrounds and possibly in different environments.

Desirable components of ideotype trees have been suggested by several authors without stating specific phenotypic goals (Dickman 1985; Fege 1981; Siren *et al.* 1979; Siren 1985). A list of components which are of almost universal importance was proposed by Koski and Vihera-Aarnio (1986) that include:

- high rate of net photosynthesis;
- efficient light interception;
- full utilization of the growing season;
- high harvest index;
- efficient use of water and nutrients;
- rapid juvenile growth;
- tolerance to competition;
- tolerance to abiotic stress;
- freedom from pests and diseases;
- suitable biomass properties; and
- ease of reproduction and plantation establishment.

Zsuffa and Papadopol (1984) proposed the following ideotype tree components for biomass plantations of poplars and willows:

- fast juvenile growth;
- high and constant sprouting ability;
- immunity towards foliar diseases;
- resistance to stem disease;
- high capacity for healing of cuts and low stump decay rate;
- responsiveness to increased cultural inputs;
- non-preference from insect pests;
- narrow crown with relatively few ascending branches;
- ability to use the growing season fully;
- dark foliage with high specific leaf weight; and

- tolerance to post planting herbicides.

Ideotype trees for on-farm growing may not require all of the components listed above as farmers' requirements are very specific and indicative. The ideotype components need proper prioritization and will vary according to factors such as species, site conditions, and cultural systems.

Eighty-two ideotypes have been designed for specific environments in Asia (Appendix 2). Some are very similar and common to a wide range of ecological conditions, but different environments and cultural practices require different models. There is no universal ideotype suitable for all sites and end uses required by village communities in Asia.

The general specification of the ideotypes described above and in specific locations (Appendix 2), and the inventory and establishment of breeding stock must be the first steps in the program. Selection and breeding will then, in a relatively short time, provide cultivars and clones superior to those used earlier which will be far more productive.

Breeding of ideotypes must be a cooperative effort. Some steps, such as the characterization of planting systems and definition of traits, multiplication, and testing and demonstration of stock, must involve silviculturalists and tree growers. In other steps, researchers of different disciplines such as economists, sociologists, extensionists, geneticists, physiologists, and pathologists must work together. Only effective teamwork and sustained effort can yield results.

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Table 2. Tree use practices by small farm holders in Asian countries.

Category	Species	Countries	Uses
I. Fruit and food species	<i>Artocarpus heterophyllus</i>	Bangladesh, Philippines, Sri Lanka, Indonesia	Fruit, fuelwood, fodder, timber, medicinal purposes
	<i>Mangifera indica</i>	Bangladesh, India, Sri Lanka, Philippines	Fruit, fuelwood, timber, fodder
	<i>Madhuca longifolia</i>	Sri Lanka	Fruit, timber, fuelwood
	<i>Artocarpus altilis</i>	Sri Lanka	Fruit, timber, fuelwood
	<i>Achras zapota</i>	Indonesia	Fruit, minor timber
	<i>Psidium guajava</i>	Sri Lanka, Philippines	Fruit, timber
	<i>Tamarindus indica</i>	Sri Lanka, India	Fruit, Fuelwood, timber, medicinal purposes, fodder
	<i>Persea gratissima</i>	Sri Lanka	Fruit, fuelwood
	<i>Persea americana</i>	Philippines	Fruit, fuelwood, timber medicinal purposes
	<i>Coffea arabica</i>	Philippines	Fruit, fuelwood, medicinal purposes, mulch
	<i>Cocos nucifera</i>	Sri Lanka, India, Philippines	Fruit, timber, other minor uses
	<i>Pithecellobium dulce</i>	India	Fruit, fodder, fuelwood

	<i>Zizyphus mauritiana</i>	India	Fruit, fuelwood, timber, fodder
	<i>Syzygium cuminii</i>	India	Fruit, fuelwood, timber
	<i>Parkia speciosa</i>	Indonesia	Food, fuelwood
	<i>Sesbania grandiflora</i>	Thailand	Food, soil conservation, fuelwood
II. Fast growing MPTS	<i>Gliricidia sepium</i>	Sri Lanka, Philippines	Fuelwood, mulch, fodder, timber, food
	<i>Leucaena Leucocephala</i>	Thailand, Philippines, India	Fuelwood, fodder, mulch, fuelwood, timber, food, windbreak, shade

able 2. (cont'd)

Category	Species	Countries	Uses
	<i>Eucalyptus camaldulensis</i>	Philippines	Timber, medicinal purposes
	<i>Acacia nilotica</i> var. <i>indica</i>	India	Timber, fodder, fuelwood, tannin
	<i>Ceiba pentandra</i>	Thailand	Fuelwood, silk-cotton
	<i>Prunus cerasoides</i>	Nepal	Fuelwood, fodder, timber
	<i>Alnus nepalensis</i>	Nepal	Fuelwood, timber
	<i>Betula alnoides</i>	Nepal	Fuelwood, timber, fodder
	<i>Azadirachta indica</i>	India, Thailand	Fuelwood, fodder, timber, medicinal purposes, mulch
23	<i>Acacia nilotica</i> var. <i>cupressiformis</i>	India	Fuelwood, fodder, timber
	<i>Delonix elata</i>	India	Mulch, timber, fuelwood
	<i>Thespesia populnea</i>	India	Mulch, Fodder, Timber
	<i>Prosopis juliflora</i>	India	Fuelwood, fodder, timber
	<i>Albizia lebbeck</i>	India	Fuelwood, timber, fodder
	<i>Acacia leucophloea</i>	India	Fuelwood, timber, fodder
	<i>Sesbania sesban</i>	India	Fodder, fuelwood, timber
	<i>Melia azaderach</i>	India	Fodder, fuelwood, timber
	<i>Dalbergia sissoo</i>	India	Fuelwood, timber, soil conservation

<i>Morus serrata</i>	India	Fuelwood, fodder, fruit, handicrafts
<i>Carissa spinarum</i>	India	Fuelwood, fruit, medicinal value
<i>Prosopis spicigera</i>	India	Fuelwood, fodder, timber, soil conservation
<i>Borassus flabellifer</i>	India	Timber, fruit, leaves, as construction material, other minor uses

Table 2. (cont'd)

Category	Species	Countries	Uses
III. Natural forest tree species	<i>Ailanthus excelsa</i>	India	Mulch, timber, fuelwood
	<i>Paraserianthes falcataria</i>	Indonesia, Philippines	Timber, fuelwood, fodder, handicrafts
	<i>Maesopsis eminii</i>	Indonesia	Timber, fuelwood, fodder
	<i>Albizia procera</i>	Indonesia	Timber, fuelwood, fodder
	<i>Alnus maritima</i>	Philippines	Fuelwood, shade, fencing, mulch
	<i>Pterocarpus indica</i>	Philippines	Timber, fuelwood
	<i>Vitex parviflora</i>	Philippines	Timber, fuelwood
	<i>Pinus kesiya</i>	Philippines	Timber, fuelwood
	<i>Schima wallichii</i>	Nepal	Timber, fuelwood
	<i>Phocebe sterculiodes</i>	Philippines	Timber, handicrafts
	<i>Dipterocarpus grandiflora</i>	Philippines	Fuelwood, timber
	<i>Shorea obtusea</i>	Thailand	Fuelwood, timber
	<i>shorea siamensis</i>	Thailand	Fuelwood, timber
<i>Dipterocarpus tuberculata</i>	Thailand	Fuelwood, timber	
<i>Dipterocarpus obtusifolia</i>	Thailand	Fuelwood, timber	

<i>Irvingia malayana</i>	Thailand	Timber, fuelwood
<i>Dipterocarpus alatus</i>	Thailand	Timber, fuelwood
<i>Pterocarpus macrocarpa</i>	Thailand	Timber, fuelwood
<i>Cotylelobium melanoxylon</i>	Thailand	Timber, fuelwood
<i>Albizia amara</i>	India	Timber, fuelwood, fodder

Note: All of these species have environmental uses such as for shade, windbreaks and soil conservation. These uses have only been noted where the farmer was using these species specifically for environmental purposes.

Appendix 1. Selected features of the study sites.

1.1

Country name: Bangladesh

Village name: Belpukur, Rajshahi district, N.W. Bangladesh

Population:

Total: 1650

Male: 846 Female: 804

No. of households: 289

Area of the village (ha): 161

Land Use Pattern (ha):

Forests	6
Agriculture	105
Homestead	23
Ponds/ditches	16
Fallow	3
Roads etc.	8

Crops grown: Paddy, wheat, sugarcane, pulses, oilseeds,
vegetables, jute

Soil type: Loamy, Sandy loam

Topography: Flat

Annual rainfall: 1500 mm

Distribution of rainfall: Mostly in June to September

Minimum and maximum

temperatures: Mean max 35°C
 Mean min 15°C

1.2

Country name: Bangladesh

Village name: Samsadipur, Rajshahi district, N.W. Bangladesh

Population:

Total: 1700

Male: 870 Female: 830

No. of households: 319

Area of the village (ha): 164

Land Use Pattern (ha):

Forest	8
Agriculture	106
Homestead	25
Ponds/ditches	18
Fallow	3
Road etc.	4
Pasture land	0

Crops grown: Paddy, wheat, sugarcane, pulses, oilseeds, jute, vegetables

Soil type: Loamy, sandy loam

Topography: Flat

Annual rainfall: 1500 mm

Distribution of rainfall: Mostly in June to September.

Minimum and maximum:

temperatures: Mean max 35°C
 Mean min 15°C

1.3

Country name: India

Village name: Thennalur, Pudukottai, Tamil Nadu

Population:

Total:	2420	
Male:	1175	Female: 1245

No. of households: 420

Area of the village (ha): 989.09

Land Use Pattern (ha):

Land under forests	81.33
Total agricultural land	657.76
Irrigated land	178.85
Culturable wasteland	29.67
Land not available for cultivation	250.00
Pasture land	0.00

Crops grown: Paddy, groundnuts, cotton, maize, finger millet

Soil type: Combination of sandy and loamy, alkaline soils

Topography: Flat

Annual rainfall: 880.7 mm

Distribution of rainfall: Sept - Nov (NE Monsoon) 371 mm
June - Aug (SW Monsoon) 343 mm

Minimum and maximum

temperature: mean max. 39.2°C
mean min. 21.2°C

1.4

Country name: India

Village name: Vadapalanji, Tiruparakundram, Madurai, Tamil Nadu

Population:

Total: 2750
Male: 1250 Female: 1500

No. of households: 600

Area of the village (ha): 160

Land Use Pattern (ha):

Land under forests	0
Total agricultural land	80
Irrigated land	50
Culturable wasteland	10
Land not available for cultivation	20
Pasture land	0

Crops grown: Paddy, groundnuts, bananas, vegetables

Soil type: Shallow sandy loam of recent origin

Topography: Flat

Annual rainfall: 575 mm (average for 1984-86)

Distribution of rainfall: Sept - Nov (NE Monsoon)
June - Aug (SW Monsoon)

Minimum and maximum
temperatures:

mean max. 34°C
mean min. 24.3°C

1.5

Country name: India

Village name: Sukhomajri, Kalka, Ambala, Haryana

Population:

Total: 538
Male: 298 Female: 240

No. of households: 83

Area of the village (ha): 595.38

Land Use Pattern (ha):

Land under forests	493
Total agricultural land	92.15
Irrigated land	10.23
Culturable wasteland	0
Land not available for cultivation	0
Pasture land	0

Crops grown: Maize, sugarcane, wheat, vegetables, fodder grasses

Soil type: Sandy loam on surface, loam in lower layers

Topography: Undulating, slope up to 10%

Annual rainfall: 1137 mm

Distribution of rainfall: 82% of rainfall between June and Sept.

Minimum and maximum

temperatures: June: Max. 43.0°C
Min. 20.2°C
Jan.: Max. 23°C
Min. 2°C

1.6

Country name: India

Village name: Sahajpur, Daund, Pune, Maharashtra

Population

Total: 1285
Male: 375 Female: 360 Children: 550

No. of households: 327

Area of the village (ha): 796.8

Land Use Pattern (ha):

Land under forests	12.4
Total agricultural land	606
Irrigated land	560
Culturable wasteland	0
Land not available for cultivation	166.4
Pasture land	12

Crops grown: Wheat, sugarcane, vegetables, sorghum, groundnuts,
pearl millet, fruits

Soil type: n.a.

Topography: Flat

Annual rainfall: 463 mm, coeff of var. 28.61%, no. of rainy days
31

Distribution of rainfall: Mostly in the months of July to Oct.

Minimum and maximum
temperatures: n.a.

1.7

Country name: India

Village name: Yavat, Daund, Pune, Maharashtra

Population:

Total:	7167	
Male:	3717	Female: 3450

No. of households: 2829

Area of the village (ha): 4121

Land Use Pattern (ha):

Land under forests	186
Total agricultural land	3054
Irrigated land	1034
Culturable wasteland	350
Land not available for cultivation	881
Pasture land	0

Crops grown: Wheat, sugarcane, vegetables, sorghum, groundnuts,
pearl millet

Soil type: n.a.

Topography: Flat

Annual rainfall: 463 mm, coeff of var. 28.61%, no. of rainy days
31

Distribution of rainfall: Mostly in the months of July to Oct.

Minimum and maximum
temperature: n.a.

1.8

Country name: India

Village name: Shiradhon, Pune, Maharashtra

Population:

Total:	7000	
Male:	n.a.	Female: n.a.

No. of households: 1246

Area of the village (ha): 843

Land Use Pattern (ha):

Land under forests	172
Total agricultural land	519
Irrigated land	240
Culturable wasteland	100
Land not available for cultivation	20
Pasture land	132

Crops grown: Pearl millet, sunflowers, pigeonpea, sugarcane

Soil type: Black

Topography: Undulating

Annual rainfall: 810 mm, coeff of var. 24.22%, no. of rainy days
51

Distribution of rainfall: Mostly in the months of July to Oct.

Minimum and maximum
temperature: n.a.

1.9

Country name: India

Village name: Kadus, Rajgurunagar, Pune, Maharashtra

Population:

Total:	9632	
Male:	4789	Female: 4843

No. of households: 1367

Area of the village (ha): 4312

Land Use Pattern (ha):

Land under forests	0
Total agricultural land	3281
Irrigated land	714
Culturable wasteland	0
Land not available for cultivation	1025
Pasture land	6

Crops grown: Sorghum, pearl millet, groundnuts, potatoes,
vegetables, onions, wheat

Soil type: n.a.

Topography: Undulating

Annual rainfall: 750 - 1250 mm

Distribution of rainfall: 4 Months - July to Oct.

Minimum and maximum
temperatures: n.a.

1.10

Country name: India

Village name: Satara, Aurangabad, Maharashtra

Population:

Total:	2176	
Male:	1119	Female: 1057

No. of households: 387

Area of the village (ha): 2793.82

Land Use Pattern (ha):

Land under forests	67.80
Total agricultural land	1597.45
Irrigated land	80.15
Culturable wasteland	378.26
Land not available for cultivation	750.31
Pasture land	0

Crops grown: Pearl millet, sorghum, sugarcane, cotton, sunflowers, vegetables, maize, peas, mungbeans

Soil type: Light and medium black soil

Topography: Hilly

Annual rainfall: 724 mm

Distribution of rainfall: Maximum rain during June to September.

Minimum and maximum
temperatures: 6.2° and 43.4°C

1.11

Country name: India

Village name: Shindwane, Haveli, Pune, Maharashtra .

Population:

Total: 2361

Male: 1252

Female: 1109

No. of households: 600

Area of the village (ha): 2009

Land Use Pattern (ha):

Land under forests	239
Total agricultural land	1531
Irrigated land	1000
Culturable wasteland	531
Land not available for cultivation	239
Pasture land	0

Crops grown: Pearl millet, sorghum, sugarcane, wheat,
vegetables, onions

Soil type: n.a.

Topography: n.a.

Annual rainfall: 500 mm

Distribution of rainfall: Mostly in the months of July to Oct.

Minimum and maximum
temperatures: n.a.

1.12

Country name: Nepal

Village name: Kankre, Kavre district

Population:

Total: 812
Male: 412 Female: 400

No. of households: 116

Area of the village (ha): 52.25

Land Use Pattern (ha):

Forest	22.25
Agriculture	23.0
Rice	5.8
Other Annuals	8.7
Perennial crops	1.0
Agro-Forestry	6.0
Fallow	7.5
Homestead gardens	3.0
Pasture land	2.5
Wasteland	1.5

Crops grown: Paddy, maize, millet, wheat

Soil type: Combination of sandy loam and silty

Topography: Hilly, terraced

Annual rainfall: 2089 mm

Distribution of rainfall: June to September 1596 mm
Rest of the months 498 mm

Minimum and maximum

temperatures: Summer minimum 18°C maximum 28°C
Winter minimum -4°C maximum 15°C

1.13

Country name: Nepal

Village name: Tusal, Kavre district

Population:

Total: 1000

Male: 524 Female: 476

No. of households: 118

Area of the village (ha): 229

Land Use Pattern (ha):

Forest	163
Agriculture	60
Rice	30
Other Annuals	23
Perennial	1
Agro forestry	6
Fallow	6

Crops grown: Paddy, maize, millet, wheat, potatoes

Soil type: Combination of loamy clay and loamy

Topography: Hilly, terraced

Annual rainfall: 2089

Distribution of rainfall: June to September 1596 mm
Rest of the months 498 mm

Minimum and maximum

temperatures: Summer min. 18°C max. 28°C
Winter min. 4°C max. 15°C

1.14

Country name: Nepal

Village name: Rakhi, Rakhi Panehayat, Kaski

Population:

Total: 4301

Male: 2150

Female: 2151

No. of households: 746

Area of the village (ha): 870

Land Use Pattern (ha):

Land under forests 151

Total agricultural land 562

Irrigated land 285

Culturable wasteland 84

Land not available for 60

cultivation

Pasture land 97

Crops grown: Annual crops: rice, maize, rye Perennial crops: fuelwood and timber species, fodder, fruit

Soil type: Sandy loam (20%), loam (60%), loamy clay (20%)

Topography: Rolling plain (50%), hilly (50%)

Annual rainfall: 3387 mm

Distribution of rainfall: n.a.

Minimum and maximum

temperature:

7°C to 30°C

Note: Rainfall and temperature data are based on Kaski district-Pokhara station.

1.15

Country name: Nepal

Village name: Lekhnath, Lekhnath village Panchayat, Kaski

Population:

Total: 6439

Male: 3541

Female: 2898

No. of households: 1121

Area of the village (ha): 1359

Land Use Pattern (ha):

Land under forests 344

Total agricultural land 870

Irrigated land 450

Culturable wasteland 57

Land not available for 102

cultivation

Pasture land 43

Crops grown: Annual crops: rice, maize, vegetables Perennial crops: fuelwood and timber species, fodder, fruit.

Soil type: Sandy loam (40%), loam (30%), loamy clay (30%)

Topography: Flat (35%), rolling plain (45%), hilly (20%)

Annual rainfall: 3387 mm

Distribution of rainfall: n.a.

Minimum and maximum

temperature: 7°C to 30°C

Note: Rainfall and temperature data are based on Kaski district-Pokhara station.

1.16

Country name: Sri Lanka

Village name: Madugalla, Udadumbara, Kandy

Population:

Total: 1874
Male: 939 Female: 935

No. of households: 334

Area of the village (ha): 1466

Land Use Pattern (ha):

Area under forest	490
Area under agriculture	888
Irrigated area	0
Culturable wasteland	73
Land not available for cultivation	0
Pasture land	15

Crops grown: Paddy, tobacco, vegetables

Soil type: Sandy and loamy

Topography: Mountainous

Annual rainfall: 940 mm

Distribution of rainfall:

October-January (NE monsoon) 650 mm
February-March (Intermediate dry spell) 45 mm
April-May (SW monsoon) 145 mm
June-September (dry season) 100 mm

Minimum and maximum:
temperatures:

Minimum = 17°C (February) Maximum = 33°C (March-April)
Mean maximum = 30.7°C
Mean minimum = 21.0°C

1.17

Country name: Sri Lanka

Village name: Bambarabedda, Udadumbāra, Kandy

Population:

Total: 1600

Male: 888 Female: 712

No. of households: 398

Area of the village (ha): 349

Land Use Pattern (ha):

Area under forest	99
Area under agriculture	206
Irrigated area	0
Culturable wasteland	34
Land not available for cultivation	0
Pasture land	10

Crops grown: Vegetables, paddy, tobacco

Soil type: Sandy and loamy

Topography: Mountainous

Annual rainfall: 940 mm

Distribution of rainfall:

October-January (NE monsoon) 650 mm

February-March (Intermediate dry spell) 45 mm

April-May (SW monsoon) 145 mm

June-September (dry season) 100 mm

Minimum and maximum
temperatures:

Minimum = 17°C (February) Maximum = 33°C (March-April)

Mean maximum = 30.7°C

Mean minimum = 21.0°C

1.18

Country name: Indonesia

Village name: Payungagung, Panumbangan, Ciamis, West Java

Population:

Total: 3800
Male: 1874 Female: 1976

No. of households: 1010

Area of the village (ha): 782

Land Use Pattern (ha):

Land under forest	50
Total Agri. land	594
Irrigated land	134
Culturable wasteland	406
Land not available for cultivation	54
Pasture land	0

Crops grown: Rice, corn, *Eugenia aromatica*, *Paraserianthes falcataria*, *Artocarpus heterophyllus*

Soil type: Andosol, grumusol

Annual rainfall: 2869 mm

Distribution of rainfall: Nov.-April (West monsoon) 1973 mm
May-October (East monsoon) 896 mm

Minimum and maximum
temperatures: 22°C and 30°C

1.19

Country name: Indonesia

Village name: Karang Sari, Padaherang, Ciamis, West Java

Population:

Total: 3645

Male: 1803 Female: 1842

No. of households: 950

Area of the village (ha): 1649.9

Land Use Pattern (ha):

Land under forest	0
Total Agri. land	1018.2
Irrigated land	221.6
Culturable wasteland	591.7
Land not available for cultivation	40.0
Pasture land	0

Crops grown: Rice, cassava, corn, groundnuts, soybeans, fruits vegetables

Soil type: Latosol, grumusol

Annual rainfall: 1743 mm

Distribution of rainfall: Nov.-April (West monsoon) 1201 mm
May-October (East monsoon) 542 mm

Minimum and maximum

temperatures: 26°C and 33°C

1.20

Country name: Philippines

Village name: San Isidro, Baybay, Leyte, Philippines

Population:

Total: 1400
Male: n.a. Female: n.a.

No. of households: 220

Area of the village (ha): 3500

Land Use Pattern (ha):

Land under forest	0
Total Agri. land	3325
Irrigated land	1995
Non-irrigated land	1330
Cultivable wasteland	0
Land not available for cultivation	0
Pasture land	0

Crops grown: Rice, coconut, bananas, fruit trees, rootcrops

Soil type: Sandy loam

Topography: Flat

Annual rainfall: n.a.

Distribution of rainfall: Evenly distributed throughout the year; highest precipitation occurs from December to January.

Minimum and maximum

temperatures: Mean min. 27.1°C
Mean max. n.a.

1.21

Country name: Philippines

Village name: San Miguel, San Isidro, Leyte, Philippines

Population:

Total: 733

Male: n.a. Female: n.a.

No. of households: 220

Area of the village (ha): 2500

Land Use Pattern (ha):

Land under forest	250
Total Agri. land	2400
Irrigated land	0
Cultivable wasteland	0
Land not available for cultivation	250
Pasture land	100

Crops grown: Corn, mungbeans, rootcrops, peanuts, bananas, tobacco, trees (leucaena)

Soil type: Medellin clay

Topography: Mountainous

Annual rainfall: n.a.

Distribution of rainfall: Distinct dry and wet seasons. Rainy months from July to January; highest precipitation occurs in August; dry months from February to June.

Minimum and maximum:
temperatures: n.a.

1.22

Country name: Philippines

Village name: Barangay Bila, Bauko

Population:

Total:	862	
Male:	n.a.	Female: n.a.

No. of households: 172

Area of the village (ha): 40

Land Use Pattern (ha):

Land under forest	0
Total Agri. land	33
Residential	7

Crops grown: Rice

Soil type: Clay loam, fine textured soil

Topography: Lowland

Annual rainfall: 1800 mm

Distribution of rainfall: 80% May to October

Minimum and maximum temperatures: n.a.

1.23

Country name: Philippines

Village name: Barangay Guizadon, Bauko

Population:

Total: 3280

Male: n.a. Female: n.a.

No. of households: 656

Area of the village (ha): 144

Land Use Pattern (ha):

Land under forest 0

Total Agri. land 130

Residential 14

Crops grown: Rice and vegetables

Soil type: Clay loam, fine textured soil

Topography: Lowland, near a river

Annual rainfall: 1800 mm

Distribution of rainfall: 80% May to October

Minimum and maximum
temperatures: n.a.

1.24

Country name: Philippines

Village name: Barangay Paitan, Naujan, Oriental Mindoro

Population:

Total:	1000	
Male:	50%	Female: 50%

No. of households: 250

Area of the village (ha): 463

Land Use Pattern (ha):

Land under forest	353
Settlement Core Area	6
Total Agri. land	104

Crops grown: Coffee, bananas, sweet potatoes, cassava, citrus, calamansi, mango, jackfruit, coconut, gabi

Soil type: Clay loam, sandy loam, sandy clay

Topography: Moderately rolling slopes of 3-5 degrees

Annual rainfall: Average of 11 years = 3,903.8 mm/yr (with no pronounced maximum rain period)

Distribution of rainfall: Rainfall is just about evenly distributed throughout the year.

Minimum and maximum

temperature: 22.7°C (Average minimum)
31.4°C (Average Maximum)

1.25

Country name: Philippines

Village name: Sitio Banilad, Barangay Dulangan 3, Baco, Oriental Mindoro

Population:

Total: 300
Male: 53% Female: 47%

No. of households: 61

Area of the village (ha): 345

Land Use Pattern (ha):

Land under forest	250
Settlement Core Area	2
Total Agri. land	93

Crops grown: Sweet potatoes, cassava, bananas, gabi, citrus, coconut, coffee

Soil type: San Miguel sandy loam

Topography: 400 meters above sea level

Annual rainfall: Average of 11 years = 3,903.8 mm/yr (with no pronounced maximum period)

Distribution of rainfall: Rainfall is just about evenly distributed throughout the year

Minimum and maximum

temperatures: 22.7°C (Average minimum)
28°C (Average Maximum)

1.26

Country name: Philippines

Village name: Jose P. Laurel, Laguna

Population:

Total: 581

Male: n.a. Female: n.a.

No. of households: 146

Area of the village (ha): 94

Land Use Pattern (ha):

Land under forest 5

Total Agri. land 80

Residential 9

Crops grown: a) Plantation crops/fruit trees: citrus, coconut, coffee, bananas.
b) Root Crops: Gabi, sweet potatoes, cassava

Soil type: Antipolo clay with pH 6.51

Topography: Plain to hilly and mountainous with elevation of 200 to 300 meters above sea level.

Annual rainfall: 1900-2000 mm

Distribution of rainfall: June to Nov. 1444 mm
Dec. to May 444 mm

Minimum and maximum

temperatures: Mean maximum 31.3°C

Mean minimum 23.4°C

1.27

Country name: Philippines

Village name: Juan Santiago, Laguna

Population:

Total: 1381

Male: n.a. Female: n.a.

No. of households: 230

Area of the village (ha): 1790

Land Use Pattern (ha):

Land under forest 0

Total Agri. land 2500

Settlement/Residential 290

Institutional/Roads

Crops grown: a. Plantation crops/fruit trees: citrus, coconut, coffee, bananas.
b. Root Crops: Gabi, sweet potatoes

Soil type: Antipolo clay

Topography: Plain to hilly and mountainous with elevation of 300 to 400 meters above sea level.

Annual rainfall: 1900-2000 mm

Distribution of rainfall: June to Nov. 1444 mm
Dec. to May 444 mm

Minimum and maximum

temperatures: Mean maximum 31.3°C

Mean minimum 23.4°C

1.28

Country name: Thailand

Village name: Non Si Sawat, Kalasin

Population:

Total: 396
Male: 200 Female: 196

No. of households:

Area of the village (ha): 265

Land Use Pattern (ha):

Land under forest	35
Total Agri. land	210
Irrigated land	0
Culturable wasteland	0
Land not available for cultivation	0
Pasture land	0
Homestead	10
Other (Roads, waterway, fishpond, temple area)	10

Crops grown: Rice, cassava, maize, sugarcane

Soil type: Combination of sandy and sandy loam

Topography: Combination of plains and rolling plains

Annual rainfall: 1050

Distribution of rainfall: >90% April to October

Minimum and maximum

temperature: max. 40°C in April
min. 10° December

1.29

Country name: Thailand

Village name: Ban Kam Kham, Kalasin

Population:

Total: 1235

Male: 620 Female: 615

No. of households:

Area of the village (ha): 640

Land Use Pattern (ha):

Land under forest	74
Total Agri. land	450
Irrigated land	0
Culturable wasteland	8
Land not available for cultivation	0
Pasture land	0
Homestead	48
Other (Roads, waterway, fishpond, temple area)	30

Crops grown: Rice, cassava, maize, sugarcane

Soil type: Combination of sandy and sandy loam

Topography: Combination of plains and rolling plains

Annual rainfall: 1050

Distribution of rainfall: >90% April to October

Minimum and maximum

temperatures: max. 40°C in April
min. 10°C December

1.30

Country name: Thailand

Village name: K.M. 7, Ladkrating, Sanamchaikhet, Chachoengsao

Population:

Total: 1200
Male: 641 Female: 559

No. of households: 278

Area of the village (ha): 3097.12

Land Use Pattern (ha):

Land under forests	0
Total agricultural land	2,887.52
Irrigated land	0
Culturable wasteland	0
Land not available for cultivation	20.8 (reservoir)
Pasture land	0

Crops grown: Rice, cassava, rubber, pineapples, cashew nuts

Soil type: Loamy-clay, clay

Topography: Flat, rolling plains

Annual rainfall: 1240 mm

Distribution of rainfall: Feb. to Apr. 170 mm
May to Oct. 1070 mm

Minimum and maximum temperatures:

max. 28.29°C
min. 25.08°C

1.31

Country name: Thailand

Village name: Nongyang, Kuyaymee, Sanamchaikhet, Chachoengsao

Population:

Total:	3684	
Male:	1906	Female: 1778

No. of households: 650

Area of the village (ha): 2660.8

Land Use Pattern (ha):

Land under forests	0
Total agricultural land	2,436
Irrigated land	0
Culturable wasteland	0.8
Land not available for cultivation	0
Pasture land	0

Crops grown: Paddy, cassava

Soil type: Sandy-clay, lateritic

Topography: Flat

Annual rainfall: 755 mm

Distribution of rainfall: May to Oct.

Minimum and maximum

temperatures: max. 29.8°C
min. 25.66°C

1.31

Country name: Thailand

Village name: Nongyang, Kuyaymee, Sanamchaikhet, Chachoengsao

Population:

Total:	3684	
Male:	1906	Female: 1778

No. of households: 650

Area of the village (ha): 2660.8

Land Use Pattern (ha):

Land under forests	0
Total agricultural land	2,436
Irrigated land	0
Culturable wasteland	0.8
Land not available for cultivation	0
Pasture land	0

Crops grown: Paddy, cassava

Soil type: Sandy-clay, lateritic

Topography: Flat

Annual rainfall: 755 mm

Distribution of rainfall: May to Oct.

Minimum and maximum

temperatures: max. 29.8°C
min. 25.66°C

Appendix 2. Ideotype specifications for MPTS.

2.1 Ideotype specification for *Artocarpus heterophyllus* for small farms in northwestern Bangladesh.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, timber, fodder and fuelwood.

General selection criteria: Vigor, fruit production, pest and disease free.

Ancillary information:

Known: Not resistant to severe drought or flooding, pruning is possible, grows slowly with short stem.

Required: Growth habits.

IDEOTYPE DESCRIPTION

Crown: Round, high on the stem with several large branches.

Stem: Straight single stem.

Root: Strong taproot with few lateral roots.

Response to management: Regrowth after branch pruning, shade tolerant.

Deciduousness: Short period of leaflessness.

DISCUSSION

Fruit and timber are the highest priorities, followed by fodder. Vigorous growth would satisfy these requirements.

2.2 Ideotype specification for *Swietenia mahagani* for small farms in northwestern Bangladesh.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Timber, fodder.

General selection criteria: Vigor, pest and disease free.

Ancillary information:

Known: Tolerates flooding and drought, grows straight, pruning possible.
Required: Fodder value.

IDEOTYPE DESCRIPTION

Crown: Light with a few branches at the top, very high up.

Stem: Long, straight cylindrical bole.

Root: Strong, deep taproot.

Response to management: Not specified.

Deciduousness: Prefer evergreen type.

DISCUSSION

For timber scarce Bangladesh, this is considered a favorite species for its high quality wood. Its slow growth and long rotation are discouraging to small farmers.

2.3 Ideotype specification for *Mangifera indica* for small farms in northwestern Bangladesh.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruits, fuel, fodder and timber.

General selection criteria: Vigor, high productivity, pest and disease free.

Ancillary information:

Known: Tolerates drought but cannot tolerate flooding. Strong northwesterly winds in April and thunderstorms damage fruits. Fog in February reduces productivity.

Required: Resistance to storm and fog damage, increased productivity, stronger growth.

IDEOTYPE DESCRIPTION

Crown: Round and high on the stem with many large branches.

Stem: Straight single stem.

Root: Strong taproot with few lateral roots.

Response to management: Regrowth after branch pruning, shade tolerant, positive response to fertilizer application.

Deciduousness: Short period of leaflessness in the winter.

DISCUSSION

Since high quality fruit is the first priority, fruit bearing capacity is the most important concern. Strong, straight stem bole could provide much needed timber and will become a top priority MPTS.

2.4 Ideotype specification for *Azadirachta indica* for small farms in Tamil Nadu and Maharashtra, India.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Timber for construction of houses and agricultural implements, woody branches for fuelwood and agricultural implements, leaves for green manure and fodder, fruit for extraction of oil for medicinal purposes, shade for cattle.

General selection criteria: Vigor and volume production.

Ancillary information:

Known: Found on wastelands, dry lands owned by farmers, homesteads and field margins. Regenerates naturally, withstands drought conditions. Lopping and pruning is possible. Resistant to pests and diseases.

Required: Possibility of use as insect repellent.

IDEOTYPE DESCRIPTION

Crown: Large but not too spreading, with many branches positioned high on stem. Dense foliage.

Stem: Straight and thick with no branches up to a height of 5 m. Long bole is very important.

Roots: Deep taproot with few lateral roots.

Response to management: Prolific regrowth after lopping for mulch.

Fruit: Big seeds for greater production of oil and prolific fruiting.

Deciduousness: Evergreen.

DISCUSSION

With timber, fuelwood and leaves as major priorities, a long, clear straight bole with heavy branching are important characteristics for selection criteria.

2.5 Ideotype specification for *Acacia nilotica* var. *indica* for small farms in Tamil Nadu and Maharashtra, India.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Wood and woody branches for fuelwood, wood for timber and construction purposes, agricultural implements and bullock carts, leaves and pods as forage for goats and sheep, gum.

General selection criteria: Vigor, wood and biomass production, resistance and insects.

Ancillary information:

Known: Found on wastelands, dry lands owned by farmers, homesteads and field margins. Regenerates naturally, withstands drought conditions, pollarding is possible.

Required: Fodder quality.

IDEOTYPE DESCRIPTION

Crown: No particular shape, but with many branches high on the stem.

Stem: Single or multiple stems acceptable. A long straight bole is important.

Roots: Geotropic

Response to management: Not specified

Deciduousness: Prefer evergreen

DISCUSSION

Selection criteria must be for biomass production.

2.6 Ideotype specification for *Delonix elata* for small farms in Tamil Nadu, India.

DESIGN SPECIFICATION

Products and service required: (given in order of importance): Leaves for mulch and fodder, wood and woody branches for fuelwood and in the construction of wells.

General selection criteria: Vigor, leaf biomass, pest and disease free.

Ancillary information:

Known: A leguminous tree grown on field bunds, boundaries and homesteads. The leaves are very good mulch for use in paddy fields. Wood does not dry quickly and produces much smoke when burned. Trees are pollarded at a height of about 2 m and green leaves are incorporated into the soil. Branches are used as fuelwood.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Lots of branches with dense foliage and bigger leaves.

Stem: Single stem with no branches up to 5 m.

Foliage characteristics: Larger sized leaves.

Response to management: Rapid, profuse regrowth after pollarding.

Deciduousness: Prefer evergreen

DISCUSSION

Selection criteria must be for leaf biomass with a long clear bole and good pollarding characteristics.

2.7 Ideotype specification for *Thespesia populnea* for small farms in Tamil Nadu and Maharashtra, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Wood and woody branches for fuelwood, construction of houses and yokes for bullocks, leaves as mulch and fodder, roots and bark for fuelwood.

General selection criteria: Vigor, wood and leaf biomass, pest and disease free.

Ancillary information:

Known: Grown from cuttings and planted on farm bunds and boundaries, homesteads and dry lands not used for agricultural purposes. Growth rate of the tree is enhanced by regular pollarding. It is often susceptible to disease when pollarded, leaving the wood hollow and weak. Leaves are lopped and applied as green manure for the paddy crop. Some shoots are allowed to grow as straight poles and harvested in about 2-3 years.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Large, with many branches and dense foliage.

Stem: Single stem with no branches up to a height of 5 m.

Root: Geotropic.

Response to management: Prolific regrowth on pollarding.

Deciduousness: Prefer evergreen

DISCUSSION

Selection criteria must be for vigor, wood and leaf biomass, and stem resistance to disease on pollarding.

2.8 Ideotype specification for *Prosopis juliflora* for small farms in Tamil Nadu and Maharashtra, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Wood, woody branches and roots for fuelwood, wood for charcoal, pods for forage, wood for agricultural implements, thorny branches as fences.

General selection criteria: Vigor, wood biomass, pest and disease free.

Ancillary information:

Known: Grows in semi-arid conditions in various types of soils. Coppices profusely.
Rapid germination from seeds dispersed by goats eating the pods.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Medium to large with many branches.

Stem: Single or multiple stems with many branches.

Root: Prefer big, shallow or lateral roots.

Fruit: Many pods, big and fleshy.

Other: Fewer, non-poisonous or no thorns at all.

Response to management: Not specified.

Deciduousness: Not specified.

DISCUSSION

Selection criteria should focus on wood biomass and increasing pod production. A minor point in the selection is the reduction in the number of thorns.

2.9 Ideotype specification for *Albizia lebbeck* for small farms in Tamil Nadu, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Wood for agricultural implements and furniture, leaves for mulch and fodder, woody branches for fuelwood.

General selection criteria: Vigor, wood and leaf biomass, pest and insect free.

Ancillary information:

Known: Wood is valuable but not for house construction. Leaves used as fodder only in the summer months. Pollarding and coppicing possible.
Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Large, with only 4-5 major branches high on the stem, dense foliage.

Stem: Single stem, as long as possible, without any branches low on the stem.

Roots: Deeply rooted to withstand high winds.

Response to management: Rapid regeneration of leaves after pollarding for mulch and fodder.

Deciduousness: Short period of leaflessness (it is presently about 30 days).

DISCUSSION

Selection criteria should be focused on wood and leaf biomass by increasing crown volume and branches, and improving stem form.

2.10 Ideotype specification for *Ailanthus excelsa* for small farms in Tamil Nadu, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Wood and woody branches for house construction, leaves for mulch and fodder, wood for fuelwood and toy making.

General selection criteria: Vigor, wood and leaf biomass, resistance to insects and pests.

Ancillary information:

Known: Pollarding and coppicing possible.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Large, with many branches high on the stem. Each branch should be quite thick. Dense foliage.

Stem: Straight, clear bole of 4-5 m.

Foliage characteristics: Leaves should be bigger and thinner to be more useful as mulch.

Response to management: Rapid regeneration after pollarding.

Deciduousness: Prefer evergreen.

DISCUSSION

Selection criteria must be on increase in wood and leaf biomass through increase in crown volume and branches. Improvement in stem form and leaf size is also desired.

2.11 Ideotype specification for *Albizia amara* for small farms in Tamil Nadu, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Wood and woody branches for doors, windows and firewood, leaves for fodder.

General selection criteria: Vigor, woody biomass, insect and pest resistance.

Ancillary information:

Known: Fast growing tree, adapted to poor soils. Leaves are used occasionally as buffalo feed.

Required: Fodder quality.

IDEOTYPE DESCRIPTIONS

Stem: Single or multiple stems.

Foliage characteristics: Leaves should be larger so they can be used as mulch.

Roots: Deep rooting.

Response to management: Not specified.

Deciduousness: Prefer evergreen.

DISCUSSION

Select for wood production with branches and leaves as second priorities.

2.12 Ideotype specification for *Borassus flabellifer* for small farms in Tamil Nadu, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Stem for house construction and fuel, leaves for thatching roofs and weaving baskets, sap for alcohol, fruit.

General selection criteria: Rapid growth, straightness, early fruit set.

Ancillary information:

Known: Found scattered on farms, it is extensively used for house construction. It is raised from seed and is a very slow growing species.

Required: Natural and artificial regeneration.

IDEOTYPE DESCRIPTION

Crown: No modifications.

Stem: Straight, long cylindrical bole with good wood properties.

Roots: Geotropic.

Response to management: Not specified

Deciduousness: No modification.

DISCUSSION

Selection criteria to be focused on fast growth, stem form and early fruit set.

2.13 Ideotype specification for *Tamarindus indica* for small farms in Tamil Nadu and Maharashtra, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Pods for edible pulp, wood for fuelwood, timber and charcoal, leaves for fodder, seed for extraction of starch for textile and paper production.

General selection criteria: Vigor, fruit quality, early fruit set, resistance to pests and insects.

Ancillary information:

Known: Not specified.

Required: Fodder value of leaf.

IDEOTYPE DESCRIPTION

Crown: Round, large canopy with many branches. Fruit set is on the branches, so to enhance the production of fruit, there should be many branches.

Stem: Large, with no branches up to a height of 2-3 m.

Fruit: Production should begin in the fourth or fifth year. There should be a greater yield of fruit with a good yield every year instead of the current cyclical pattern in yield. The fruiting season could be longer. The fruit itself should be bigger and fleshier.

Response to management: Not specified.

Deciduousness: No modification.

DISCUSSION

Selection criteria must be for fruit yield and size of pods.

2.14 Ideotype specification for *Mangifera indica* for small farms in Tamil Nadu, Sukhomajri and Maharashtra, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Fruit, wood for timber and fuelwood, leaves as fodder.

General selection criteria: Vigor, fruit quality and early fruit set, resistance to insects and pests.

Ancillary information:

Known: Well known species with wide range of distribution and arrays of varieties to select for.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Large canopy with many branches, not very high on the stem.

Stem: Straight, with no low branches (to be used as timber after the tree no longer bears fruits).

Fruit: The tree should yield fruit in the fourth or fifth year on a yearly basis. Fruits should be large and fleshy.

Response to management: Not specified.

Deciduousness: Not specified.

DISCUSSION

Major priorities in the selection criteria are fruit quality and yield.

2.15 Ideotype specification for *Acacia leucophloea* for small farms in Tamil Nadu, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Wood for timber, agricultural implements and house construction, pods for fodder, bark in the making of alcohol.

General selection criteria: Vigor, volume production of wood, resistance to pests and insects.

Ancillary information:

Known: Found on common lands, wastelands and scattered on farmland. There is profuse germination of seeds in the monsoon season. The seeds are dispersed by livestock after they eat the pods. The pods provide a high protein supplement to fodder in the dry season.

Required: Fodder value.

IDEOTYPE DESCRIPTION:

Crown: Large, with many branches high on the stem.

Stem: Long, clear bole with no branches up to a height of 6-8 m.

Root: Not specified.

Response to management: Not specified.

Deciduousness: No modification.

Other: Less thorns.

DISCUSSION

The major priorities for selection criteria are stem characteristics and volume production of wood.

2.16 Ideotype specification for *Cocos nucifera* for small farms in Tamil Nadu, India.

DESIGN SPECIFICATION

Product and service requirements (given in order of importance): Fruit, wood for house construction, leaves for thatching and weaving, other minor products.

General selection criteria: Vigor, fruit yield.

Ancillary information:

Known: Well known species with wide range of distribution and many varieties and forms.

Required: Not specified.

IDEOTYPE DESCRIPTION:

Crown: No modification.

Stem: Tall and strong.

Fruit: Fruit set should be earlier than it is now and produce large quantities of coconuts.

Roots: Geotropic.

Response to management: Not specified.

Deciduousness:

DISCUSSION

Early fruit set and yield are major considerations for selection.

2.17 Ideotype specification for *Pithecellobium dulce* for small farms in Tamil Nadu, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Fruit, leaves for fodder and mulch, wood and woody branches for fuelwood.

General selection criteria: Vigor, adaptability to poor soils, fruit production and resistance to insects and pests.

Ancillary information:

Known: Tolerates drought and grows on a variety of soils.

Required: Not specified.

IDEOTYPE DESCRIPTION:

Crown: Large with many branches.

Stem: Multiple or single stem(s) of medium height before branching.

Fruit: Big pods, sweet in taste.

Roots: Deep roots.

Response to management: Rapid, profuse regrowth on lopping.

Deciduousness: Not specified.

DISCUSSION

Selection criteria should focus on fruit production and taste, with heavy branching.

2.18 Ideotype specification for *Acacia nilotica* var. *cupressiformis* for small farms in Maharashtra, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Wood and woody branches for agricultural implements, timber, house construction and fuelwood, leaves for fodder.

General selection criteria: Tall narrow canopy, vigor, resistance to insects and pests.

Ancillary information:

Known: Grows erect, ideally suited for areas with annual rainfall in the range 300-500 mm. Less thorny than *Acacia nilotica* var. *indica*.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Narrow with branches growing almost parallel to the main stem.

Stem: Long bole with no branches low on the stem.

Roots: Geotropic.

Response to management: Not specified.

Deciduousness: No modifications.

DISCUSSION

Canopy shape and stem form should be a selection criteria in addition to vigor and resistance to insects and pests.

2.19 Ideotype specification for *Leucaena leucocephala* for small farms in Maharashtra, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Leaves, green branches and green pods as fodder, wood for fuelwood.

General selection criteria: Vigor, resistance to pests and insects, good burning quality, reduced flowering and pod set.

Ancillary information:

Known: Fast growing, drought tolerant, grows well at altitudes up to 2800 m, prefers moist, deep soils that are well drained and will grow on slightly acidic soils. Coppices well.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Moderate to large crown with many branches.

Stem: Single or multiple stem(s) with branches.

Foliage: Dense with bigger leaves.

Fruit: Reduced flowering and pod set.

Response to management: Rapid, profuse regrowth on lopping.

Deciduousness: No modifications.

DISCUSSION

Selection criteria should be for less flowering and pods. Stem form and branch characteristics are also priorities. Should be more tolerant of alkaline soils.

2.20 Ideotype specification for *Sesbania sesban* for small farms in Maharashtra, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Leaves for fodder, wood as a temporary construction material, wood and woody branches as fuelwood.

General selection criteria: Vigor, good burning quality, resistance to pests and diseases.

Ancillary information:

Known: Fast growing, drought tolerant and grows on a variety of soils. Short lived when lopped regularly for fodder.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Narrow crown to avoid shading agricultural crops, but dense foliage.

Stem: Single or multiple stems with no branches low on the stem(s).

Response to management: Good regrowth of foliage after lopping for fodder and sustained vigor.

Other: Improved burning quality of wood.

Deciduousness: Short period of leaflessness.

DISCUSSION

Selection criteria must be for vigor and improved wood quality.

2.21 Ideotype specification for *Melia azadirach* for small farms in Maharashtra, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Wood for agricultural implements, bullock carts and house construction, woody branches for fuelwood, leaves as fodder for sheep and goats.

General selection criteria: Vigor, resistance to pests and diseases.

Ancillary information:

Known: Drought tolerant, grows on a variety of soils but prefers deep, moist soils.
Fast growing, achieving good diameter at breast height after 3-4 years.

Required: Not specified.

IDEOTYPE DESCRIPTIONS

Crown: Medium sized canopy with a few branches high on the stem.

Stem: Single straight stem, with no branches up to a height of 5 m.

Roots: Deep rooting.

Response to management: Pruning of side branches should not affect vigor of the tree.

DISCUSSION

Breeding objectives should be for vigor and stem form.

2.22 Ideotype specification for *Zizyphus mauritiana* for small farms in Maharashtra, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Fruit, wood and woody branches for fuelwood, leaves as fodder for sheep, green and woody branches for fencing material for sheep and goat pens.

General selection criteria: Vigor, resistance to insects and pests, fruit quality and yield.

Ancillary information:

Known: Grows in areas with annual rainfall as low as 200 mm, in soils that are low in organic matter and have little water-holding capacity. It has high regenerative powers and is extensively used as a multipurpose species in arid areas.

Required: Not specified.

IDEOTYPE DESCRIPTION:

Crown: Large, with many branches.

Stem: Multiple stems with many branches.

Fruit: Fruit must be large, fleshy, sweet and red/green in color. They should be less susceptible to insects and keep for a longer period than the average fruit now.

Other: Fewer or no thorns.

Response to management: Good regeneration of branches and little or no reduction in fruit yield when branches are lopped for fuelwood or for use as fencing material.

DISCUSSION

Vigor, quality and yield of fruit, and regenerative abilities are the major selection criteria.

2.23 Ideotype specification for *Syzygium cumini* for small farms in Maharashtra and Sukhomajri, India

DESIGN SPECIFICATION

Product and service required (given in order of importance): Fruit, wood and woody branches for fuelwood, wood for timber, house construction.

General selection criteria: Vigor and fruit quality.

Ancillary information:

Known: Found mostly on wastelands and common lands.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Moderate to large canopy with many branches.

Stem: Single or multiple with branches moderately high on the stem(s).

Fruit: Large and sweet. Fruit set should start earlier than it does now on the average tree.

Response to management: None specified.

DISCUSSION

Selection criteria must be for fruit size and taste. Improved quality of wood is an additional factor.

2.24 Ideotype specification for *Morus serrata* for small farms in Sukhomajri, India

DESIGN SPECIFICATION

Product and service required (given in order of importance): Wood and woody branches for fuelwood, fruit, green branches for weaving baskets.

General selection criteria: Vigor and stem form.

Ancillary information:

Known: Moderate to large tree found in mixed lower western Himalayan forest from 1,200 - 2,700 m. Tree has multiple uses. Coppices well. Found on commonlands, wastelands and in natural forests. Also grown as a plantation crop in areas where sericulture is practiced.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Moderate size with many branches.

Stem: Single or multiple with branches moderately high on the stem(s).

Fruit: Large and sweet. Fruit set should start earlier than it does now on the average tree.

Response to management: Rapid regrowth after being lopped for fuelwood and fodder.

DISCUSSION

Selection criteria should be for stem form.

2.25 Ideotype specification for *Carissa spinarum* for small farms in Sukhomajri, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): Wood and woody branches for fuelwood, wood for handles, combs and other household articles, fruit.

General selection criteria: Vigor, stem form and increased woody biomass.

Ancillary information:

Known: The spiny bushes of this hardy species can be found growing in the forests and wastelands of the sub-Himalayan region. It grows on poor soils. Although it has many medicinal uses and its fruit is edible and rich in protein it is primarily used as fuelwood.

Required: Not specified.

IDEOTYPE DESCRIPTION

None given.

DISCUSSION

This species is underutilized because its potential is not recognized. Selection criteria must be for increased woody biomass.

2.26 Ideotype specification for *Prosopis spicigera* for small farms in Sukhomajri, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): As vegetative barriers against soil erosion, wood for fuelwood, wood for making agricultural implements, leaves for fodder.

General selection criteria: Vigor and stem form.

Ancillary information:

Known: A thorny tree, it grows 5-9 m high and has an open crown. Because of its deep taproot, it does not compete with annuals, which may be grown close to its stem. Its wood is preferred for cooking and its fodder value is high.

Required: Not specified.

IDEOTYPE DESCRIPTION

None given.

DISCUSSION

Selection criteria must be for vigor.

2.27 Ideotype specification for *Dalbergia sissoo* for small farms in Sukhomajri, India.

DESIGN SPECIFICATION

Product and service required (given in order of importance): As a vegetative barrier against soil erosion, wood for furniture, agricultural implements, cart wheels, wood for house construction, wood and woody branches for fuelwood.

General selection criteria: Vigor and increased woody biomass.

Ancillary information:

Known: Large, moderately fast growing tree that occurs throughout the Indian subcontinent. It is grown on irrigated plantations and as scattered tree on farmers' fields. Strong development of root suckers and runners make the species popular as a living barrier against soil erosion.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Large, with many branches high on the stem.

Stem: Single, straight bole with no branches low on the stem, little taper.

Roots: Deep with little lateral spread.

DISCUSSION

Selection criteria must be for vigor and stem form.

2.28 Ideotype specification for *Prunus cerasoides* for small farms in Ugrachandi Village Panchayat of Kavre district, Nepal.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Leaves and green branches for fodder, woody branches for fuelwood, and wood for timber, making pegs, supports, etc.

General selection criteria: Vigor, leaf and branch biomass, free from pests and diseases.

Ancillary information:

Known: Also planted as avenue trees, colorful flowers in winter.

Required: Growth habit including viability and method of propagation.

IDEOTYPE DESCRIPTION

Crown: Narrow, with many branches high on the stem.

Stem: Single, straight bole with no major branches low on the stem.

Root: Not specified.

Response to management: Rapid, profuse regeneration of leaves and branches after lopping.

Deciduousness: Prefer evergreen.

DISCUSSION

Planted on field margins in addition to privately owned forest land and in natural forests. Shading of the annuals is a major drawback when planted on fields. Tender leaves and buds are sometime harmful to "loaded" females.

2.29 Ideotype specification for *Alnus nepalensis* for small farms in Ugrachandi Village Panchayat of Kavre district, Nepal.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Woody branches for fuelwood, wood for timber for house construction.

General selection criteria: Vigor, wood properties, disease and insect free.

Ancillary information:

Known: Fast growing tree, grows well in wet gullies as well as on eroded areas.
Sandy loams are favorable.

Required: Wood properties.

IDEOTYPE DESCRIPTION

Crown: Narrow, with branches high on the stem.

Stem: Single, straight bole.

Root: Geotropic.

Response to management: Rapid branching after lopping.

Deciduousness: Evergreen.

DISCUSSION

Planted on field boundaries. Grows in gullies, on eroded sites, and on privately owned farmland. Good for erosion control. Grows by direct seeding, as well planting seedlings. It is also found in natural forests in pure patches.

2.30 Ideotype specification for *Betula alnoides* for small farms in Ugrachandi Village Panchayat of Kavre district, Nepal.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Wood for timber, green branches and leaves for fodder, woody branches for fuelwood.

General selection criteria: Vigor, branch and leaf biomass, pest and disease free.

Ancillary information:

Known: Wood quality is not good, warps and cracks on exposure.

Required: Growth habits.

IDEOTYPE DESCRIPTION

Crown: Narrow crown with many branches high on the stem.

Stem: Single, straight bole.

Root: Geotropic.

Response to management: Rapid branching after lopping.

Deciduousness: Evergreen.

DISCUSSION

Selection criteria to be focused on wood properties, wood, branch and leaf biomass.

2.31 Ideotype specification for *Schima wallichii* for small farms in Ugrachandi Village Panchayat of Kavre district, Nepal.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Woody branches for fuelwood, wood as timber and construction material and for making agricultural implements.

General selection criteria: Vigor, wood properties, pest and disease free.

Ancillary information:

Known: Bark causes itching.

Required: Artificial and natural regeneration and growth habits.

IDEOTYPE DESCRIPTION

Crown: Narrow to medium sized canopy with many branches high on the stem.

Stem: Single, straight bole.

Root: Geotropic.

Response to management: Rapid branching after lopping.

Deciduousness: Evergreen.

DISCUSSION

Improvement to be focused on rapid growth, coppicing and spouting ability, with particular emphasis on improvement of stem and crown forms.

2.32 Ideotype specification for *Castanopsis indica* for small farms in Lekhnath and Rakhi Villages, Kaski, Nepal.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Food, fodder, fuelwood and timber.

General selection criteria: Vigor, well adapted to local climate, good natural regeneration.

Ancillary information:

Known: Lopping and pruning possible. Tall plant, good fuelwood and timber, leaves as fodder for goats. Grows well naturally or on plantations in hilly areas, good for soil conservation.

Required: Mechanical and strength properties.

IDEOTYPE DESCRIPTION

Crown: Narrow, small branches at the top.

Stem: Round, single straight bole.

Root: Deep taproot system with lateral rooting.

Response to management: Profuse branching after lopping.

Deciduousness: Short period of deciduousness in dry season.

DISCUSSION

Selection criteria are fruit, leaf, and branch production with consideration of stem and root improvement.

2.33 Ideotype specification for *Ficus glaberrima* for small farms in Rakhi and Lekhnath Villages, Kaski, Nepal.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Leaves for fodder, wood for fuelwood and timber, woody branches for fuelwood, bark for making ropes.

General selection criteria: Vigor, leaf and branch production, pest and disease free.

Ancillary information:

Known: This species is widely grown in village areas, normally with a crooked stem and many branches.

Required: Wood properties.

IDEOTYPE DESCRIPTION

Crown: Round, medium size with many branches.

Stem: Round, straight stem.

Root: Deep taproot with lateral branching.

Response to management: Good natural pruning of branches.

Deciduousness: Prefer evergreen type.

DISCUSSION

Improvement of this species follows the general selection criteria for stem and wood properties.

2.34 Ideotype specification for *Schima wallichii* for small farms in Lekhnath and Rakhi Villages, Kaski, Nepal.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Woody branches and stem are for fuelwood, leaves for cattle bedding.

General selection criteria: Vigor, wood and leaf biomass.

Ancillary information:

Known: Important species for the area, grows and adapts well on hill slopes.
Lopping and pruning possible. Minimum pest and disease disturbance.
Required: Wood properties.

IDEOTYPE DESCRIPTION

Crown: Oval shape with many branches and leaves.

Stem: Round, straight long bole.

Root: Deep taproot with lateral rooting.

Response to management: Profuse sprouting after lopping.

Deciduousness: Evergreen.

DISCUSSION

In addition to the products and services given above, this species is good for erosion control.

2.35 Ideotype specification for *Artocarpus heterophyllus* for small farms in Bambarabedda and Madugalla, Sri Lanka.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, branches for fuelwood, bole for timber.

General selection criteria: Fruit and wood biomass production, vigor, straight grain, pest and disease free.

Ancillary information:

Known: Tolerates poor soil, regenerates naturally, seeds also sown. Planted generally in homegardens or as hedges and fences.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Medium, with branches high on the stem.

Stem: Single, long, straight stem with few major branches high on the stem.

Root: Prefer strong taproot with few lateral roots. For planting on sloping sites, strong taproot with profuse lateral roots are required to withstand wind, bind soil and improve infiltration.

Response to management: Branches lopped for use as fuelwood should not affect yield of fruit.

Deciduousness: No improvement needed.

DISCUSSION

With fruit as the major priority, selection criteria should follow traditional fruit tree improvement with consideration of fuelwood and timber characteristics.

2.36 Ideotype specification for *Mangifera indica* for small farms in Bambarabedda and Madugalla, Sri Lanka.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, branches for fuelwood, bole for timber.

General selection criteria: Fruit and wood biomass production, vigor, straight grain, pest and disease free.

Ancillary information:

Known: Well known species grown in orchards, homegardens, field margins and intercropped with annuals. Wide range of natural distribution of various varieties.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Narrow to medium canopy.

Stem: Single, straight stem with branches high on the stem.

Root: Strong, deep taproot with few lateral roots.

Response to management: No improvement needed.

Deciduousness: No improvement needed.

DISCUSSION

With fruit as the major priority, selection criteria should follow traditional fruit tree improvement with consideration of fuelwood and timber characteristics.

2.37 Ideotype specification for *Gliricidia sepium* for small farms in Bambarabedda and Madugalla, Sri Lanka.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Support for pepper vines, poles for construction, green manure, fodder, fuelwood, soil erosion control, food.

General selection criteria: Vigor, pest and disease free.

Ancillary information:

Known: NFT, tolerates poor soil fertility, dry season, and shade. Easy vegetative production, lopping and pruning possible.

Required: Fodder value of leaves and flowers.

IDEOTYPE DESCRIPTION

Crown: Narrow to medium with branches high on the stem.

Stem: Single, straight long bole.

Root: Deep, strong taproot.

Response to management: Prolific regrowth after pollarding and individual branch pruning. Reliable coppicing response.

Deciduousness: Short period of dry season leaflessness.

DISCUSSION

With support, poles and green manure as the major priorities, a strong, single straight stem is most important.

2.38 Ideotype specification for *Maduca longifolia* for small farms in Madugalla, Sri Lanka.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruits, branches for fuelwood and bole for timber.

General selection criteria: Fruit and wood biomass production, vigor, straight grain, pest and disease free.

Ancillary information:

Known: Regenerates naturally, tolerates shallow infertile soils.

Required: Vegetative propagation, fuel and wood properties.

IDEOTYPE DESCRIPTION

Crown: Large with many branches for planting on common land, but narrow and dense canopy for farm and home planting.

Stem: Single or multiple, but with a long straight bole with branches high on the stem.

Root: Deep, strong taproot to withstand wind.

Response to management: No improvement needed.

Deciduousness: No improvement needed.

DISCUSSION

Selection criteria should focus on fruit improvement with consideration of fuelwood and timber production.

2.39 Ideotype specification for *Artocarpus altilis* for small farms in Bambarabedda and Madugalla, Sri Lanka.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, bole for timber and branches for fuelwood.

General selection criteria: Fruit and timber are important. Straight grain, pest and disease free.

Ancillary information:

Known: Tolerates poor soil, but deep soil is needed, planted in homegardens and on common land. Propagates from exposed lateral roots.

Required: Possibility of improving fruit size and quality.

IDEOTYPE DESCRIPTION

Crown: Broad, with branches high on the stem.

Stem: Single, long straight bole with a few major branches high on the stem.

Root: Prefer strong taproot to withstand the wind.

Response to management: Not specified.

Deciduousness: No improvement needed.

DISCUSSION

Selection criteria should focus on fruit improvement and the possibility of broadening the canopy and early fruiting.

2.40 Ideotype specification for *Psidium guajava* for small farms in Bambarabedda and Madugalla, Sri Lanka.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, branches for fuelwood, stem for tool handles and fuelwood.

General selection criteria: Fruit and wood biomass.

Ancillary information:

Known: Well known species grown in orchards, homegardens, as fences, on common lands and in forests. Wide range of varieties are known, tolerates poor and dry soils.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Narrow, low canopy.

Stem: Multiple branching from the lower level of the stem.

Root: Strong deep taproot with few lateral roots.

Response to management: Natural branch pruning.

Deciduousness: No improvement needed.

DISCUSSION

With fruit as a major priority, selection criteria should follow traditional fruit tree improvements. Genetic improvements of the fruits, ie. large size, more flesh and sweetness could be taken into consideration in promoting the quality.

2.41 Ideotype specification for *Tamarindus indica* for small farms in Bambarabedda and M. dugalla, Sri Lanka.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, branches for fuelwood, bole for timber.

General selection criteria: Fruit and wood biomass production, vigor, pest and disease free.

Ancillary information:

Known: Tolerates poor soil, low water consumption, regenerates naturally.
Maintained on common lands, in homegardens and along roadsides.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Medium, with branches high on the stem.

Stem: Straight stem with multiple branches high on the stem.

Root: Prefer strong taproot with few lateral roots.

Response to management: Not specified.

Deciduousness: No improvement needed.

DISCUSSION

With fruit as the major priority, selection criteria should follow traditional fruit tree improvements with consideration of fuelwood and timber characteristics.

2.42 Ideotype specification for *Persea gratissima* for small farms in Madugalla, Sri Lanka.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, branches for fuelwood.

General selection criteria: Fruit and wood biomass.

Ancillary information:

Known: Generally planted in homegardens, tolerates poor soil.
Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Medium, with branches low on the stem, low canopy.

Stem: Straight, single, short with branching low on the stem.

Root: Deep taproot with a few lateral roots.

Response to management: Not specified.

Deciduousness: No improvement needed.

DISCUSSION

With fruit as the major priority, better quality fruit production, ie. taste and size of the fruits must be aimed for.

2.43 Ideotype specification for *Paraserianthes falcataria* for small farms in the eastern part of West Java, Indonesia.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Wood for timber, branches and wood for fuelwood, leaves for fodder.

General selection criteria: Vigor, pest and disease free.

Ancillary information:

Known: Naturally regenerating seedlings are planted in mixed tree gardens and homegardens. Fast growing timber used for light construction. Lopping and pruning possible.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Large, with many branches and dense foliage.

Stem: Single, straight bole with no branches low on the stem.

Root: Deep taproot.

Response to management: Prolific sprouting after lopping. Regenerate quickly and profusely.

Deciduousness: Not specified.

DISCUSSION

With light construction timber, fuelwood and fodder as major priorities, phenotypic selection should concentrate on tree attributes which support this, such as a long, straight, large clear bole with dense branching and foliage.

2.44 Ideotype specification for *Artocarpus heterophyllus* for small farms in the eastern part of West Java, Indonesia.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, wood for timber, leaves as fodder.

General selection criteria: Vigor, fruit production, pest and disease free.

Ancillary information:

Known: Planted in gardens/homegardens and sometimes intercropped with perennials. Shading under other perennials is possible. Widely spaced planting stimulates intensive branching and dense foliage, but short clear bole. Planting with narrow spacing (as in forest stands) produces straight stems and decreased branching.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Medium to large, with many branches and dense foliage.

Stem: Single or multiple stems, with no branches low on the stem.

Root: Deep taproot.

Response to management: Rapid, profuse regeneration of leaves and branches after lopping.

Deciduousness: No modification needed.

DISCUSSION

Selection criteria to be focused on fruit, fuelwood and wood production.

2.45 Ideotype specification for *Maesopsis eminii* for small farms in the eastern part of West Java, Indonesia.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Wood for timber, wood and woody branches as fuelwood and leaves as fodder.

General selection criteria: Vigor, disease and pest free.

Ancillary information:

Known: Fast growing tree with ability to grow on a variety of soils. Regenerates naturally and is lopped regularly for fuelwood and fodder.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Narrow to medium canopy with many branches and dense foliage.

Stem: Straight, single stem with no major branches low on the stem.

Root: Deep taproot.

Response to management: Rapid, profuse regeneration of leaves after lopping.

Deciduousness: Prefer evergreen.

DISCUSSION

Selection criteria should follow products and services required.

2.46 Ideotype specification for *Parkia speciosa* for small farms in the eastern part of West Java, Indonesia.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit and fuelwood.

General selection criteria: Vigor, early fruiting, pest and disease free.

Ancillary information:

Known: NFT, planted in gardens, intercropped with perennials and annuals.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Large crown with many branches and medium to dense foliage.

Stem: Single stem, large straight bole with many branches.

Root: Deep taproot.

Response to management: Not specified.

Deciduousness: Not specified.

DISCUSSION

Selection criteria are for crown volume and stem form.

2.47 Ideotype specification for *Albizia procera* for small farms in the eastern part of West Java, Indonesia.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Wood for timber and fuelwood, leaves for fodder.

General selection criteria: Vigor, pest and disease free.

Ancillary information:

Known: Fast growing tree with relatively good coppicing ability, naturally regenerating well in forest and farm areas.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Medium to large dense canopy with many branches.

Stem: Single, straight, tall stem with no major branches low on the stem.

Root: Not specified.

Response to management: Rapid regeneration after lopping of leaves and branches.

Deciduousness: Not specified.

DISCUSSION

Improvement is needed for stem and crown form for wood and leaf production.

2.48 Ideotype specification for *Achras zapota* for small farms in the eastern part of West Java, Indonesia.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, and wood for making kitchen utensils after decline of fruit production.

General selection criteria: Vigor, fruit production.

Ancillary information:

Known: Grows on well drained and fertile soils. Requires good care.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Large canopy with many branches and dense foliage.

Stem: Short, multiple stems.

Root: Not specified.

Response to management: Adaptability to wide range of soil conditions.

Deciduousness: No modifications needed.

DISCUSSION

Improvement is for fruit production with stem form as the second priority.

2.49 Ideotype specification for *Artocarpus heterophyllus* for small farms in San Isidro, Baybay, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruits for food, stem for timber, woody branches for fuelwood, and leaves for fodder.

General selection criteria: Vigor, fruit production and improved taste, wood quality, disease and pest free.

Ancillary information:

Known: Deeply rooted, straight stem, relatively thick leaves.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Round canopy similar to mango, plenty of branches high on the stem.

Stem: Single, straight bole, with a large diameter for processing into lumber; numerous branches at the end of the bole.

Root: Deep, strong taproot.

Response to management: Requires little or no maintenance, resistant to pests and diseases, thrives in marginal soil, not easily uprooted by typhoons.

Deciduousness: No modification.

Leaves: Improve quality for fodder.

DISCUSSION

Breeding should focus on improvement of fruit production, branching habits and quality of leaves for fodder (thinner and more succulent).

2.50 Ideotype specification for *Leucaena leucocephala* for small farms in San Isidro and San Miguel, Leyte, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Leaves for fodder/fertilizer, woody branches for fuelwood, and stem for poles.

General selection criteria: Vigor, pest and disease free.

Ancillary information:

Known: NFT, deeply rooted compared to *Gliricidia*, low resistance to psyllid infestation, fast growth.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Many branches low on the stem, leaves resistant to psyllid.

Stem: Several branches.

Root: Deeply rooted to serve as effective erosion control.

Response to management: Requires little or no maintenance, resistant to pests and diseases, not easily uprooted by typhoons, and thrives in marginal soil.

Deciduousness: Prefer evergreen.

DISCUSSION

1. Breeding should focus on improvement of rooting habits, nitrogen-fixation capability, and resistance to pests and diseases, especially the psyllid.
2. More branching on the lower stem for use in contour hedgerows and straight, long bole for use in fencing and posts.

2.51 Ideotype specification for *Pterocarpus indicus* for small farms in San Isidro, Baybay, Leyte, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Stem for timber, woody branches for fuelwood, nitrogen fixing.

General selection criteria: Vigor, fire tolerance, straightness, pest and disease free.

Ancillary information:

Known: NFT, high quality timber.

Required: Natural and artificial regeneration.

IDEOTYPE DESCRIPTION

Crown: Round canopy with branches high on the stem.

Stem: Single, straight long clear bole.

Root: Strong taproot.

Response to management: Thrives in marginal soil, requires little maintenance.

Deciduousness: Non-deciduous.

DISCUSSION

Breeding should focus on improvement of rate of growth, stem and crown form as well as rate of nitrogen fixation.

2.52 Ideotype specification for *Vitex parviflora* for small farms in San Miguel, San Isidro, Leyte, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Stem for lumber, woody branches for fuelwood.

General selection criteria: Vigor, quality of timber, branching habits, pest and disease free.

Ancillary information:

Known: Hardwood, thrives on marginal soil, slow growth.

Required: Natural and artificial regeneration and growth habits.

IDEOTYPE DESCRIPTION

Crown: Round, with many branches.

Stem: Single, straight bole, branches high on the stem.

Root: Strong taproot.

Response to management: Thrives in marginal soil, requires little maintenance.

Deciduousness: Non-deciduous.

DISCUSSION

Breeding should focus on improvement of rate of growth and branching habits.

2.53 Ideotype specification for *Persea americana* for small farms in San Miguel, San Isidro, Leyte, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruits for food, stem for poles, woody branches for fuelwood, leaves for medicine.

General selection criteria: Vigor, fruit production, pest and disease free.

Ancillary information:

Known: Can withstand long periods of summer dryness. Rainfall requirement: 750-1000 mm per annum. Tolerates wide ranges of temperatures, from -2 to 40°C. Yields 500-1200 fruits/tree/year.

Required: Chemical properties of leaves.

IDEOTYPE DESCRIPTION

Crown: Large, with many branches high on the stem.

Stem: Single, straight bole, large in diameter for processing into lumber; numerous branches at the end of the bole.

Root: Deep, strong taproot.

Response to management: Requires little or no maintenance, resistant to pests and diseases, thrives in marginal soil, not easily uprooted by typhoons.

Deciduousness: Non-deciduous.

DISCUSSION

Breeding should focus on improvement of fruits, leaves for fodder, branching habit and rate of growth.

2.54 Ideotype specification for *Pinus kesiya* for small farms in Barangay Bila, Bauko, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Timber, lumber, fuelwood, and handicrafts (pine needles).

General selection criteria:

Vigor, fire, disease and pest resistance.

Ancillary information:

Known: Naturally found growing at high altitudes from 800- 2,000 m. Light demanding, can grow on relatively wide range of soil conditions, but not in heavy or poorly drained soils.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: No modification.

Stem: Straight, long clear bole with prolific branching high on the stem.

Root: Geotropic.

Response to management: Not specified.

Deciduousness: Not specified.

DISCUSSION

Selection criteria must be for vigor and stem form with consideration of improving branching habit.

2.55 Ideotype specification for *Leucaena leucocephala* for small farms in Barangay Bila, Bauko, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fuelwood, fence posts, fodder, medicine (raw leaves).

General selection criteria:

Vigor, pest and disease free, good burning quality.

Ancillary information:

Known: NFT, not frost tolerant, thrives at altitudes up to 500 m., drought resistant, grows well in wide range of soils except acid soils.
Required: Yield and fodder value.

IDEOTYPE DESCRIPTION

Crown: No modification.

Stem: Large, cylindrical, straight long bole with many branches.

Root: Geotropic.

Response to management: Prolific regrowth after lopping.

Deciduousness: Short period of dry season leaflessness.

DISCUSSION

Selection criteria must be for stem form and branch characteristics.

2.56 Ideotype specification for *Pterocarpus indicus* for small farms in Barangay Bila, Bauko, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Timber, lumber, and fuelwood.

General selection criteria:
Vigor, pest and disease free.

Ancillary information:

Known: Tree with short bole, wide canopy, grows well in areas up to 700 m and withstands a wide range of temperatures (17° - 35°C). Can tolerate high or low rainfall but grows well in places with a mean annual rainfall of about 2000 mm.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: No modification.

Stem: Long, straight bole with prolific branching high on the stem.

Root: Geotropic.

Response to management: Not specified.

Deciduousness: Not specified.

DISCUSSION

Breeding objectives and selection criteria should be for vigor and improved stem form.

2.57 Ideotype specification for *Eucalyptus camaldulensis* for small farms in Barangay Bila, Bauko, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Lumber, timber, poles, construction materials and leaves for medicine.

General selection criteria:

Vigor, pest and disease free, wood properties.

Ancillary information:

Known: Grown at a wide range of altitudes from sea level to 2000 m. Tolerates temperatures from 10°-40°C. Drought resistant and grows well even in soils with low fertility. Fast growing, fire resistant and coppices well.

Required: Variation in wood properties.

IDEOTYPE DESCRIPTION

Crown: Narrow.

Stem: Straight, long clear bole with light branching and good natural pruning.

Root: Deep taproot.

Response to management: Not specified.

Deciduousness: Not specified.

DISCUSSION

Selection criteria must be for vigor, stem form, light branches and wood properties.

2.58 Ideotype specification for *Pinus kesiya* for small farms in Barangay Guinzadan, Bauko, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Timber, lumber, fuelwood, and handicrafts (pine needles).

General selection criteria:

Vigor, fire, disease and pest resistance.

Ancillary information:

Known: Naturally found growing at high altitudes from 800- 2,000 m. Light demanding, can grow on a relatively wide range of soil conditions, but not in heavy, poorly drained soils.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: No modification.

Stem: Straight, long clear bole with prolific branching high on the stem.

Root: Geotropic.

Response to management: Not specified.

Deciduousness: Not specified.

DISCUSSION

Selection criteria must be for vigor and stem form with consideration of improving branching habit.

2.59 Ideotype specification for *Alnus maritima* for small farms in Barangay Guinzadan, Bauko, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fuelwood, shade, live fence, windbreak, fertilizer (leaves).

General selection criteria:

Vigor, pest and disease free. Adaptability to wide range of environmental conditions.

Ancillary information:

Known: Small sized tree grows well even on poor soils, but prefers moist conditions; light demanding, coppices well. Grows well at high altitudes with temperatures as low as 5°C.

Required: Water intake.

IDEOTYPE DESCRIPTION

Crown: Wide crown.

Stem: Straight, long bole but with many branches.

Root: Geotropic.

Response to management: Not specified.

Deciduousness: Not specified.

DISCUSSION

Selection criteria must be for vigor, increased branching and leaf production.

2.60 Ideotype specification for *Fersea americana* for small farms in Baranga Guinzadan, Bauko, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, fuelwood, medicine (leaves).

General selection criteria:

Vigor, fruit production, pest and disease free.

Ancillary information:

Known: Drought tolerant, grows well at altitudes up to 2,800 m, prefers moist, deep soils, moderately acidic and well drained.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Large dense crown.

Stem: Single or multiple stems are acceptable with profuse branching.

Root: Geotropic.

Response to management: Adaptability to wide range of environmental conditions.

Deciduousness: Not specified.

DISCUSSION

Selection criteria should be focused on fruit production, crown shape and adaptability.

2.61 Ideotype specification for *Psidium guajava* for small farms in Barangay Guinzadan, Bauko, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, fuelwood, farm tool handles, medicine (leaves).

General selection criteria:

Vigor, fruit production, pest and disease free.

Ancillary information:

Known: Small tree of multistems or multibranches, drought tolerant, coppices well.

Required information: Not specified.

IDEOTYPE DESCRIPTION

Crown: Wide crown.

Stem: No modification needed.

Root: Geotropic.

Response to management: Not specified.

Deciduousness: Not specified.

DISCUSSION

Selection criteria should focus on fruit production and taste, with a wide crown and more branches.

2.62 Ideotype specification for *Phoebe sterculioides* for small farms in Oriental Mindoro, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Timber for house construction and handicrafts.

General selection criteria: Vigor, durability and hardness of wood, resistance to ants and termites, thin bark.

Ancillary information:

Known: A medium sized tree, with a diameter 40-50 cm found in dipterocarp forests.

Required: Seed production and vegetative propagation.

IDEOTYPE DESCRIPTION

Crown: Narrow with branches high on the stem.

Stem: Single, straight bole with very few branches. Taller trees are desired.

Root: No modification needed.

Response to management: No modification needed.

Deciduousness: No modification needed.

DISCUSSION

Availability of the tree is a constraint. Planting material is generally obtained from the forest. Selection criteria should follow traditional tree improvement for industry.

2.63 Ideotype specification for *Persea americana* for small farms in Oriental Mindoro, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, wood from roots for household handicrafts and farm tools, leaves and bark for medicinal purposes.

General selection criteria: Vigor, fruit production, pest and disease free.

Ancillary information:

Known: Although it is known to prefer moist, well drained, deep soils, it can withstand up to 4-5 months of dry conditions. Rainfall requirements: 750-1000 mm. Tolerates a wide range of temperatures, from -2 to 40°C, and yields 500-1200 fruits/tree/yr.

Required: Chemical properties of leaves.

IDEOTYPE DESCRIPTION

Crown: Large, with many branches for increased fruit production.

Stem: Crooked stems are preferred to straight boles. The height of the tree should be reduced. Branches should be low on the stem.

Root: No change.

Response to management: Not specified.

Deciduousness: Not specified.

DISCUSSION

Improvement should focus on increased fruit production, reduction of tree height, and increase in crown volume.

2.64 Ideotype specification for *Leucaena leucocephala* for small farms in Oriental Mindoro, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Leaves as fodder, branches and wood as fuelwood.

General selection criteria: Vigor, pest and disease free, good burning quality, charcoal production.

Ancillary information:

Known: Drought resistant, grows on poor acidic soils. NFT, good coppicing ability.
Not frost tolerant, thrives at altitudes up to 500 m.

Required: Yield and fodder value of leaves and flowers.

IDEOTYPE DESCRIPTION

Crown: Moderately sized with many branches.

Stem: Single or multiple stems.

Root: Strong taproot with few lateral roots.

Response to management: Profuse and rapid regeneration after lopping.

Deciduousness: Short period of dry season leaflessness.

DISCUSSION

Has other uses such as timber, soil conservation, and green manure. See also specification for northeastern region of Thailand.

2.65 Ideotype specification for *Gliricidia sepium* for small farms in Oriental Mindoro, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Branches and stem as fuelwood and for handicrafts, leaves for fodder and mulch.

General selection criteria: Vigor, wood biomass, free from pests and diseases.

Ancillary information:

Known: NFT, adaptable to both moist and dry soils, good coppicing ability. Has other uses such as for tannin, shade, hedges, and bee forage.

Required information: Chemical composition (fodder value) of leaves and flowers.

IDEOTYPE DESCRIPTION

Crown: Large crown with many branches and dense foliage.

Stem: Single or multiple, with bigger diameters and increased height.

Root: Deep taproot.

Response to management: Rapid, profuse regeneration after being lopped for fodder and mulch.

Deciduousness: Short period of dry season leaflessness.

DISCUSSION

It is a good fuelwood species and the wood is resistant to termites. Leaves are useful as fodder and mulch. As fodder it is a good substitute for *Leucaena leucocephala*. See also specification for Sri Lanka.

2.66 Ideotype specification for *Mangifera indica* for small farms in Oriental Mindoro, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, branches for fuelwood, bole for timber.

General selection criteria: Fruit and wood biomass production, vigor, straight grain, pest and disease free.

Ancillary information:

Known: Well known species grown in orchards, homegardens, on field margins and intercropped with annuals. Wide range of natural distribution with various varieties.

Required: Not specified

IDEOTYPE DESCRIPTION

Crown: Narrow to medium canopy.

Stem: Single, straight stem with branches high on the stem.

Root: Deep strong taproot with few lateral roots.

Response to management: No improvement needed.

Deciduousness: No improvement need.

DISCUSSION

With fruit as the major priority, selection criteria should follow traditional fruit tree improvement with consideration of fuelwood and timber characteristics.

2.67 Ideotype specification for *Artocarpus heterophyllus* for small farms in Oriental Mindoro, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, branches for fuelwood, bole for timber.

General selection criteria: Fruit and wood biomass production, vigor, straight grain, pest and disease free.

Ancillary information:

Known: Tolerates poor soil, regenerates naturally, seeds also sown. Generally planted in homegardens or as hedges and fences.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Medium, with branches high on the stem.

Stem: Single, long, straight stem with few major branches high on the stem.

Root: Prefer strong taproot with few lateral roots. For planting on sloping sites, a strong taproot with profuse lateral roots are required to withstand wind, bind soil and improve infiltration.

Response to management: Branches lopped for use as fuelwood should not affect yield of fruit.

Deciduousness: No improvement need.

DISCUSSION

With fruit as the major priority, selection criteria should follow traditional fruit tree improvement with consideration of fuelwood and timber characteristics.

2.68 Ideotype specification for *Paraserianthes falcataria* for small farms in Oriental Mindoro, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fuelwood, and roots for handicrafts.

General selection criteria: Vigor, wood biomass, pest and disease free.

Ancillary information:

Known: Drought resistant but needs well-drained, deep, fertile soils. Good coppicing ability.

Required: Seed production and vegetative propagation.

IDEOTYPE DESCRIPTION

Crown: As it is at present but with many branches higher on the stem.

Stem: Single, straight bole.

Root: Deep taproot.

Response to management: Not specified.

Deciduousness: Not specified.

DISCUSSION

Other uses include pulpwood, shade, tannin and timber.

2.69 Ideotype specification for *Coffea arabica* for small farms in Laguna, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fruit, fuelwood, mulch and medicine.

General selection criteria: Vigor, free of pests and diseases.

Ancillary information:

Known: Shade tolerant plant but can not withstand frost. Grows at altitudes from 900-1500 m.

Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Narrow with many branches.

Stem: Straight, single stem to a height of 2 m.

Bark: Smooth with lenticels.

Response to management: Since pruning is required to reduce the effect of biennial bearing and to make harvesting easier, the leaves should regenerate quickly and profusely.

Deciduousness: Not specified.

DISCUSSION

Also used as a flavoring agent, stimulant and a diuretic.

2.70 Ideotype specification for *Dipterocarpus grandiflorus* for small farms in Laguna, Philippines.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fuelwood, charcoal, timber.

General selection criteria: Vigor, wood specific gravity, pest and disease free.

Ancillary information:

Known: A primary forest species found at low and medium altitudes in dipterocarp forests.

Required: Seed production and vegetative propagation.

IDEOTYPE DESCRIPTION

Crown: Preferably ovoid or oblong with many branches.

Stem: Straight, single stem about 12 m long with no branches low on the stem.

Root: Deep taproot.

Response to management: Grows well in homegarden and field.

Deciduousness: Normal.

DISCUSSION

Improvement must stress heavy branching and good stem characteristics.

2.71 Ideotype specification for *Shorea obtusa* for small farms in the northeastern region of Thailand.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Construction materials, fuelwood, charcoal, soil erosion control.

General selection criteria: Vigor, fire tolerance, straight grain, pest and disease free.

Ancillary information:

Known: Tolerates poor soil, grazing, drought; vegetative propagation not easy, low seed production; lopping, pruning, and coppicing possible.

Required: Induced seed production, vegetative propagation.

IDEOTYPE DESCRIPTION

Crown: Preferably round and light, with many branches positioned high on the stem (or dense, narrow crown with many branches).

Stem: As straight and cylindrical as can be found. Multi-stem phenotypes are acceptable but a long bole is important.

Root: Strong taproot with few lateral roots.

Response to management: Prolific regrowth after branch pruning. Reliable coppicing response.

Deciduousness: Short period of dry season leaflessness.

DISCUSSION

With construction material, fuelwood and charcoal production as the major priorities, a straight, long bole with heavy branching and vigor are the most important selection criteria.

2.72 Ideotype specification for *Shorea siamensis* for small farms in the northeastern region of Thailand.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Construction materials, fuelwood, charcoal, soil erosion control.

General selection criteria: Vigor, fire tolerance, straight grain, pest and disease free.

Ancillary information:

Known: Tolerates poor soil, grazing, drought; vegetative propagation not easy, low seed production; lopping, pruning and coppicing possible.
Required: Induced seed production, vegetative propagation.

IDEOTYPE DESCRIPTION

Crown: Preferably round and light, with many branches positioned high on the stem.

Stem: As straight and cylindrical as can be found. Multi-stem phenotypes are acceptable but a long bole is important.

Root: Strong taproot with few lateral roots.

Response to management: Prolific regrowth after branch pruning. Reliable coppicing response.

Deciduousness: Short period of dry season leaflessness.

DISCUSSION

With construction material, fuelwood and charcoal production as the major priorities, a straight, long bole with heavy branching and vigor are the most important selection criteria.

2.73 Ideotype specification for *Dipterocarpus tuberculatus* for small farms in the northeastern region of Thailand.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Construction materials, fuelwood, charcoal, soil erosion control.

General selection criteria: Vigor, fire tolerance, straight grain, pest and disease free.

Ancillary information:

Known: Tolerates poor soil, grazing, drought; vegetative propagation not easy, low seed production; lopping, pruning and coppicing possible.
Required: Induced seed production, vegetative propagation.

IDEOTYPE DESCRIPTION

Crown: Preferably round and light, with many branches positioned high on the stem (or dense, narrow crown with many branches).

Stem: As straight and cylindrical as can be found. Multi-stem phenotypes are acceptable but a long bole is important.

Root: Strong taproot with few lateral roots.

Response to management: Prolific regrowth after branch pruning. Reliable coppicing response.

Deciduousness: Short period of dry season leaflessness.

DISCUSSION

With construction material, fuelwood and charcoal production as the major priorities, a straight, long bole with heavy branching and vigor are the most important selection criteria.

2.74 Ideotype specification for *Dipterocarpus obtusifolius* for small farms in the northeastern region of Thailand.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Construction materials, fuelwood, charcoal, soil erosion control.

General selection criteria: Vigor, fire tolerance, straight grain, pest and disease free.

Ancillary information:

Known: Tolerates poor soil, grazing, drought; vegetative propagation not easy, low seed production; lopping, pruning and coppicing possible.
Required: Induced seed production, vegetative propagation.

IDEOTYPE DESCRIPTION

Crown: Preferably round and light, with many branches positioned high on the stem (or dense, narrow crown with many branches).

Stem: As straight and cylindrical as can be found. Multi-stem phenotypes are acceptable but a long bole is important.

Root: Strong taproot with few lateral roots.

Response to management: Prolific regrowth after branch pruning. Reliable coppicing response.

Deciduousness: Short period of dry season leaflessness.

DISCUSSION

With construction material, fuelwood and charcoal production as the major priorities, a straight, long bole with heavy branching and vigor are the most important selection criteria.

2.75 Ideotype specification for *Leucaena leucocephala* for small farms in the northeastern region of Thailand.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Fodder, fuelwood, food, windbreaks, shade, green manure.

General selection criteria: Pest and disease free, vigor, good burning quality, charcoal production.

Ancillary information:

Known: NFT, not frost tolerant; thrives at altitudes up to 500 m., drought resistant, grows well in the northeastern region except for areas with acid soils; good coppicing potential.

Required: Yield and fodder value of leaves and flowers.

IDEOTYPE DESCRIPTION

Crown: Preferably wide with dense crown, many branches and profuse leaves.

Stem: Single or multiple stems are acceptable.

Root: Strong taproot with few lateral roots.

Response to management: Prolific regrowth after cutting, pruning, pollarding.

Deciduousness: Short period of dry season leaflessness.

DISCUSSION

With fodder, fuelwood, food, windbreaks and shade as major priorities, a strong, wide, dense crown and profuse leaf production are the most important selection criteria.

2.76 Ideotype specification for *Sesbania grandiflora* for small farms in the northeastern region of Thailand.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Food (leaves and flowers), soil improvement, fuelwood.

General selection criteria: Pest and disease free, vigor.

Ancillary information:

Known: NFT, tolerates poor soil, dry season and shade; ample seed production; lopping and pruning possible; poor burning quality.
Required: Not specified.

IDEOTYPE DESCRIPTION

Crown: Preferably round, with many branches positioned low on the stem.

Stem: Single straight stem or multiple stems acceptable but profuse shooting and flowering are important.

Root: Geotropically angled rather than horizontal lateral roots.

Response to management: Prolific regrowth after pollarding and pruning. Reliable coppicing response.

Deciduousness: Short period of dry season leaflessness.

DISCUSSION

With food and soil improvement as the major priorities, selection must stress leaf production with a wide, dense crown. Subsequent phenotypic selection should concentrate on wood density for improvement of burning quality.

2.77 Ideotype specification for *Ceiba pentandra* for small farms in the northeastern region of Thailand.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Cotton-like material, fuelwood.

General selection criteria: Vigor, heavy fruit production, pest and disease free.

Ancillary information:

Known: Tolerates poor soil, drought; vegetative propagation not easy, ample seed production; lopping and pruning possible.

Required: Vegetative propagation, wood characteristics.

IDEOTYPE DESCRIPTION

Crown: Light crown with heavy branching, heavy fruiting.

Stem: Single or multiple stems acceptable but wind tolerance is more important.

Root: Deep, strong taproot.

Response to management: Heavy fruiting under extensive management.

Deciduousness: Preferably long period of dry season leaflessness.

DISCUSSION

Selection criteria should focus on crown, stem and heavy branching for profuse fruit production. Wind tolerance is also desirable. Burning quality should be improved by increasing specific gravity.

2.78 Ideotype specification for *Dipterocarpus alatus* for small farms in Nong Yang Village, Chachoengsao, Eastern Thailand.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Timber and fuelwood.

General selection criteria: Vigor, long straight stem, adaptability to wide range of environmental conditions.

Ancillary information:

Known: Tree grows in evergreen forests, prefers moist, deep soil. Survival rate of natural regeneration is low. Very slow growing tree.

Required: Natural and artificial regeneration.

IDEOTYPE DESCRIPTION

Crown: Dense, round canopy with many branches high on the stem.

Stem: Long clear bole.

Root: Deep taproot.

Response to management: Improved germination and survival. Good natural branch pruning.

Deciduousness: Evergreen.

DISCUSSION

Selection criteria should follow traditional industrial tree improvement methods with additional consideration of improving branch volume for fuel.

2.79 Ideotype specification for *Irvingia malayana* for small farms in Nong Yang Village, Chachoengsao, Eastern Thailand.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Timber, fuelwood and charcoal.

General selection criteria: Vigor, long straight stem.

Ancillary information:

Known: Tree grows in evergreen forests, prefers moist, deep soil. Survival rate of natural regeneration is low. Moderately slow growing tree.

Required: Natural and artificial regeneration. Wood properties.

IDEOTYPE DESCRIPTION

Crown: Dense, round canopy with many branches high on stem.

Stem: Long clear bole.

Root: Deep taproot.

Response to management: Improved germination and survival. Good natural branch pruning.

Deciduousness: Evergreen.

DISCUSSION

Selection criteria should follow traditional industrial tree improvement methods with additional consideration of improving branch volume for fuel.

2.80 Ideotype specification for *Pterocarpus macrocarpus* for small farms in Nong Yang Village, Chachoengsao, Eastern Thailand.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Timber/lumber, wood for construction and for furniture, branches for fuelwood and charcoal.

General selection criteria: Vigor, long straight stem, adaptability to poor soil conditions, disease and pest free.

Ancillary information:

Known: Tree grows in evergreen and mixed deciduous forests, prefers moist, deep soil. Survival rate of natural regeneration is low. Very slow growing tree.
Required: Natural and artificial regeneration and growth habits.

IDEOTYPE DESCRIPTION

Crown: Dense, round canopy with many branches high on stem.

Stem: Long clear bole.

Root: Deep taproot.

Response to management: Improved germination and survival. Good natural branch pruning.

Deciduousness: Evergreen.

DISCUSSION

Selection criteria should follow traditional industrial tree improvement methods with additional consideration of improving branch volume for fuel.

2.81 Ideotype specification for *Cotylelobium melanoxylon* for small farms in Nong Yang Village, Chachoengsao, Eastern Thailand.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Timber for construction, branches for farm implements and fuelwood/charcoal.

General selection criteria: Vigor, long straight stem.

Ancillary information:

Known: Trees normally left growing on farmland, prefer good sites. Survival rate of natural regeneration is low. Slow growing tree.

Required: Natural and artificial regeneration.

IDEOTYPE DESCRIPTION

Crown: Dense, round canopy with many branches high on stem.

Stem: Long clear bole.

Root: Deep taproot.

Response to management: Improved germination and survival. Good natural branch pruning.

Deciduousness: Evergreen.

DISCUSSION

Selection criteria should follow traditional industrial tree improvement methods with additional consideration of improving branch volume for fuel.

2.82 Ideotype specification for *Azadirachta indica* for small farms in K.M. 7 Village, Chachoengsao, Eastern Thailand.

DESIGN SPECIFICATION

Products and service required (given in order of importance): Wood for construction of houses and agricultural implements, woody branches for fuelwood and agricultural implements, leaves for green manure and fodder, fruit for extraction of oil for medicinal purposes, shade for cattle.

General selection criteria: Vigor and volume production.

Ancillary information:

Known: Found on wastelands, dry lands owned by farmers, homesteads and field margins. Regenerates naturally, withstands drought conditions; lopping and pruning is possible. Resistant to pests and diseases.

Required: Possibility of use as insect repellent.

IDEOTYPE DESCRIPTION

Crown: Large but not too spreading, with many branches positioned high on the stem. Dense foliage.

Stem: Straight and thick with no branches up to a height of 5 m. A long bole is very important.

Roots: Deep taproot with few lateral roots.

Response to management: Prolific regrowth after lopping for mulch.

Fruit: Big seeds for greater production of oil and prolific fruiting.

Deciduousness: Evergreen.

DISCUSSION

With timber, fuelwood and leaves as major priorities, a long, clear straight bole and heavy branching habits are important characteristics for selection criteria.