Research on

Farmers' Objectives for Tree Breeding

Forestry/Fuelwood Research and Development (F/FRED) Project

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Research on Farmers' Objectives for Tree Breeding

report of a workshop following a regional study in Asia

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Cover: The line drawing at top shows *Artocarpus heterophyllus* (jackfruit) as desired by Sri Lankan farmer respondents in the Tree-Breeding Objectives study. In the photo, farmer respondents in San Isidro, Philippines, select drawings of preferred tree characteristics as researchers record their choices (photo: Lucylen B. Ponce).

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Introduction

In 1989, scientists in the Multipurpose Tree Species Research Network undertook two regional socioeconomic studies: one on farm and village forest- and land-use practices, and a second on farmers' tree-breeding objectives. The former, involving 13 researchers and 26 communities in 6 Asian countries, was designed to provide a basis for understanding patterns of land- and tree-use and trends across national and cultural boundaries (see Mehl 1991). The second study, involving 14 researchers and 31 communities in 7 countries, built upon the first for the more specific aim of describing tree species and characteristics preferred by farmers.

This is the report of a working meeting held in Kandy, Sri Lanka, in September 1991, at which the researchers who took part in the latter study informally reviewed their substantive findings and methodological experience. The preferred tree ideotypes as initially reported by Chuntanaparb and Ranganathan (1990) are included in Appendix 1.

The report is intended for two main audiences. The information on farmers' chosen species and characteristics is intended to help tree breeders and other foresters to understand the demand of farmers as a client group. While some of the preferences and ideotypes expressed by the farmers in the study cannot be addressed through breeding programs alone, they can inform foresters as to which varieties and management practices are most likely to be adopted by farmers in these areas.

The methodological experience documented in this report should be useful not only in future related Network studies, but as another contribution to the growing literature of interdisciplinary studies in forestry and agroforestry. This aspect of the study may be of most interest to social scientists and other non-foresters. For this broader audience, a glossary of terms is included at the back.

Pursuing the idea and practice of farmer-based tree improvement, the MPTS Research Network has launched a program of community-based tree improvement. The last three papers in this report describe the basis for this program and preliminary results.

Summary of Findings

John B. Raintree and Anoja Wickramasinghe

Background

The study of Farmers' Tree Breeding Objectives (TBO) was carried out in 31 villages in 7 countries of Asia. It built on a previous Network study of Farm and Village Forestry Practices in Asia (see Mehl 1991) and included a subset of the villages in that earlier study, along with a complement of villages in India that had not participated in the earlier study (Figure 1, Tables 1 and 2).

The study aimed to describe ideotypes of multipurpose trees desired by the farmer respondents. "Ideotype" means "a form denoting an idea"; an "ideotype tree" is a plant model designed to yield products of greater quality and quantity than a conventional cultivar or wild plant (Dickmann 1985, cited in Chuntanaparb and Ranganathan 1990).

At the September 1991 meeting in Kandy, Sri Lanka, the scientists involved in the study reviewed and informally discussed the substantive findings and methodological experience, with the aim of refining the TBO methodology and recommending follow-up activities.

In retrospect, it is clear that this type of research involves previously unsuspected methodological and interpretative complexities, and that the present findings are preliminary until confirmed by further research. Appendix 1 of this report provides farmers' ideotypes for each community. In addition to these, the study's main

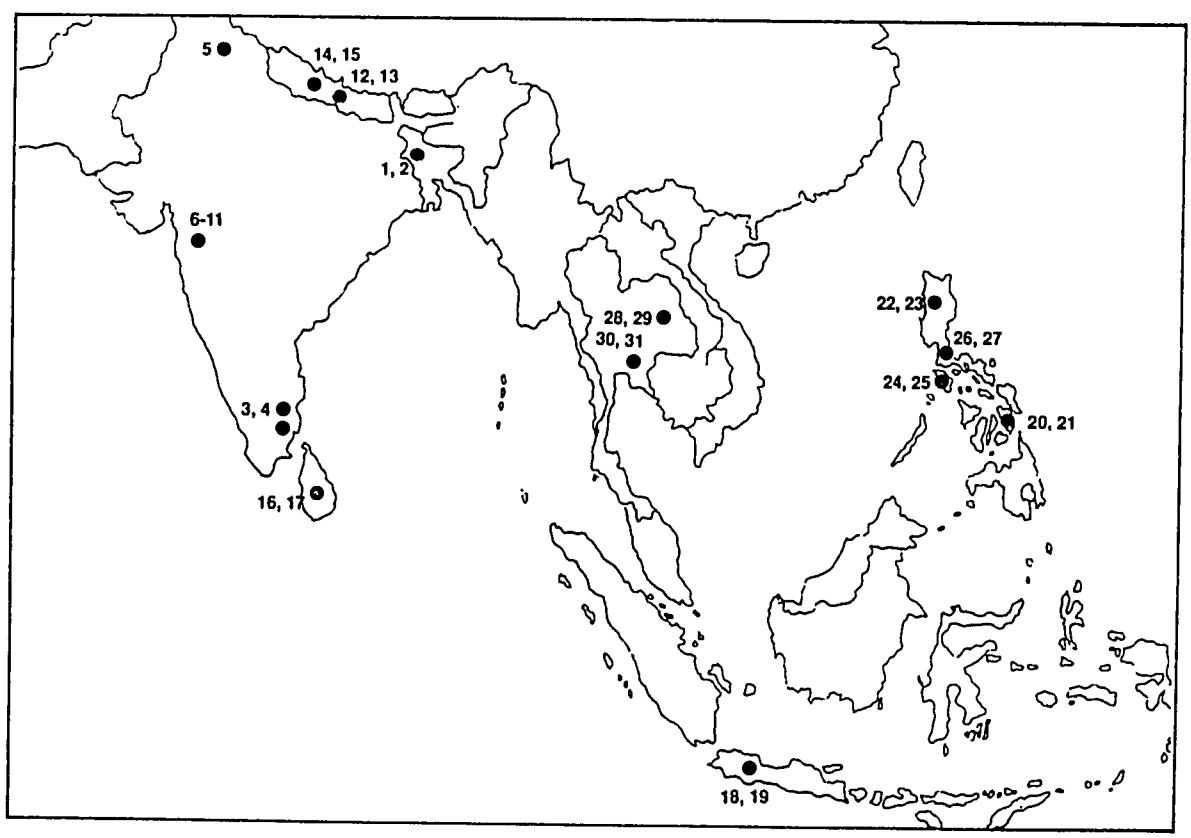


Figure 1. Map of the study sites in South and Southeast Asia.

Table 1. Study sites in South Asia.

Country	District and Village	Area (ha)	Population Total	Population Male	Population Female	No. of households	Annual rainfall (mm)	Min, Max Temp. (°C)	Soils	Topography
Bangladesh	*Rajshahi (Northwest)*									
	1. Belpukur	161	1650	846	804	289	1500	15, 35	loamy-sandy loam	flat
	2. Samsadipur	164	1700	870	830	319	1500	15, 35	loamy-sandy loam	flat
India	*Tamil Nadu*									
	3. Thennalur	989	2420	1175	1245	420	881	21, 39	sandy, loamy alkaline soils	flat
	4. Vadapalanji	160	2750	1250	1500	600	575	24, 34	shallow sand loam	flat
	Haryana									
	5. Sukhomajri	595	538	298	240	83	1137	2, 43	sandy loam, loam	undulating, slope up to 10%
	Maharashtra									
	6. Sahajpur	797	1285	—	—	327	463	—	—	flat
	7. Yavat	4121	7167	3717	3450	2829	463	—	—	flat
	8. Shiradhon	843	7000	—	—	1246	810	—	black	undulating
	9. Kadus	4312	9632	4789	4843	1367	750-1250	—	—	undulating
	10. Satara	2794	2176	1119	1057	387	724	6, 43	light-medium black	hilly
	11. Shindwane	2009	2361	1252	1109	600	500	—	—	—
Nepal	*Kavre*									
	12. Kankre	52	812	412	400	116	2089	-4, 28	sandy-loam, silty	hilly, terraced
	13. Tusal	229	1000	524	476	118	2089	4, 28	sandy-clay, loamy	hilly, terraced
	Kaski									
	14. Rakhi	870	4301	2150	2151	746	3385	7, 30	loam, sandy-loam, loamy-clay	rolling plain/hilly
	15. Leknath	1359	6439	3541	2898	1121	3385	7, 30	sandy-loam, loam, loamy-clay	rolling plain/flat/hilly
Sri Lanka	*Kandy*									
	16. Madugalla	1466	1874	939	935	334	940	17, 33	sandy and loamy	mountainous
	17. Bambarabedda	349	1600	888	712	398	940	17, 33	sandy and loamy	mountainous

Table 2. Study sites in Southeast Asia.

Country	District and Village	Area (ha)	Population Total	Male	Female	No. of households	Annual rainfall (mm)	Min, Max Temp. (°C)	Soils	Topography
Indonesia	*West Java*									
	18. Payungagung	782	3800	1874	1976	1010	2869	22, 30	andosols, grumusols	mountainous
	19. Karangsari	1650	3645	1803	1842	950	1743	26, 33	latosols, grumusols	hilly
Philippines	*Leyte*									
	20. San Isidro	3500	1400	—	—	220	2058	27, —	sandy loam	flat
	21. San Miguel	2500	733	—	—	220	1496	—	Medellin clay	hilly/flat
	Bauko									
	22. Bila	40	862	—	—	172	1800	—	clay loam, fine textured	lowland/hilly
	23. Guizadan	144	3280	—	—	656	1800	—	clay loam, fine textured	lowland/hilly, near river
	Oriental Mindoro									
	24. Paitan	463	1000	—	—	250	3,904	23, 31	clay loam, sandy loam sandy clay	rolling/mountainous
	25. Sitio Banilad	345	300	159	141	61	3,904	23, 28	sandy loam	mountainous
	Laguna									
	26. Jose P. Laurel	94	581	—	—	146	1952	23, 31	Antipolo clay (pH 6.51)	plain/hilly/ mountainous
	27. Juan Santiago	1790	1381	—	—	230	1952	23, 31	Antipolo clay	plain/hilly/ mountainous
Thailand	*Kalasin*									
	28. Non Si Sawat	265	396	200	196	—	1050	10, 40	sandy, sandy loam	flat/rolling plain
	29. Kam Kham	640	1235	620	615	—	1050	10, 40	sandy, sandy loam	rolling plan/flat
	Chachoengsao									
	30. Komo 7	3097	1200	641	559	278	1240	25, 28	loamy-clay, clay	rolling plain/flat
	31. Nongyang	2661	3684	1906	1778	650	755	26, 30	sandy-clay, lateritic	flat/rolling plain

conclusion at this point is that farmers' tree-breeding objectives can be elicited by the methodology used, but the exact expression of these ideotypes will be conditioned by methodological variables and factors related to the local situation.

Substantive Findings

To understand the study findings, we must recognize at the start that there are at least four levels of choice encountered in dealing with the selection of tree attributes:

Level 1 Choice of a particular **type of tree** in accordance with one or more of a number of possible functions (food, fodder, fuelwood, timber, shade, etc.).

Level 2 Choice of a particular **tree species** for a particular use in a particular landscape niche

Level 3 Choice of seed or vegetative propagules from existing **plus trees** or **cultivars** of a particular species which possess desirable qualities.

Level 4 Definition of a particular **ideotype** for one species as a target for future tree improvement work.

The primary intention of the TBO study was to elicit Level 4 information. However, in order to interpret the results we must acknowledge that most farmers interviewed could satisfy most of their needs and preferences at Level 1 or 2. Good farmers might make operational decisions at Level 3. But it was apparent that none of the respondents had given much thought to Level 4 choices until they were asked by researchers in this study. Likewise, most of the brief discussion papers in this report and much of the discussion at the Kandy meeting dealt with Level 1 and 2 type choices, reflecting the dominant focus of the farmer respondents. This range is reflected in the following analysis of the discussions.

What has been learned about farmers' tree ideotypes, strictly speaking? From the data in Appendix 1, collected in each village using some variation of the recommended methodology, perhaps one significant generalization can be made (Chuntanaparb and Ranganathan 1990): Over 50% of the species valued primarily for fruit and food provide timber after fruit yields have ended. Many also provide fuelwood. Thus, although farmers may not always place a high value on timber and fuelwood products from these trees, woody biomass production could be added as desirable to the major selection criteria for fruit production and resistance to pests and diseases, provided it does not interfere with the tree's primary food production use.

From a methodological point of view, however, it is not clear exactly how comparable the study data are or just how much weight any particular set of results should receive as a guide to local tree-breeding efforts. What we can now say, following the meeting in Kandy, is which factors are involved in farmers' choice of tree ideotypes.

Situational Factors Influencing Tree and Ideotype Preferences

Two types of situational factors appear to influence the expression of preferred tree characteristics:

- o factors pertaining to the intended use and situation of the tree
- o factors pertaining to the situation of the farmer respondent

Situation of the Tree

In the first category, the workshop participants considered the following to be most important:

- o Intended use or function of the tree
- o Landscape niche in which the tree is to be planted
- o Farming system, land- and tree-use patterns
- o Characteristics preferred by local processing facilities

Intended Use or Function

Obviously, different tree characteristics will be preferred for different uses. Despite this, planting programs continue to introduce species without benefit of a diagnosis of local needs and priorities for specific uses.

Trees that are truly multipurpose present the same problem to both farmers and researchers: How does one rank the characteristics associated with different uses? The study participants' experience indicates that different farmers handle this in different ways. Where there is a clear primary use, ideotypes expressed tend to reflect the characteristics associated with the primary economic value of the tree. An example is the preference for long, straight boles for high-value timber trees, which provide fuelwood as a "by-product" (see Francisco's case study from Mountain Province, Philippines). The primary use value, and hence the ideotype, is much less clear in the case of a truly multipurpose tree like *Leucaena leucocephala* (leucaena) or *Artocarpus heterophyllus* (jackfruit). Economic values are not always marketized, but farmers are more likely to prioritize attributes according to their "cash value" where commercial markets are well developed.

In other situations, farmer-respondents apparently give little thought to the question of ranking and there is little consistency among them.

There are also situations in which multipurpose trees are deliberately valued for the *variety* of products and services they provide, and where farmers avoid more limited economic assessments. The ideotypes they express reflect multipurpose valuations (see Wickramasinghe's case study from Sri Lanka).

A related anomaly occurred during the study, when one researcher decided arbitrarily to exclude fruit trees from consideration on the grounds that they did not meet his definition of a "multipurpose tree" — even though the trees in question were definitely used for multiple purposes. The other researchers made no such exclusion and unanimously agreed that trees should be defined as "multipurpose" based on empirical observation, and that no tree should be presumptively excluded from this category.

Planting Location

Another point more directly related to ideotype preferences is that farmers may prefer different morphological characteristics for the same tree species planted for the same purpose, depending on *where* it is planted. For example, the Sri Lankan farmers interviewed said that trees grown on common land could be allowed to have a spreading crown, but they preferred trees on their farmland to have a narrow columnar canopy. In one area in Sri Lanka farmers showed preference in farm-boundary plantings for a early-maturing jackfruit variety with a tall columnar canopy, bearing all of its fruits on the main stem. In addition to its characteristic of early bearing, farmers appreciated this narrow-canopied tree because it fit so nicely into the boundary-planting niche without competing much with adjacent crops.

Land-Use System

In addition to the ecological factors that determine which tree species are suitable to a given area, the prevailing farming system or land-use system can strongly condition the way in which farmers incorporate trees into the system. For example, in all the study villages except those in Sri Lanka, trees scattered in croplands were common. The exception was due to the prevalence of tobacco as the dominant crop in the farming system. In both Sri Lankan villages, trees were seen as harmful to tobacco and kept out of the main fields. In this farming system, the homegarden was perceived as the "natural" place for trees. This choice of planting location, in turn, had implications for the preferred morphological characteristics of the trees.

Other User Groups

While the TBO study focussed on small farmers' preferences, the discussion in Kandy noted that in commercialized production systems the most important user group for ideotype identification may be the local buyers, processors, and end-use consumers of processed tree products. Local processors and buyers of tree crops are most

directly concerned with obtaining high-quality raw material for their enterprises. Where quality differences are reflected in price differences, farmers' ideotypes may already reflect the preferences of the processors and middlemen. Even where market prices do not reward farmers for higher-quality tree products, which are relatively slow to yield, tree improvement programs should still account for these downstream market preferences in anticipation of future market rewards.

Situation of the Respondent

Among this group of situational factors, five significant influences identified were the survey respondent's:

- o Gender
- o Wealth
- o Size of landholding
- o Tenure over the land
- o Ethnic identify and cultural tradition

Gender

Gender differences in preferences for trees and their ideotypes were evident and, although the pattern was consistent, the strength of gender differences was not at all uniform. Overall, gender differences in tree preferences were felt to be stronger in South Asia than in Southeast Asia.

In general, men preferred trees with commercial value while women preferred trees for household use. In Nepal, for example, where gender was reported to be the single most important determinant of differences in preference, women expressed a strong preference for fodder and fuelwood trees, while men were most interested in timber trees.

Showing a weaker version of the same pattern, in the Mountain Province villages of the Philippines, Francisco found no gender differences on the main wood-based uses of trees, but in one village women showed greater awareness of and concern with "minor", non-wood domestic uses of trees and offered supplementary information about these uses. In the other, more commercialized village of Mountain Province, the women did not offer such information.

Another interesting observation by Francisco is that, from her sample, men appear to think more concretely about trees than women do. The men interviewed by her had greater difficulty than the women in thinking of preferred tree attributes independent of a particular species. This is obviously a preliminary observation that would require further study to confirm. It may also be a culture-specific observation.

Wealth

Scientists in the study said that tree preferences were also related to wealth differentials. The clearest example came from Nepal, where, according to Das, the wealthy preferred trees with good timber quality for eventual harvest, while the poor preferred trees which would give high yields of fodder and fuelwood biomass on an annual basis.

Size of Landholding

Size of holding strongly influenced both functional and morphological preferences. Small farmers tended to prefer smaller, more compact or narrow-canopied trees that could fit more easily into the spaces available on their farms. Where farm sizes are very small and farmers must use severely limited land resources efficiently to meet a variety of subsistence and commercial needs, they tend to value *multipurpose trees* highly. Of special note in this category are the multipurpose fruit trees like *Mangifera indica* (mango), jackfruit, and *Cocos nucifera* (coconut), which provide not only fruit but also fodder, timber, fuelwood, and other basic needs. The way that small farmers think about multipurpose food trees can perhaps be suggested by the question: If you were a small farmer, which would you prefer — a timber tree that produced food or one that didn't?

Land Tenure

The workshop field trip provided an observation regarding land tenure. Wickramasinghe had pointed out that farmers in the study villages in Sri Lanka tolerated broadly spreading crowns on common land, but preferred narrow, compact trees on their own land. During the field trip we passed a stand of very tall, straight jackfruit trees, from

which apparently all side branches had been removed, resulting in an almost ideal timber form. We stopped to ask the local farmers about the rationale for this unusual jackfruit morphology.

The farmers replied that the grove in question was located on government land, and the occupants were squatters. The jackfruit trees were already there when they arrived. Since they were not allowed to fell the trees, the timber form was accidental. The lack of side branches was due to heavy lopping for fodder over many years. One elderly woman, asked if she would prefer to have more branching trees with greater potential for fruit production, answered, "Yes, of course!" However, she explained that since she did not own the land she could not prevent others from lopping the trees for fodder. Although no one had the right to fell the trees, everyone had the right to lop them for fodder.

Tenure was therefore seen to be the controlling variable and fodder was the use with the highest obtainable value for the multipurpose jackfruit tree under the prevailing tenure system. The excellent timber form of the local jackfruit trees, which the foresters attending the workshop found to be of great interest, was *incidental* to their management for fodder and of no use to any of the local farmers. This is in marked contrast with the situation in central Bangladesh, where the jackfruit trees on private farms all have clear, straight boles up to a height of almost 3 meters and are ultimately bound for the sawmill. There they provide a cash windfall to the farm owners at the end of their fruit-bearing years.

Ethnicity and Culture

The workshop participants agreed that ethnic and cultural differences comprise a major source of differences in tree preferences. Indeed, although situation-specific economic adjustments do occur, broad patterns of traditional land use and farming behavior are learned in one's native community and passed from one generation to the next. People seek to maintain their ethnic identity, and land-use behavior is often one of the most important markers of ethnic and cultural identity. The clearest example of this in the TBO study is seen in Nepal, where different ethnic groups occupy different altitude ecozones, each with their own land- and tree-use patterns.

The Methodological Experience

Much of the discussion at the workshop examined methodological issues. When the study was planned, the methodology seemed straightforward, but in the course of the study it became clear that at several points in the recommended procedures there were a number of alternative ways of proceeding.

Since this was explicitly intended as an exploratory study to develop and test a novel methodology for investigating a previously unexplored realm of experience, the workshop participants felt that the lack of standardization in the implementation of the recommended methodology was not regrettable, but was rather an opportunity to explore methodological alternatives and learn which was best.

The intent of the discussions of methodology, then, was to review and evaluate the scientists' actual experience, sort out the effects of methodological variations, and highlight those methods thought to be most effective.

The Original TBO Methodology

The original methodological proposal, as documented in the terms of reference given to the study participants by F/FRED, appears in the box on the following page. This is essentially the same as the methods described by the coordinators of the study in their original tabulation of the data (Chuntanaparb and Ranganathan 1990). At the Kandy workshop, however, it became clear that there had been considerable variation in the implementation of the basic methodology.

Variations in the Methodology

The main methodological variables were:

- Method of sample stratification
- Interview method (group vs. individual)
- Order of elicitation procedures
- Type of visual stimuli used

Excerpt from the Original Study Guidelines

At present, tree improvement workers use traditional timber definitions — such as straight, clear bole to 16 m — to select and breed trees for the future. The major questions asked through this study are: (1) is this a suitable definition for improved tree MPTS for small farmers? (2) can we define a more relevant set of ideotypes for MPTS breeding programs?

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.

Approach

This study builds upon the effort in the ongoing regional study on farm and village land and forest-use practices. Two site visits are planned for that regional study — this study adds one additional visit to the same sites.

Step 1 will be carried out using data from the regional FVF study.

1. Extract a list of priority species and tree products from the regional FVF study, summarizing it in the following format by household:

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

Products are defined as leaves, branches, flowers, etc. Summarize this data after the first field data collection from the regional FVF study and before the next field visit.

Conduct Steps 2-5 with the cooperation of five males and five females from households participating in the regional study during a second visit to the study sites.

2. Prioritize the list of products using the following format:

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

3. Ask respondents to describe the planting niches they would like to use for these priority species. This will define the areas in which the trees are likely to be planted (e.g., homegardens, field margins, intercropped with annual staple crops).

4. Ask respondents to describe which characteristics they dislike about the priority species identified above.

5. Ask respondents to identify the top three individual trees for each of the priority species, and why these trees are superior or preferred. Take photographs of each tree and label clearly. Ask respondents the source of the planting materials for these trees (i.e., neighbor, forestry department, private nursery, natural forest, etc.).

6. Ask respondents to identify tree species which are used to provide the priority products listed in Step 1, BUT which are not as desirable, and why they are not preferred.

7. Use a series of line drawings of the following tree parts to help informants describe the "ideotypes" they would like for each priority species:

   - branching habit — e.g., many or few large branches, arrangement of branches (i.e., phyllotaxy)
   - stem form — i.e., single stem, multiple stemmed, straight or crooked, etc.
   - rooting habit — e.g., strong taproot with little lateral branching, fibrous rooting system with strong lateral branching
   - foliage characteristics — e.g., palatability, leaf size, etc.

Conduct Step 8 after the second site visit.

8. Summarize the information collected in Steps 2-7 after the second field visit. This synopsis will provide the basis for the presentation to be made in Step 9.

Step 9 will be done on a third site visit.

9. Present and discuss this summary in group meetings with villagers. At least one meeting should be held with a woman's group. These meetings will be conducted to obtain consensus on the ideotypes described by the sampled households. The line drawings used in Step 7 will also be used in the group meetings as a basis for discussions.

10. Researchers will provide the F/FRED study coordinators with summaries of up to 6 composite ideotypes which are agreed to in Step 9.

11. The coordinating committee will assemble all of the ideotype descriptions from the final reports and distill a maximum of 4-6 generalized ideotypes for final publication.

Method of Sample Stratification

The guidelines indicate that Steps 2-5 should be conducted with five men and five women participants from the FVF study. It did not specify whether both genders were to be interviewed in a combined group, or in separate groups, or individually. In fact, all three methods were used. Not unexpectedly, the researchers reported that the results seemed to vary depending on whether men and women were interviewed together or separately, in groups or individually. Interviewing them together tended to obscure gender differences and present a homogenized result. Interviewing them in separate groups tended to bring out gender differences more strongly.

The same effect was reported to have occurred with respect to other socioeconomic differentials, such as wealth class, caste, and ethnicity. Since the guidelines did not specify a standard stratification strategy, some researchers selected the sample of respondents so as to have a homogeneous respondent group, thus maximizing the fidelity of the responses for this user group. Others attempted to select a cross-section of different groups within the community so as to force the participants to arrive at a "homogenized" consensus from a meeting of all respondents.

The merits and demerits of both approaches were discussed during the meeting, and the consensus at the end was that this latter method ran the risk of producing a result that no one within the community would adopt. In general, it was felt to be a better strategy to stratify the respondents according to pertinent socioeconomic criteria or user groups and elicit responses from each group separately, thus obtaining a set of tree-breeding objectives appropriate to each distinctive interest group within the community. If the ideotypes for different user groups turned out to be similar, they could be lumped together later, but homogeneity of response should not be assumed (or forced) prior to a group-specific inquiry.

Interview Method

Researchers also differed in how they applied the guidelines for group interviews. Some researchers administered all interview and elicitation procedures to a succession of individual respondents only. Most of the researchers used small groups for at least part of the procedure, but they differed in respect to which parts of the elicitation procedures they applied this method to and, as mentioned above, in the method of stratification of the groups.

Kartasubrata actually made the individual vs. group opinion a variable in his study, and reports different preference orders of trees from the same respondents using the two different methods (see his paper in this report). The consensus of the meeting, after much discussion, was that group discussion was an important process for eliciting meaningful ideotypes, but that such discussion should be conducted within homogeneous focus groups.

Order of Elicitation Procedures

The order in which the different elicitation procedures was applied also proved to be an important methodological variable. The stated intention was to elicit tree ideotypes for the priority multipurpose species, but very different interpretations of this arise, depending on which of the following elicitation procedures are used:

1. First select the farmers' top ranking species (for all uses), then elicit preferred ideotypes for each *species*. (Chuntanaparb, Francisco, Kartasubrata)

2. First identify the important landscape *locations* for trees, then select the farmers' priority species (for all uses) at each of the locations, then elicit ideotypes for each of the *priority species in each location*. (Wickramasinghe)

3. First elicit the *priority species for each use*, then elicit preferred ideotypes for each of the *species for each use category*. (Maligalig, Mallion)

4. First identify the important landscape *locations and uses* for trees, then select the farmers' priority species at each of the locations for each use, and then elicit ideotypes for each of the *priority species-location-use* combinations.

The methods differ in the way they handle certain situation variables felt by the researchers to influence ideotype expression. Method 1 is the one recommended in the terms of reference for the study, and was apparently followed by the greatest number of participating researchers. The result is a distinct ideotype for each *species*. This ideotype, presumably, represents some kind of composite which "averages out" effects of location and use.

Method 2 is the same as Method 1 except that it accounts for the location variable, and results in a distinct ideotype for each *species-location* combination. Method 3 does not consider locational effects but it does differentiate ideotypes by use. It results in a distinct ideotype for each *species-use* combination. Method 4 is a logical extension of this line of development but, in fact, none of the TBO researchers reached this level of differentiation.

Farmers may hold in their minds different ideotypes for each of the above situations, but it is unlikely that they will consciously and systematically differentiate them in their responses to researchers' questions unless a deliberate and intelligible effort is made to systematically elicit them. On the other hand the responses so elicited may be an artifact of the researcher-respondent dialogue that has little reality in everyday life. For example, most of the TBO researchers thought the leaf shape preferences reported in the original TBO results constituted artifacts of this type.

Scientists at the Kandy meeting generally agreed that, since morphological preferences appear to be strongly influenced by planting location, Method 2 should be recommended over Method 1. There was less consensus about how to handle the effects of use, since obtaining a distinct ideotype for a single use category would tend to seriously distort the perception of *multipurpose* trees. The methods focussing on species (Methods 1 and 3) might be expected to yield a less distorted treatment of multipurpose trees, assuming that farmers' answers reflected some kind of overall multiple-use-weighted response.

Use of Visual Stimuli

Perhaps the most interesting innovation to result from the exploratory TBO study was in the use of visual stimuli. All participating researchers found that the original set of line drawings provided by the Network Secretariat (Figure 2) were very useful as a way of introducing the subject of ideotypes to farmers and in focusing the ensuing discussion of desired characteristics. Some of the researchers were told by farmers that the prepared line drawings did not convey an adequate idea of the ideotypes in farmers' minds. In response, several researchers modified the procedure to allow farmers to redraw the figures or suggest modifications to reflect their ideotypes more faithfully.

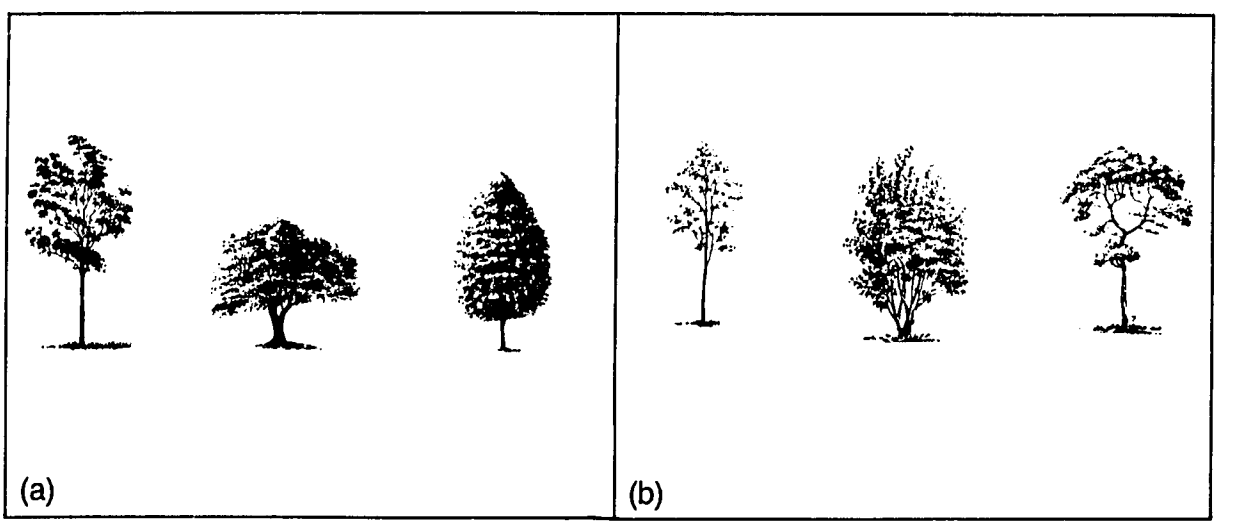


Figure 2. Examples of line drawings used to elicit preferred (a) canopy shape and (b) stem form.

Several different ways of doing this were devised. One researcher reproduced the original line drawing on a blackboard and invited farmers to come to the board to make the necessary modifications (see Wickramasinghe's paper). Three other researchers, working in consultation with each other, decided to bring an artist along with them to the interviews to modify the drawing according to farmers' specifications or to redraw the ideotype completely (see Francisco's paper). Either way, the ability to modify the drawings enabled the farmers to better communicate the ideotypes they actually had in mind, and the process of drawing provided an excellent concrete focus for group discussion of ideotype characteristics. Most of the other researchers agreed that this was an innovation that should be adopted generally.

Recommended Follow-Up Activities

In going beyond the TBO study to engage in actual tree improvement work with farmers, the scope of consultation would need to be broadened beyond farmers to include other interest groups within the community.

For this reason, the name of the relevant F/FRED program element within the Extension Research and Development (ER&D) program under the Interdisciplinary Studies category has been changed from "Tree Improvement by Farmers" to "Community-Based Tree Improvement" (CBTI). This broader scope of activities was well illustrated by the report on the early experience of the Jackfruit Pilot Project in Cebu, where survey work is focusing on a wide range of jackfruit processors and marketing agents, as well as growers.

The CBTI activity appeared to be a logical follow-up to the TBO study, and participants from Indonesia and Nepal expressed a desire to enter the CBTI network with their own projects. Noting that the TBO study investigated local ideotypes for tree improvement but that it did not actually look into indigenous *processes* of tree improvement, the workshop participants felt that the existing processes by which farmers improve trees was neglected and should be investigated initially on a small scale to determine whether a larger netw study was warranted.

In discussing future tree improvement wor with farmers, a number of participants advance the argument (see especially the paper by Hegc that, while farmers might be involved in long-te genetic tree improvement activities, much more common and more productive in the short to medium term was tree improvement by management, or "ideotype by management" as (Nepalese participant phrased it. The workshop participants were strongly in favor of including various forms of vegetative tree improvement (I example, grafting and budding) within the scop any future community-based tree improvement efforts within the Network, right alongside such readily practiced tree breeding methods as simp mass selection and establishment of clonal seed orchards.

It was also suggested that a new round of ideotype investigations, using an improved, standardized TBO methodology, might be in or for the original TBO sites. This should lead to identification of plus trees of the most importar local species for establishment of clonal seed orchards for the benefit of the communities in which the TBO study was conducted.

The participants in the Kandy meeting requested the F/FRED Network Secretariat to look into possibilities for funding for these activities.

Individual Reports

Defining Tree-Breeding Objectives in Northeastern Thailand

Lert Chuntanaparb

Introduction

The F/FRED-sponsored research exploring farmer-selected ideotypes for tree species in South and Southeast Asia is described in Chuntanaparb and Ranganathan (1990). This discussion paper summarizes the findings in two forest settlement villages in Kalasin, in northeastern Thailand.

Methodology

The study on tree ideotypes was designed as an ancillary component to the regional study on Farm and Village Forest-use Practices (FVF). Two site visits were made for the regional FVF study and one additional visit for ideotype study.

In order to identify ideotypes appropriate to farmers' needs, a ten-step method was developed and used. Step 1 was carried out using data from the regional FVF study. The author used the same format to collect data in two villages. Steps 2-7 were conducted with the cooperation of five men and five women from households participating in the regional study during the second visit to the study sites. Step 8 was conducted after the second visit; Step 9 took place during the third site visit.

1. List priority species and tree products extracted from the regional study and summarizing in the following format by household:

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

Products were defined as leaves, branches, flowers, etc. This information was tabulated after the first field data collection from the regional FVF study.

2. Prioritize the list of products using the following format:

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

3. Ask respondents to describe the planting niches they prefer for these priority species (for example, homegardens, field margins, intercropped with annual staple crops).

4. Ask respondents to describe which characteristics they dislike about the priority species identified above.

5. Ask respondents to identify the top three individual trees for each of the priority species and why these trees are superior or preferred. Take photographs of each tree and label clearly. Ask respondents the source of the planting materials for these trees (neighbor, forestry department, private nursery, or natural forest).

6. Ask respondents to identify tree species used to provide the priority products listed in Step 1, but which are not as desirable, and list the reasons they are not preferred.

7. Use a series of line drawings of the following tree parts to help informants describe the ideotypes they would like for each priority species:

   - branching habit — many or few large branches, arrangement of branches
   - stem form — single stem, multiple stemmed, straight or crooked

- o rooting habit — strong taproot with little lateral branching, fibrous rooting system with strong lateral branching

- o foliage characteristics — palatability, leaf size, etc.

8. Summarize the information collected in Steps 2-7 after the second field visit. This synopsis provided the basis for the presentation to be made in Step 9.

9. Present and discuss the summary in group meetings with villagers.

   Two meetings were held with the women's group. These meetings (and individual trees visits) were conducted to obtain a consensus on the ideotypes described by the sampled households. The line drawings used in Step 7 were used in the group meetings as a basis for discussions. This step was performed on the third site visit.

10. Provide the F/FRED study coordinators with summaries of the seven ideotypes agreed upon in Step 9.

Although the methodology described above was developed for the specific purposes of this study, this does not mean that it cannot be used in other studies. Given clear breeding objectives, the methodology can be tailored appropriately for ideotype identification. If the desired species is known, for example, the 10 steps can be much reduced.

The author used all steps (with slight modification) and identified ideotypes of seven species in two locations in the northeastern region of Thailand. He believes that the ideotypes thus described reflect farmers' objectives.

Findings

Four of the seven priority tree species identified in the study are left to grow in cultivated land around the study sites:

Shorea obtusa
Shorea siamensis
Dipterocarpus tuberculatus
Dipterocarpus obtusifolius

The products desired from these four species are similar. 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. Specific desirable characteristics are:

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.

For the tree's response to management, farmers prefer prolific regrowth after branch pruning and reliable coppicing.

Regarding deciduousness, a short period of dry-season leaflessness is ideal.

Three of the seven species (*Leucaena leucocephala, Sesbania grandiflora,* and *Ceiba pentandra*) are grown in home lots (see plates). The ideotype descriptions for these appear in Appendix 1.

For *Leucaena* to produce the desired fodder, fuelwood, food, windbreaks and shade, a strong, wide, dense crown and profuse leaf production are the most important selection criteria.

With food and soil improvement as the major priorities for *Sesbania grandiflora*, selection should stress leaf production and dense crown. Subsequent phenotypic selection should concentrate on wood density to improve burning quality.

Selection criteria for *Ceiba pentandra* (kapok) should focus on crown, stem and heavy branching

Dipterocarpus obtusifolius

Shorea obtusa

Dipterocarpus tuberculatus

Sesbania grandiflora

Leucaena leucocephala

Ceiba pentandra

Plates. Farmers' preferred individuals of priority species in the study villages of Kalasin District.

for profuse fruit production. Wind tolerance is also desirable. Burning quality should be improved by increasing wood specific gravity.

Discussion

Differences in opinion of male group occurred in Step 5 when they identified the top three individual trees. But at Step 9, when meetings were held together with the women's group, a consensus on ideotypes was obtained.

Almost all farmers undertook basic steps in tree improvement work to obtain trees with desirable characteristics. For example, some farmers sought better varieties or seed sources of kapok, *Sesbania grandiflora* and *Leucaena* for their homegardens. In cultivating their farmland, they removed species and trees with undesirable characteristics and left selected species and individuals to stand. In tree-breeding terms, this represents a creation of improved seed stand. The major species now existing on farms are *Shorea obtusa, S. siamensis, Dipterocarpus tuberculatus,* and *D. obtusifolius*.

Of the seven priority species, improvement of the four slower growing ones that farmers allow to grow in cropland will require time and consistent effort. Moreover, information on flowering, fertilization, and propagation is not readily available. At present, it is rather difficult to embark on an improvement program for these.

Among the three homegarden species, *Leucaena* has received the most study interest and improvement work in many regions, and improved seeds can be obtained relatively easily. This species thus does not need a specific improvement program. *Sesbania grandiflora* is a good subsistence crop for household consumption, but it has very little market value.

An "ideal" tree for poor farmers in northeast Thailand should be useful for household consumption as well as having economic value. Kapok is a good example of this. Selection criteria for this species should be improved fruit production and related characteristics, increased wood specific gravity, and resistance to stem borers.

Identifying Tree-breeding Objectives of Small-scale Farmers in Sri Lanka

Prof. Anoja Wickramasinghe

Introduction

Farmers' experience, knowledge, and interest in nurturing trees dates back many centuries. In remote, traditional communities, use of traditional species and management practices have not changed much. However, not all widely used tree species possess physical characteristics and forms preferred by farmers. Farmers have identified, selected, and nurtured the most productive trees, but without the benefits of scientific methods of tree improvement. Modern breeding techniques can be used to obtain better quality products and the physical forms which are more suited to existing farming systems.

This was the aim of the study conducted in two villages located in the Ma-Oya catchment of the central highlands of Sri Lanka. The primary objectives were to identify the priority species and their uses, identify farmer perceptions regarding the species and characteristics, and see what improvements were needed for better integration of trees in their farming systems.

The Study Sites

The two villages, Madugalla and Bambarabedda, depend on agriculture for employment and subsistence. Resource distribution in the area is uneven due to: (1) differences in the impact of plantations established in the 1840s, which restricted community expansion in some areas, and (2) legislation protecting forest lands.

Trees are widely used in this area. Use of tree-borne food for household consumption, and collection of medicinal herbs and fuelwood for cooking are ancient practices. There is a great diversity in tree distribution and species composition. This diversity is associated with the individual family occupying the land, the farm size, and the farming system. Homegardens represent the most common of three units of farm production. The other two — paddy land and highland plots of other crops — depend on a family's wealth and location. Few families in Bambarabedda possess either paddy or highland plots; families in Madugalla are relatively better off, with greater land areas and comparativeiy better terrain.

Methodology

For the group discussions conducted to identify the farmers' tree-breeding objectives, the methods described by Chuntanaparb and Ranganathan (1990) were followed, but with many modifications.

Collecting information on farmers' perceptions of tree improvement and tree ideotypes was extremely difficult. This was in part due to the effects of other factors, including inequalities in land distribution and survival systems. At first, resource-poor farmers contributed very little information on characteristics of trees for farmland. Farmers had no experience or conceptual aids for describing their views on these subjects. Here researchers had to assist them to pool their ideas and experience. Traditional experience and examples helped to support and bring out their views. A stepwise procedure was followed to motivate farmers to play their roles. One strategy was to make them think and formulate their ideas of trees not just as physical objects, but as constituents of their survival systems that can be promoted practically and better integrated into their land.

Because this study followed the study on Farm and Village Forest-use Practices (FVF), the researchers and the community were familiar with each other. This familiarity, established through surveys, discussions, informal meetings, and observation, strengthened the researchers' understanding of the biophysical and socioeconomic situation and the farming systems, and allowed them to interact with the community very closely.

Central to this research was the ideotype identification, based on a series of "workshops". These workshops were informally organized and intended to motivate farmers to talk freely and discuss issues collectively. The flexibility of the agenda and informality made this possible.

Farmers' Workshops

Researchers prepared materials to present these discussions in an attractive way. The procedure can be divided into two stages. Orientation aimed to give the subject of land use a local grounding and promote the participants' interest in the subject. The Motivation and Presentation stage aimed to identify the species characteristics, both disliked and preferred, for different land uses and specific locations.

Stage 1: Orientation

- o Maps and aerial photographs were used to focus on the land-use components and the spatial patterns of land and plot arrangements.

- o From this, the group prepared a list of species found in the different production systems (for example, homegardens, hedges, fences, and hedgerows).

Stage 2: Motivation and Presentation

- o At this stage, the drawings of stem form and canopy shape provided by the study organizers were useful in motivating the participants.

- o The groups, consisting of children, women, and men with different interests and experiences, were excited and challenged by the line drawings, which they found to be "artificial". This unrealistic quality of the line drawings was, in most cases, the motivation that brought the participants to the blackboard to draw their own pictures of trees in their area.

- o Through discussion and reference to individual trees found in common places, the first line drawings were adjusted and features were changed.

- o Undesirable features of familiar trees were then pinpointed. At this stage the group was able to discuss the disadvantages of broad-canopied species with lateral roots.

- o Finally, the groups identified tree-breeding requirements and transformed the original line drawings to preferred ideotypes. After lengthy discussion, undesirable features were eliminated. The differences in their requirements at different sites was a striking point that emerged at this stage. Their consensus on requirements were site-specific and guided by priority products, space requirements, and the purpose for growing the trees. An ideotype of *Artocarpus heterophyllus* (jackfruit) as drawn by the group is shown in Figure 1.

Limitations

The farmers' tree-breeding requirements were strongly guided by: (1) the culture of tree-use practices, (2) their biophysical and socioeconomic situation, and (3) local farming systems. These must be considered when asking farmers for their ideas on how to improve tree species.

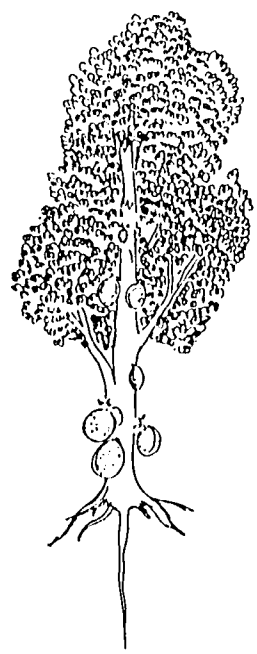


Figure 1. Drawing of *Artocarpus heteropyllus* as desired by farmers in the study.

Table 1. Species grown by the village households, and their order of frequency.

Species	Bambarabedda		Madugalla	
	No. of Hh Growing	Rank	No. of Hh Growing	Rank
Artocarpus heterophyllus	24	1	11	1
Cocos nucifera	19	2	8	3
Mangifera indica	4	4	4	6
Artocarpus altilis	3	5	-	-
Gliricidia sp.	6	3	6	4
Coffea arabica	3	5	-	-
Psidium guajava	1	6	-	-
Tamarindus indica	1	6	-	-
Madhuca longifolia	-	-	9	2
Persea gratissima	-	-	2	7
Acacia caesia	-	-	1	8
Croton laccifer	-	-	1	8
Pongamia pinnata	-	-	4	6
Musa acuminate colla	-	-	2	7
Eugenia faranica	-	-	2	7
Careya arborea	-	-	1	8

Hh = Households. Source: Wickramasinghe 1991.

Substantive Findings

Table 1 shows the priority species identified for each village — 8 for Bambarabedda and 14 for Madugalla. The major tree species in Bambarabedda are those intentionally planted and nurtured. In Madugalla, where land is more available, the opposite pattern was evident: most of the species are *not* intentionally grown. Except for *Artocarpus heterophyllus* (jackfruit), *Cocos nucifera* (coconut), and a few *Mangifera indica* (mango) trees, all the others are not planted, but protected and sustained for their uses. This suggests that where trees are widespread and not restricted to farmland or homegardens, a number of indigenous species are found.

Tree-Use Practices

Species priority can be a direct indicator of why farmers prefer some species to others, and can point to the criteria for species selection. In these villages, what appears to be most important is the tree's ability to produce food or kernels from which medicinal and edible oils can be extracted. Tables 2 and 3 show that all of the high-priority species are nurtured for their multiple uses. Production of food and fruit is the major determinant; fuelwood, fodder, mulch and others are of secondary importance. Cultural tree use is also associated with food habits. In Sri Lanka, jackfruit is used in many ways as a rice substitute and in other dishes. Coconut is used in almost every meal. Traditionally, many products of *Madhuca longifolia* have been used for extraction of medicinal and edible oils and other purposes. In dry-zone areas, oil extracted from kernels is still widely used as the best substitute for coconut oil.

Two examples show the importance of the placement of farmland production components. First is the widespread maintenance of food trees in homegardens, where they are nurtured for convenient harvest and where the produce can be

Table 2. Priority species, their primary uses, and availability among households in Bambarabedda.

Species	Household Number																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Artocarpus heterophyllus	*2f	*1f	*1f	*1f		*1f	*1f	*1f	*1f	*1f	*1f	*1f	*2f	*2f	*2f	*1f	*2f	*1f	*1f	*1f	*2f	*2f	*2f	*1f	*2f
Cocos nucifera	*1f		*2f		*1f	*2nf	*2f			*2f	*2f	*2f	*1f	*1f	*1f	*2f	*1f		*2f	*1f	*1f	*1f	*2f		*1f
Mangifera indica	*3f			*2f														*2f						*2f	
Coffea arabica						*	*3f	*2f																	
Tamarindus indica						3f	*																		
Gliricidia sepium		*2nf	*3nf		*2f					3nf						*3nf		*3nf							
Psidium guajava				*3f																					
A. altilis							*		*2f								*3f								

* = present in the household area. Priority of species: 1 = highest priority; 2 = second priority; 3 = third priority. Primary uses: f = primary use is food; nf = primary use is non-food. Source: Wickramasinghe, in press.

Table 3. Priority species, their primary uses, and availability among households in Madugalla.

Species	Household Number																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Artocarpus heterophyllus	*2f		*1f			*2f			*2f	*2f	*2f			*2f		*1f			*1f					*1f	*1f
Cocos nucifera	*1f				3f	*1f	*1f	*1f	*1f	*1f		*2f					*1f								
Mangifera indica					*1f							*1f	*3f					*1f							
Coffea arabica																									
Tamarindus indica																									
Gliricidia sepium		*1nf						*2nf				*3nf		*2nf			*2nf			*3nf		*3nf			
Psidium guajava					*2f						*1f				*2f	*2f			*2f						
A. altilis																									
Persea gratissima				*1f									*1f												
Careya arborea							*2f													*2f					
Acacia caesia																						*1nf			
Madhuca longifolia														*1f	*1f			*2f	*3f	*1f	*1f		*1f	*2f	*2f
Musa acuminate colla														*3nf											
Pongamia pinnata																					*2nf	*2nf	*2nf		*3nf

* = present in the household area. Priority of species: 1 = highest priority; 2 = second priority; 3 = third priority. Primary uses: f = primary use is food; nf = primary use is non-food. Source Wickramasinghe, in press.

protected from theft. The second example is in terms of tree form: food trees in homegardens frequently are allowed to have a dense canopy. Trees found in hedges and along fences, by contrast, usually have a single, long stem.

Undesirable Characteristics

Not all characteristics of the priority species are appreciated equally. Broad canopy and lateral rooting were generally not appreciated.

Desired Improvements

The farmers' tree-breeding objectives were to:

1) eliminate the disliked characteristics
2) obtain a regular harvest
3) improve the quality of produce
4) improve resistance to drought and wind

The main problems faced by farmers in tending familiar species related to scarcity of land. *Artocarpus altilis* (breadfruit), *Tamarindus indica* (tamarind), and *Madhuca longifolia* are examples of trees presenting problems in this regard. If farmers prune these species to narrow the canopy width in order to accommodate more crops in the understory, their food harvest is vastly reduced. For these species, a broader canopy and many branches are needed for good harvests. In this context, jackfruit has an advantage in being adaptable to the ideotype by management: it can withstand pruning without reduced fruit production. This is one reason for its appeal for farmers. Following a traditional belief, farmers often prune jackfruit branches in order to induce more fruits to emerge on the main stem. For this species, farmers desire more fruits lower on the stem and better harvests from young trees.

What is sought through tree improvement is improved varieties without reduction in their range of uses and benefits (see Table 4).

Tree Ideotypes

The line drawings were intended to determine the differences between the priority species' present characteristics and preferred improvements. As with disliked characteristics, farmers' decisions on preferred characteristics varied according to the tree's ecological niche.

Farmers' preference for a narrower canopy without reduced production appeared to explain the gradual disappearance of some species traditionally grown, such as breadfruit, tamarind, and *Madhuca longifolia*. For these, a broad canopy and many branches are necessary for good harvests of food/fruit, the priority use of these species. As mentioned above, jackfruit is exceptional in its ability to withstand pruning management for a narrower canopy without reduced fruit yields.

Ecological Niches

As mentioned above, the importance of ecological niches emerged in the group discussions. The final line drawings produced at the on-farm workshops illustrate this point. Farmers indicated few improvements for trees on common or reserve lands (Figure 2), but when they produced line drawings for trees on their own farm land (Figure 3), they showed much concern about reducing the canopy width.

Differences between ideotypes for trees on farmland and those in homegardens related more to expected uses, particularly primary products.

Table 4. Ideotype specification for agroforestry. Source: Wickramasinghe 1991.

Products and services required	Selection Criteria	Ancillary Information	Crown	Stem	Roots	Response to management	Deciduousness
Food, Erosion control, Wind-break, Fuelwood, Timber, Mulch, Fodder	Vigor, Pest and disease free, Easy propagation/ germination	Tolerates dry season, Tolerates low fertility soils, Tolerates low soil moisture	Dense, Narrow Round, Bole ratio = 15-2	Straight/multi-stem (varies according to conditions)	Geotropic Angled	Pollarding, Branch pruning	Continuous vegetal cover

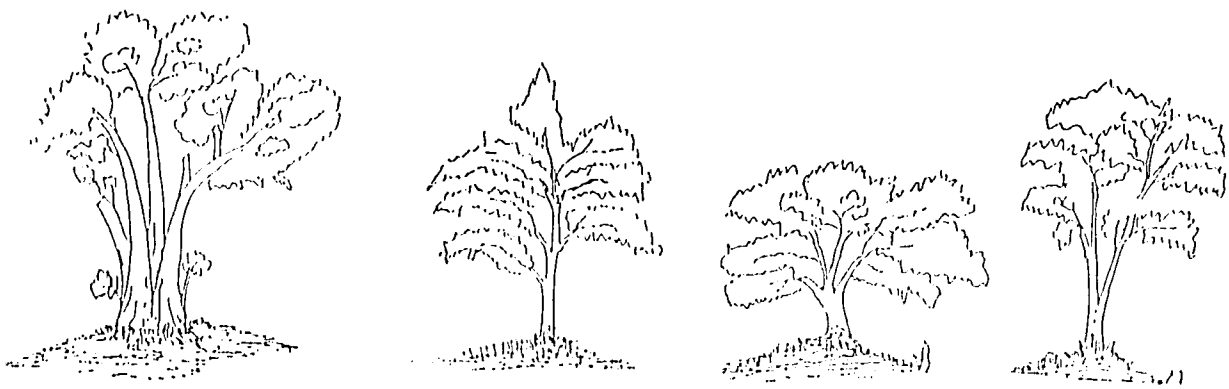


Figure 2. Ideotypes identified by farmers for common land. Source: Wickramasinghe 1991.

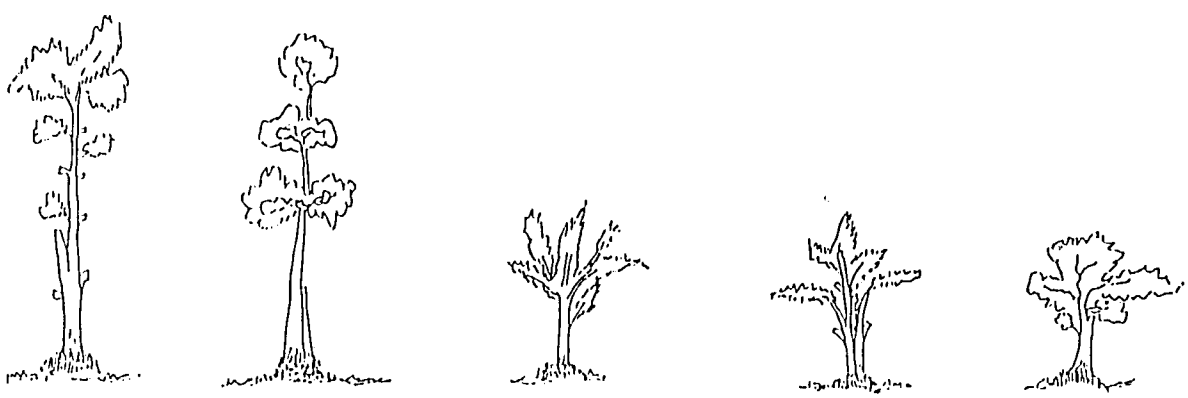


Figure 3. Ideotypes identified by farmers for farm land. Source: Wickramasinghe 1991.

Environmental benefits, such as coolness and shade, were preferred features of homegarden trees, along with food production. In farmland, farmers wanted to reduce the shade. Linearity was the main requirement for hedge and fence trees; trees that did not branch below 2-3 meters above ground level were considered ideal.

Conclusions and Recommendations

This study revealed that farmers' criteria for selecting trees are:

1. multiplicity of products
2. ability to address primary needs of food and fruit
3. ability to grow in a narrow space
4. ability to survive with limited root biomass in the upper soil layers

It is extremely important to involve heterogeneous groups in the discussions to integrate community perceptions and needs into any planned intervention. Heterogeneity, particularly in terms of gender, facilitated more practical discussions. Women participants were much closer to the reality of trees' multiple household uses and were better at drawing the tree features. Their concern with the multiplicity of products drove them to incorporate more features into the line drawings.

Based on this, the need for employing women researchers and involving women farmers should be stressed. Women researchers were able to encourage women participants to take an active part in the discussions.

Finally, the study could have been better analyzed and presented if the entire process had been recorded using audio or audiovisual equipment.

Studying Farmer's Tree-breeding Objectives in West Java, Indonesia

Junus Kartasubrata

For this study of farmers' tree-breeding objectives (TBO), two villages were purposively selected in the Citanduy river basin in the eastern part of West Java: Payungagung (600-800 m above sea level, rainfall 2000 mm/year) and Karangsari (20-200 m above sea level, rainfall 1743 mm/year). These were the same locations where the regional study on Farm and Village Forest-use Practices (FVF) was conducted (Kartasubrata 1990).

Methodology

The TBO study was carried out between March 31 and November 31, 1989, using the following steps:

1. Randomly select five males and five females in each village for household survey on the species and product preferences.

2. List respondents' priority species and products.

3. Ask respondents for their preferences regarding planting niches for these priority species.

4. Ask respondents to describe characteristics they dislike about the priority species.

5. Ask respondents to identify the top three individual trees for each of the priority species.

6. Ask respondents to identify other, less-desirable tree species used to provide the same priority products, and describe why they are not preferred.

7. Using line drawings, ask respondents to describe ideotypes they would like for each priority species, in terms of: branching habit, stem form, rooting habit, and foliage characteristics.

8. Arrange group meetings with villagers to obtain consensus on the ideotypes described by the sampled households. Use the line drawings in these group meetings.

Modifications During the Study

1. Tables were modified to accommodate more species in a limited space.

2. Following a change by the study organizers, respondents were not asked their preferences regarding rooting habit.

3. Selection and ranks were recorded for seven and eight priority species, rather than six as originally planned. This improved the frequency distribution record.

Other Suggested Changes

1. For greater accuracy, each village sample group should consist of at least 30 persons.

2. In addition to the mixed-gender group interviews, conduct separate interviews with male-only and female-only groups. This would permit records of differences in preference between males and females.

3. Invite respondents to make their own line drawings to describe their preferred ideotypes.

Study Findings

Preferred Species

The Payungagung farmers' priority species, as selected by five male and five female respondents individually, are shown in Table 1.

A group interview with the five female and five male respondents arrived at a consensus of priority species (Table 2).

Karangsari farmers' priority species, based on individual interviews, are shown in Table 3.

Based on a consensus among the five female and five male respondents in Karangsari, the species in Table 4 were selected as priority MPTS.

Preferred ideotypes

Table 5 describes the ideotypes identified for both villages (see also Appendix 1).

Differences in Farmers' Preferred Species

Tables 6 through 8 examine the differences in expressed priorities regarding tree species. Only *Paraserianthes falcataria* grows well and has economical value in both ecosystems, and hence the same rating.

Table 7 shows the differences in ranking based on individual preferences and consensus ranking. Although in Karangsari, *Tectona grandis* (teak) ranked fourth on the basis of individual preferences due to its good timber, the group complained of its slow growth and the difficulty in selling the timber

Table 1. Priority species selected by individual respondents in Payungagung.

Species	Frequency	Rank
1. *Paraserianthes falcataria*	10	1
2. *Artocarpus heterophyllus*	10	2
3. *Eugenia aromatica*	8	3
4. *Maesopsis eminii*	6	4
5. *Parkia speciosa*	3	5
6. *Schima noronhae*	2	6
7. *Swietenia macrophylla*	1	7
Total	40	

Table 2. Group consensus on priority species, with rank and perceived advantages, for Payungagung.

Rank	Species	Advantages
1	*Eugenia aromatica*	Grows well locally, relatively high price of products, particularly dried flowers (clove)
2	*Paraserianthes falcataria*	Fast growth and various uses (wood for timber and fuelwood, leaves for fodder)
3	*Artocarpus heterophyllus*	Mature fruit tastes good; immature fruit useful in soups; both marketable at a reasonable price
4	*Maesopsis eminii*	Fast growth, leaves useful for fodder
5	*Parkia speciosa*	Edible and salable pods, rather abundant; wood for firewood
6	*Swietenia macrophylla*	Good timber for house construction

Table 3. Priority species selected by individual respondents in Karangsari.

Species	Frequency	Rank
1. *Cocos nucifera*	10	1
2. *Paraserianthes falcataria*	9	2
3. *Albizia procera*	7	3
4. *Tectona grandis*	4	4
5. *Swietenia macrophylla*	3	5
6. *Eugenia aromatica*	3	6
7. *Achras zapotta*	2	7
8. *Maesopsis eminii*	2	8
Total	40	

Table 4. Group consensus on priority species, with rank and perceived advantages, for Karangsari.

Rank	Species	Advantages
1	*Cocos nucifera*	Grows well locally; high and continuous fruit production
2	*Paraserianthes falcataria*	Fast growth; valuable timber, easily marketable
3	*Albizia procera*	Fast growth; wood for construction
4	*Achras zapotta*	Produces abundant fruit that fetch a good price
5	*Swietenia macrophylla*	High quality timber for own house construction
6	*Maesopsis eminii*	Good growth in home garden; reasonably good timber

Table 5. Ideotypes for priority species.

Species	Ideotype Description
Payungagung	
Eugenia aromatica	Short, clear bole; many branches; dense foliage; easily harvested flowers.
Paraserianthes falcataria	Big, long, straight, clear bole; dense foliage.
Artocarpus heterophyllus	Big, tall; many branches; dense foliage.
Maesopsis eminii	Big, straight clear bole; tall.
Parkia speciosa	Big stem; many branches; dense foliage.
Swietenia macrophylla	Big, straight, clear bole.
Karangsari	
Cocos nucifera	Horizontal and abundant leaf stalks; big stem.
Paraserianthes falcataria	Big, long, straight, clear bole; dense foliage.
Albizia procera	Big, tall, straight, clear bole; dense foliage.
Achras zapotta	Big stem; many branches; dense foliage.
Swietenia macrophylla	Big, straight, long, clear bole; dense foliage.
Maesopsis eminii	Big, straight, long, clear bole.

due to required legal documents. The small size of the sample may be the cause of the differences in rating.

Table 8 shows gender differences in expressed species priorities. Male respondents outnumbered females in selecting *Eugenia aromatica*, *Paraserianthes falcataria*, and teak. This may be caused by the preference by males for species that yield commercial produce.

Differences in Farmers' Ideotypes

There were no major differences among farmer-identified ideotypes, especially regarding stem form. There were slight differences concerning branching habit; a number of respondents could not make up their minds.

For branching of *Maesopsis eminii*, the answers were small/few branches, or no answer at all. The mental image of a *Maesopsis* tree with small/few branches was probably created by the prevailing phenomenon that large, tall *Maesopsis* trees, particular in rather dense stands, usually have relatively small canopies with few branches.

Tree Improvement by Farmers

In general, tree improvement takes place for valuable fruit trees such as mango (*Mangifera indica*), rambutan (*Nephelium lappaceum*), citrus (*Citrus* spp.), lansone, and durian (*Durio zibethinus*). This usually employs vegetative techniques such as grafting and marcotting, and is facilitated by the horticultural extension agency.

The Forestry Agency has started breeding the forest species of teak and *Paraserianthes falcataria* by:

- identifying plus trees for breeding
- establishing seed stands for both species and clonal seed orchards for teak
- tissue culture (teak)

The *sengonization* program, which is establishing large-scale farm plantations of *Paraserianthes falcataria*, particularly in humid, low- to mid-mountain areas, could be boosted by encouraging use of seeds from plus trees and establishing seed orchards in villages.

Table 6. Differences in priority species due to ecological conditions.

Species Rank	Payungagung (upland)	Karangsari (lowland)
1	*Eugenia aromatica*	*Cocos nucifera*
2	*Paraserianthes falcataria*	*P. falcataria*
3	*Artocarpus heterophyllus*	*Albizia procera*
4	*Maesopsis eminii*	*Achras zapotta*

Table 7. Differences in ranking between individual and consensus priorities.

Rank	Individual opinions	Consensus
Payungagung		
1	*P. falcataria*	*E. aromatica*
2	*A. heterophyllus*	*P. falcataria*
3	*Eugenia aromatica*	*A. heterophyllus*
4	*Maesopsis eminii*	*Maesopsis eminii*
Karangsari		
1	*Cocos nucifera*	*Cocos nucifera*
2	*P. falcataria*	*P. falcataria*
3	*Albizia procera*	*Albizia procera*
4	*Tectona grandis*	*Achras zapotta*

Table 8. Differences in species priorities of male and female respondents (frequency pattern in selecting priority species).

Species	Respondents	
	Male	Female
Payungagung		
Eugenia aromatica	5	3
Paraserianthes falcataria	5	5
Artocarpus heterophyllus	4	5
Maesopsis eminii	4	4
Karangsari		
Cocos nucifera	5	5
Paraserianthe falcataria	5	4
Albizia procera	4	4
Tectona grandis	2	0

A New Strategy For Improving Multipurpose Tree Species

Narayan G. Hegde

The regional interdisciplinary study on the farmers' tree-breeding objectives (TBO) was intended to receive feedback from farmers about ideal forms of different tree species. Although the objective of the study was the same in each country where it was conducted, the varying feedback from farmers in different localities poses new challenges (Chuntanaparb and Ranganathan 1990). There is no easy way to meet the emerging requirements.

Factors Influencing the Farmers' Ideotypes

Three factors influence farmers' definition of an ideotype of a multipurpose tree.

1. **Tree Use**: Farmers' requirements of a tree change, depending on what type of produce they expect to harvest: timber, fodder, fuel, food, medicine, or mulch.

2. **Placement**: The desired ideotype will also vary depending on the site and system in which the tree will grow. Wickramasinghe (1991) identified homegardens, farm lands, hedges, fences and common lands as possible planting sites. Others include pastures, wastelands, marginal agricultural lands, field bunds, and road sides.

3. **Size of landholding**: This affects the availability of land for planting trees. With limited area, small farmers would tend to prefer trees with small canopies so as to conserve land for food production and avoid competitive effects on nearby agricultural crops.

Farmers' Expectations

The TBO study's results for the respective countries were common in many respects. Important findings were farmers' preferences for:

- Fruit trees that yield more fruits of good quality, and at an earlier age
- Trees with straight, long and clear boles, with medium to wide canopies
- Deep roots for stability

Other specifications were for better vigor and regeneration capacity, larger leaves and fruits, better quality wood and fodder, thornless branches, and better aroma.

Feasibility of Introducing New Traits

In reviewing the ideotypes selected by farmers, it was observed that breeding for all of these traits is neither easy nor necessary. An ideotype developed for a specific site and use may not be useful at other sites. Farmers are likely to become confused by the introduction of site-specific cultivars. In areas where forestry extension networks are weak and awareness and training facilities are inadequate, farmers are likely to select a wrong provenance, which might result in failure of the tree-planting effort. Where the environmental and socioeconomic conditions are heterogeneous, it is advantageous to select a variety with multiple uses and wider acceptance, not strains that are highly site-specific.

An Alternative Strategy

Some of the above-mentioned objectives can be fulfilled without breeding new varieties. Suitable management practices and selection of suitable varieties already available can be faster and more easily adopted than breeding. Many of farmers' needs can be fulfilled by: (1) introduction of appropriate silvicultural techniques; (2) collection and evaluation of germplasm of different tree species; and (3) breeding to develop different ideotypes.

Introduction of Appropriate Silvicultural Practices

An ideally shaped tree with a clear bole can be developed by planting at closer spacing, proper thinning, pruning side branches, and providing necessary support. Fodder production can be increased by inducing more branch growth through pruning of the main stem at various stages.

Farmers expressed the need for trees with deep root systems. However, root growth is heavily influenced by site factors such as the soil type (depth and chemical composition) and moisture content. In shallow and waterlogged areas, even tap roots do not penetrate deeply. In deep soil, even weak roots go deep in search of water and nutrients. Depending on the type of soil, special silvicultural and tillage practices can be applied to enhance root growth.

Similarly, regeneration capacity can be improved by identifying the optimum time for pruning, irrigation, and fertilizer application. Early fruit set, another important trait, can be induced through vegetative propagation. Thus many desired growth habits can be induced through silvicultural practices.

Collection of Germplasm and Evaluation

Tree species exhibit a wide range of variation in germplasm quality, yet there has been little systematic collection and evaluation of seed sources except for a few species. By selecting suitable strains already available in different regions, farmers can have trees that produce superior-quality fruits.

Likewise, thornless varieties of *Prosopis juliflora*, larger-fruiting varieties of *Azadirachta indica* (neem), and *Tamarindus indica* (tamarind) varieties that produce larger pods are also available in parts of the tropics, although the farmers participating in the TBO study may have been unaware of them. Thus germplasm collection, evaluation, and introduction can help meet farmers' requirements.

Tree Breeding

Improved silvicultural practices and collection of available germplasm can reduce the pressure on tree breeders to a great extent. Moreover, selection of promising seed sources is necessary even before a tree-breeding program can begin.

Some of the farmers' objectives that can be fulfilled only by breeding are:

- o Size of leaves, fruits, and seeds
- o Tree vigor and biomass production
- o Calorific value of the wood

However, tree breeding is a slow process that may take 8-15 years before a cultivar is ready for release. For many species,it may be difficult to achieve the above objectives. Nonetheless, this is a long-term technology that should not be ignored.

Conclusions

1. Farmers' expressed ideotypes for improved productivity and uses are based on their knowledge of the locally existing planting material.

2. Farmers' ideotypes vary depending on the demand for the produce and uses, available sites, landholding pattern, and agro-ecological conditions. If different varieties are bred to meet such specific requirements, it will be difficult for farmers to select the appropriate cultivar. It is better to make available cultivars that are suitable for a range of conditions and uses.

3. Before starting a tree-breeding program to meet farmers' objectives, it is better to explore possibilities for meeting these needs through silvicultural practices and introduction of varieties available in other regions.

4. After that, a long-term breeding program can be initiated, provided it has a set of minimum and most essential objectives that cannot be fulfilled by other methods.

Farmers' Tree-Breeding Objectives in Two Villages of Mountain Province, Philippines

H. Arocena-Francisco

Introduction

At first, research on farmers' breeding objectives for tree breeding struck me as something completely new and unconventional. This is because I had always thought that breeding was entirely in the domain of scientist-breeders who perform God-like miracles into which mortal farmers should never interfere. I was fascinated to find that some breeders were in fact interested to learn about what farmers, the technology users, look for when they select a crop or tree species.

Of course, end-users of a technology — trees, in this case — could be: farmers as direct users of tree products, consumers who buy the tree products for direct consumption or utilization, processors who buy tree products as intermediate input for the production of other commodities, or traders who move the products from point of production to point of consumption. These varied end-users will view the tree and its products differently, depending on the primary functions that the tree performs for them.

Among these end-user groups, the farmer-producers may be said to provide the best gauge of preferred tree species' characteristics for two reasons:

(1) many tree species and their products are mainly for home consumption;

(2) the farmers as producer-sellers are in the best position to know what characteristics are desired by buyers of their produce.

Knowledge of farmers' tree-breeding objectives is thus very relevant to forest scientists' breeding activities.

Methodology

Since this is a new field, there are as yet no standardized methods of data collection. The regional tree-breeding objectives (TBO) study can therefore be viewed as exploratory in methods, but the data generated in the process should in no way be considered substandard.

The TBO study was conducted together with a Farm and Village Forest-use Practices (FVF) study sponsored by F/FRED. Researchers participating in the TBO study were provided with guidelines on the methods for data collection. The proposed methods entailed conducting group interviews with single-gender groups. The identification of tree ideotypes was to be guided by line drawings highlighting particular tree characteristics. It was in the use of these line drawings where some variations in the methods of eliciting data were noted.

For the TBO study in the Mountain Province sites, household survey and group interview were the methods of data collection used.

Household Survey

A significant portion of the FVF household survey dealt with households' preferences regarding tree species found locally, as well as those not found locally. The survey also asked about households' uses of trees, parts used for different purposes, and preferred and undesirable characteristics of priority tree species. This information is, in essence, tree-breeding information.

For most households in the household survey, the source of information was the male household head. In cases where they were not available, female household heads were interviewed. The responses in Tables 1 and 2 reflect answers by both male and female respondents, and hence are not gender differentiated. If desired, gender differentiation analysis can make use of the unprocessed data. This is one advantage of the household survey over group interviews, where individual responses are generally not recorded.

Table 1. Preferred tree species identified in the household survey, Bila.

Rank	Species	Product (Rank)	Characteristics
Locally Available Species			
1	*Pinus kesiya*	timber (1) fuelwood (2) furniture (3) handicrafts (4)	durable; larger, straight trunks, hard wood; resistant to termites; burns longer; heat can be regulated; fuelwood emits less smoke
2	*Alnus maritima*	fuelwood (1)	faster growth; more leaves for shade
3	*Psidium guajava* (guava)	food (1) fuelwood (2) farm tool handles (3)	hard wood
4	*Leucaena leucocephala* (ipil-ipil)	fuelwood (1) fence posts (2) fodder - leaves (3)	faster growth; durable
5	*Ficus septica* (liwliw)	fuelwood (1) rituals (2)	high water-holding capacity; broad leaves
Species Not Found Locally			
1	*Dipterocarpus grandiflorus* (apitong)	timber (1)	durable; better quality timber
2	*Albizia saman* (acacia)	fuelwood (1) fodder (2)	hard wood; big trunks
3	*Shorea astylosa* (yakal)		hard wood
4	*Bambusa* spp. (bamboo)		faster growth

Table 2. Preferred tree species identified in the household survey, Guinzadan.

Rank	Species	Product (Rank)	Characteristics
Locally Available Species			
1	*Pinus kesiya*	timber (1) fuelwood (2) furniture (3) resin (4)	durable; termite resistant; straight trunks; hard wood; fuelwood emits less smoke; flammable; burns longer (economical usage); heat can be regulated
2	*Alnus maritima*	fuelwood (1) fence posts (2) fertilizer - leaves (3)	more branches; faster growth
3	*Psidium guajava* (guava)	food (1) fuelwood (2) medicine (3) farm tool handles (4)	hard wood
4	*Persea americana* (avocado)	food (1) fuelwood (2) medicine - leaves (3)	hard wood
Species Not Found Locally			
1	*Pterocarpus indicus* (narra)	timber (1) furniture (2) fuelwood (3)	hard wood; durable
2	*Shorea astylosa* (yakal)	timber (1)	hard wood; durable
3	*Shorea polysperma* (tanguile)	timber (1)	hard wood
4	*Leucaena leucocephala* (ipil-ipil)	fuelwood (1) fodder (2)	
5	*Eucalyptus camaldulensis*	medicine (1) posts (2) timber (3)	

Researchers noted that the respondents had no difficulty answering questions in this section of the survey and that they could verbalize quite well their tree-breeding preferences. The descriptions of specific tree ideotypes requested in the TBO study were not obtained, however, because the researchers themselves were not familiar with these descriptors.

Gender-Differentiated Group Interviews Using Line Drawings

Under this method, a group of not less than five male or female household heads from among those interviewed in the household survey were invited to a meeting. After explaining to them the objectives of the TBO study, the line drawings were shown to the group.

The different descriptors of tree characteristics considered include canopy shape, leaf arrangement, branching habit, stem form, height and rooting habit. Description of some of these characteristics was aided by the line drawings.

There were several variations in the group survey method, stemming mainly from the way the line drawings were used to generate farmers' preferences.

Respondents were made to think of an "abstract tree"

The first meeting was with a group of men in Bila. About 12 household heads attended the meeting. It was explained to them that the line drawings do not represent any particular type of tree, and that they were expected to use these drawings as guides in identifying particular attributes of a tree that they would like to have.

Respondents were asked to think of a specific priority tree species and describe what modifications they would want in these species' characteristics, using the line drawings as guide.

This method was used with the groups of women from the two villages. A modification was made when it became apparent from the experience with the Bila men's group that the respondents could not dissociate the line drawings from existing tree species that appear similar to the line drawings.

Respondents were asked to choose and rank from among the line drawings those which represent their preferred tree ideotypes.

This method was used in the meeting with the Guinzadan men's group. There were about 15

Plate. Meeting of Guinzadan men's group, with drawings used to elicit preferences in the background.

male participants in the meeting; about 5 women from an earlier meeting also joined the group. Since the group was dominated by men, however, women participated very minimally in the discussion.

The decision to modify the approach this time came from the observation that almost always, group meeting participants associated the line drawings with known tree species having similar appearance. Extra time was needed — sometimes quite a bit — to dispel this association. It was thus thought that it may be worthwhile to let the respondents continue to associate the drawings with familiar species.

With only 15 participants in the meeting, it was not too difficult to get their individual ranking of the line drawings. Before they were asked to decide on the final ranking, however, a group discussion was begun by asking volunteers to rank the line drawings according to their preference, and to explain the reasons for their choices. Research team members noted the reasons given. After all who wished to speak had done so, each male participant was asked to give his ranking. This was noted and used as a basis for obtaining the group's preferred tree ideotypes.

Research Findings

As explained above, this research studied both methods and farmers' tree-breeding objectives. The following discussion presents lessons learned from the use of several data collection methodologies in the TBO study conducted in two villages of Mountain Province, as well as the findings generated through these methodologies.

Analysis of Data Collection Methodologies

There are many possible methods by which farmers' tree-breeding objectives could be determined: using either the household survey or group interview methods; group interviews of mixed-gender or single-gender groups; conducting interviews with the aid of line drawings or by relying only on farmers' descriptions drawn in the process by a designated "artist" from among the participants or researchers. Finally, the way the line drawings are used can also vary.

From this researcher's experience in the two villages of Mountain Province emerge a few generalizations on methodology.

1. *Household surveys and group interviews can be equally potent techniques in generating the desired information.* The household survey used for the FVF study generated substantial information on farmers' preferred tree species, priority uses of trees, preferred parts for each use or purpose, and even desirable and undesirable characteristics of trees. Had the line drawings been available when the FVF survey was conducted, the specific characterizations could also have been obtained through the household survey.

Virtually the same information was secured through the group interviews, with a few more details on canopy shape, branching habit, etc. These data were generated because researchers knew that they were to collect them, which was not the case during the FVF survey. Hence, the difference in the details obtained was not due to the method of data collection employed but to the researchers' awareness of what detailed information was to be collected.

No significant deviations on the data regarding farmers' preferences for tree characteristics, uses, and species resulted from using the two methods. This further supports the observation that the two methods are almost equally potent. Which would I recommend? Group interviews are less costly than household surveys. The TBO study set out simply to get farmers' input to breeders on what to breed for, and not what proportion of the population prefer specific tree characteristics (which could be generated through household survey); group interviews are a more inexpensive way to obtain this desired research output.

2. Regarding the merit of separate single-gender group interviews: *although preferences on tree species and uses generally did not vary with respect to gender of the respondents, there were significant gender variations among responses for minor uses.*

In particular, women tended to display greater awareness of the value of trees for non-conventional uses, such as ritual and medicinal purposes. Female members of the community also identified use of certain tree parts (for example, pine needles for pottery) in cottage industries. Such important information may not emerge if only male household heads are interviewed.

For both villages, the men had more difficulty conceptualizing an abstract tree on the basis of the line drawings. (Could it be that women are more imaginative than men?) Men especially could not resist labelling the line drawings using the names of locally available tree species. This highlights the need for researchers to be flexible in how they use the line drawings.

3. *The use of prepared line drawings of trees as guides in ideotype specification by farmers is worth analyzing.*

The line drawings were most valuable to researchers trained in fields not related to forestry. These drawings enabled us to grasp what was being asked of the respondents, which was otherwise vague even to us.

The line drawings provided some points of comparison for descriptors such as height of timber, diameter size, and canopy density. Preferences expressed as, for example, a tree taller than that in the line drawings gave the researchers a more concrete answer than if expressed as "the tree has to be tall."

However, the drawings would have been more useful if the different characteristics had been drawn separately. There should be a separate set of drawings for each characteristics (canopy shape, height and diameter of trunk, leaf shape, rooting habit, etc.) instead of drawings of several trees that embodied these different characteristics. Again, it took quite some time for the respondents to dissociate real trees from the line drawings. With the different parts of trees and their characteristics drawn separately, anybody from the group could put together desired characteristics of any preferred tree species to come up with a tree ideotype for that species.

Analysis of Data on Farmers' Tree-Breeding Objectives

1. Farm Household Survey

Household survey results revealed that the three top-ranking tree species in both villages are *Pinus kesiya, Alnus maritima,* and *Psidium guajava* (guava)(Tables 1 and 2). This selection is consistent with farmers' preferred uses of trees: timber, fuelwood, and food, in descending priority.

For non-fruit bearing tree species, farmers always ranked timber first among uses. Timber is intended mainly for house construction, furniture, and fence posts. Of these uses, the desire of the members of the two ethnically different communities for housing materials is foremost and transcends generational boundaries. The desire of the present generation to ensure timber supply for their children's and grandchildren's housing requirements resulted from the strong sense of ethnicity binding the present generation to future generations. This sentiment was stronger in Bila than in Guinzadan, where greater exposure to the market economy and modernization have caused noticeable "ethnic-erosion" among the people.

Tree species capable of producing timber with hard, durable, termite-resistant wood, and straight trunks are therefore top in the priority listings of both villages, even though most respondents have their own houses already. *Pinus kesiya*, a common tree species in both villages, possesses these desirable characteristics and ranks as the most preferred tree species.

Fuelwood ranks second in priority use of trees. Species identified as good fuelwood sources included *Alnus maritima, Leucaena leucocephala, Ficus septica*, and *Pinus kesiya*. Farmers preferred fuelwood trees that grow fast, burn longer, can be regulated for heat, and emit less smoke.

For fruit-bearing tree species, secondary values (after food) include fuelwood, farm tool handles, and medicinal uses. Besides guava, the priority species were *Chrysophyllum caimito, Coffea arabica* (coffee), and *Persea americana* (avocado). The household survey yielded no information on preferred characteristics of fruit tree species.

Group Interviews (Male and Female Groups)

Both male and female members of the Bila community consider *Pinus kesiya* the most important tree species. Again, this reflects the fact that to almost everyone, a tree's timber value is still its most important use. For pine trees, they prefer species that yield straight boles at a merchantable height, with durable and hard wood, and prolific branching for its secondary use as fuelwood.

After timber, Bila households look for trees that are good fuelwood sources. Fuelwood species are indicated in Tables 3 and 4, but most are known only by their local names. A significant difference between female and male respondents was noted in Bila, where the women tend to see beyond the wood value of trees. Women identified trees with high water-holding capacity and medicinal and ritual uses in their priority listing (Table 3). By contrast, men's preferences were focussed on the wood value of trees as timber, fuelwood, farm tool handles, furniture, handicrafts, and as fence posts (Table 4). Fruit-bearing species did not emerge among the top five priority trees in either the male- or female-group interviews.

The observation regarding the greater sensitivity of Bila women to other important but "minor" uses of trees cannot be said of the Guinzadan women. As Table 5 shows, the Guinzadan women preferred wood-based products, such as timber, fuelwood, furniture, fence posts, and farm tool handles. This preference for largely economic uses might be explained by the greater exposure of Guinzadan to the larger market economy, as the village is located along the provincial highway and has the greatest number of professionals in the province.

Table 3. Group interview results, Bila women's group.

Rank	Species	Products (Rank)	Characteristics	Ideotype features
1	*Pinus kesiya*	timber/lumber (1) fuelwood (2) furniture (3) handicrafts (4)	Durable; large, straight trunks; firewood with heat that can be regulated, burns easily, and emits less smoke	Straight bole at merchantable height Prolific branching Geotropic roots
2	*Ficus nota* (tipik)	watershed (1) fuelwood (2) preserving fruit juices (3) medicine - leaves (4)	High water-holding capacity; broad leaves	No changes, except geotropic roots
3	*Ficus septica* (liwliw)	ritual use (1) watershed (2) fuelwood (3) to speed ripening of banana - leaves (4)	High water-holding capacity; broad leaves	Straight, green bole Leaves - no change Geotropic roots
4	*Eucalyptus camaldulensis*	medicine (1) timber/lumber (2) fuelwood (3)	Growth faster than *P. kesiya*; smooth surface	Leaves - longitudinal Straight bole at merchantable height
5	*Pterocarpus indicus* (narra)	timber (1) furniture (2) fuelwood (3)	Durable; hard wood	Leaves - no change Straight bole at merchantable height Geotropic roots

In choosing their most preferred tree species using the line drawings as its embodiment, farmers selected the one that looked most like *Pinus kesiya*. Consistent with the choices made by the other groups, they considered a tree's timber value as its most important use. Succeeding choices of line drawings also reflect their preferences for fuelwood and other wood-based uses.

As compared to the other method, the use of line drawings as a basis of selection enabled the respondents to identify other uses of trees such as for shade and ornamental which were not identified by the other groups. These are, however, still classified as "minor" uses.

In general, the following can be said about the findings of the TBO study in Mountain Province:

Table 4. Group interview results, Bila men's group.

Rank	Species	Products (Rank)	Characteristics	Ideotype features
1	*Pinus kesiya*	timber/lumber (1) fuelwood (2) furniture (3) handicrafts (4)	Durable; larger diameter trunks; straight trunks; fuelwood burns longer, can be regulated, emits smoke, burns well	Straight bole Longer merchantable height Prolific branching Diameter at least 30 in. (76 cm) Geotropic roots Fitted to sloping topography
2	Payen	timber/lumber (1) farm tools (2) food (3) furniture (4)	Hard wood; growth faster than *P. kesiya*; large trunk	Big trunk Fruits for food Fast growing Hardwood Geotropic root
3	*Pterocarpus indicus* (narra)	timber/lumber (1) fuelwood (2) furniture (3)	Durable; hard wood	Straight bole Free from pests and diseases Prolific branching
4	*Eucalyptus camaldulensis*	medicine (1) timber/lumber (2) fuelwood (3)	Grows faster than *P. kesiya*	Straight bole Fast growing Longer merchantable height Geotropic roots Broader canopy Leaves - longitudinal Bark - smooth
5	*L. leucocephala* (ipil-ipil)	fuelwood (1) fence posts (2) fodder (3)	Fast growth; durable	Big enough for posts Straight bole Faster growth "Giant" variety should be better adapted to grow as giant locally

1. Farmers' choice of tree species is largely based on the trees' Use-Value (largely economic). This means that a breeder probably needs to know only farm households' priority uses of trees in order to identify the tree species that would be preferred by the community. This also indicates that farmers may not be very particular about which species they grow, as long as their priority tree uses are satisfied.

2. In Mountain Province, trees are used primarily for timber and fuelwood. Other uses are for furniture, handicrafts, tool handles, food, ritual, and medicine. The primary value of trees for both villages are still wood-based products; their food value is of minor importance.

3. The tree characteristics desired by farmers generally relate to the improvement of the primary uses (timber and fuelwood). This further justifies the contention that one may need to know only trees' primary uses to individuals in order to infer farmers' breeding objectives.

Concluding Remarks

The TBO study provided insights on how farmers' breeding objectives can be assessed. Based on the experience with several methodological alternatives in Mountain Province, virtually the same kind and nature of information can be gathered irrespective of the data collection methods used. This means that researchers can be flexible in collecting data without significantly affecting the quality of that data.

Regardless of the method employed, gender differentiation of respondents appears worthwhile. This should be verified in future research.

The utility of this research should be judged by whether breeders find anything new in these findings, or if the study has confirmed hypotheses they might have held. It is also worth asking if the study has contributed something that can be translated into a technology that will benefit tree farmers in the end. These questions can be answered only by tree-breeders themselves. Any future undertakings in this field should be pursued only if breeders think that they could use the results in a worthwhile manner.

Table 5. Group interview results, Guinzadan women's group.

Rank	Species	Products (Rank)	Characteristics	Ideotype features
1	*Pinus kesiya*	timber/lumber (1) fuelwood (2) furniture (3) resin (4)	Durable; straight trunks; hard wood; firewood with heat that can be regulated and that burns well and longer, with less smoke	Straight bole Prolific branching Geotropic roots
2	*Alnus maritima*	fuelwood (1) fence posts (2)	More branches; faster growth	Straight trunk Geotropic roots
3	*Pterocarpus indicus*	timber/lumber (1) furniture (2)	Hard wood; durable	Straight trunk Geotropic roots
4	*Psidium guava* (guava)	food (1) fuelwood (2) medicine (3) farm tools (4) rituals (5)	Hard wood; more branches	Short trunk More branches Bigger fruits Geotropic roots
5	*Persea americana* (avocado)	food (1) fuelwood (2) medicine (3)	More branches	Short trunk Fewer leaves More fruits

Farmer's Tree-Breeding Objectives in Oriental Mindoro

Fe K. Mallion, Josefina Dizon, and Leni Diamante

A regional study was conducted from May to November 1989 with the main objective of defining and describing ideotypes of multipurpose tree species (MPTS) desired by small farmers. The descriptions would "provide a basis for genetic improvement of MPTS by researchers in Asia and would provide research and development institutions with information for species selection and breeding." In Oriental Mindoro, Philippines, the study was undertaken in two villages: Paitan and Sitio Banilad. The study built upon the regional study of Farm and Village Forest-use Practices (FVF), also conducted in 1989.

Methodology

A questionnaire was designed to gather the data enumerated in the guidelines provided by the study organizers (see appendix). This was administered individually to five males and five females from households participating in the regional study in each of the two villages.

Respondents were asked to enumerate their first, second, and third priority species for the tree products of fodder, fuelwood, charcoal, food, timber/construction materials, industrial use, handicrafts, house construction, and occasional and other uses (for example, clothing).

After the enumeration process, respondents were asked to identify the planting niches, desirable and undesirable characteristics, and the source of planting materials for each priority species.

The top three individual trees for each priority species per use were identified through frequency counts. Fresh samples of the identified priority species were collected with the help of a dendrologist. Line drawings of the different plant parts (stem form, leaf arrangement, branching habit, canopy shape, bark features and height) were made using the fresh samples, along with drawings of canopy shape (see page 10), stem form (Figure 1), and leaf arrangement (Figure 2). Photographs of the priority species were also taken.

The respondents were also asked to identify other tree species used to provide the listed priority products and the reasons why they were not preferred.

To come up with the desired ideotypes, respondents were asked to describe the preferred characteristics of each priority species. Line drawings of the different preferred plant parts were sketched with the help of the visuals. Based on these desired characteristics, ideotypes of the priority species were sketched.

Four site visits were conducted: one for the reconnaissance survey, two for the wet- and dry-season data gathering for the FVF study, and one additional visit for the TBO study. The list of priority species was completed after the second site visit; thus the identification of TBO took place during the third visit. Due to a lack of time, however, the survey results were not presented to the villagers as planned.

Research Results

Table 1 shows the priority species that farmers identified for each tree product, and their desired characteristics. Table 2 lists the criteria employed by the respondents in their selection. Tables 3 and 4 show the planting niches and source of planting materials for the priority species in each village.

Fuelwood

For the respondents, the most important criterion for fuelwood species is good burning quality, but the ability to produce ember is also a consideration. In Paitan, the priority species for fuelwood were, in descending order: *Pometia pinnata*, *Gliricidia sepium*, and *Cinnamomum camphora* (Table 1). Farmers prefer more branches for *G. sepium* and *P. pinnata*; for *C. camphora*, however, they prefer fewer branches.

Table 1. Desired characteristics for priority species in Paitan, Naujan and Banilad, Baco, Oriental Mindoro, Philippines.

Products (Tree Parts Used)	Paitan: Priority Species	Paitan: Desired Characteristics	Banilad: Priority Species	Banilad: Desired Characteristics
Fuelwood (woody branches, trunks)	*Pometia pinnata* (1)	More branches, straight boles	*P. falcataria* (1)	More branches, straight boles
	Gliricidia sepium(2)	More branches, larger stem diameter	*Coffea* spp. (2)	More branches, shorter trees
	Cinnamomum camphora (3)	Fewer branches, straight boles	*Shorea polysperma*(2)	More branches, thick bark, taller trees, straight boles
			Leucaena leucocephala (2)	More branches, taller trees
House construction (trunk, large branches)	*Beilschiedia glomerata*(1)	Fewer branches, thinner bark	*S. polysperma* (1)	Taller trees, thick bark
	Phoebe sterculioides (2)	None	*B. glomerata* (2)	None
	S. polysperma (3)	Less branches, thinner bark	*C. camphora* (3)	None
Handicrafts (wood/trunk)	*B. glomerata* (1)	None	*S. polysperma* (1)	Straight boles
	P. sterculioides (2)	None	*B. glomerata* (2)	None
	S. polysperma (3)	None	*P. sterculioides* (3)	Taller trees, thinner bark
			C. camphora (3)	None
Handicrafts (roots)	*Shorea negrosensis* (1)	None	*P. falcataria* (1)	None
	Duabanga moluccana (1)	Taller trees, fewer branches	*B. glomerata* (1)	None
	S. polysperma (1)	None	*Mangifera indica* (1)	
	Artocarpus heterophyllus (1)	None	*P. americana* (2)	None
	Persea americana (2)	None	*A. odoratissima* (2)	None
	G. sepium (2)	None	*A. heterophyllus* (3)	None
Fodder (leaves)	*L. leucocephala* (1)	Shorter trees, more branches		
	Albizia lebbek (2)	None		
	G. sepium (3)	Shorter trees, more branches		
Food (fruits)	*Euphoria didyma* (1)	Shorter trees, dense and bushy, more branches	*M. indica* (1)	Shorter trees, many branches
	P. americana (1)	None	*A. heterophyllus* (1)	Shorter trees, many branches
	Nephelium lappaceum (1)	None	*P. americana* (2)	Crooked, bending stem; many branches
	M. indica (1)	Shorter trees	*Lansium domesticum* (3)	Crooked, bending stem; many branches
	Citrus reticulata (2)	Shorter trees		
Medicine (bark, leaves)	*Cinnamomum mercadoi* (1)	None	*C. mercadoi* (1)	Smooth bark
	P. americana (1)	None	*P. americana* (2)	None
	Ficus balete (1)	None	*Anacardium occidentalis* (3)	None
	Syzygium cuminii (1)	None		
	Caesalpinia sappan (2)	Thinner bark		
	Citrus microcarpa (2)	None		
	M. indica (2)	None		
	Psidium guajava (2)	None		
	Croton tiglium (2)	More branches		
Clothing Material (bark)	*Ficus latsoni* (1)	None	*F. variegata* (1)	None
	Ficus variegata (1)	None		

Numbers in parentheses indicate priority for that use: 1 = highest priority; 2 = second priority; 3 = third priority.

Table 2. Criteria for preference for priority species.

Products (Tree Parts Used)	Paitan: Priority Species	Paitan: Criteria	Banilad: Priority Species	Banilad: Criteria
Fuelwood (woody branches, trunks)	*Pometia pinnata* (1)	Good burning quality	*P. falcataria* (1)	Good burning quality
	Gliricidia sepium (2)	Good burning quality	*Coffea* spp. (2)	Good burning quality
	C. camphora (3)	Good burning quality	*S. polysperma* (2)	Good burning quality
			L. leucocephala (2)	Good burning quality; produces ember
House Construction (trunk, large	*Beilschiedia glomerata* (1)	Durable wood, available	*S. polysperma* (1)	Resistance to ants and termites
	Phoebe sterculioides (2)	Durable wood, available	*B. glomerata* (2)	Durable wood
	S. polysperma (3)	Durable wood	*C. camphora* (3)	Durable wood, available
Handicrafts (wood/trunk)	*B. glomerata* (1)	Durable wood, available	*S. polysperma* (1)	Resistance to ants and termites; durable wood
	P. sterculioides (2)	Durable wood, available	*B. glomerata* (2)	Durable wood
	S. polysperma (3)	Durable wood, available	*P. sterculioides* (3)	Durable and hard wood; resistance to ants and termites
			C. camphora (3)	Durable wood; available
(Roots)	*Shorea negrosensis* (1)	Durable wood	*P. falcataria* (1)	Available
		Available	*B. glomerata* (1)	Durable wood
	Duabanga moluccana (1)	Durable wood; availability	*Mangifera indica* (1)	Hard wood
	S. polysperma (1)	Durable wood; availability	*P. americana* (2)	Durable, hard wood
	A. heterophyllus (1)	Resistance to ants and termites; durable wood	*Artocarpus odoratissima* (2)	Durable wood
	Persea americana (2)	Durable wood; availability		
	G. sepium (2)	Durable wood; resistance to ants and termites		
Food (fruits)	*Euphoria didyma* (1)	Fruits taste like rambutan	*M. indica* (1)	Delicious fruits
	P. americana (1)	Fruits nutritious and abundant	*A. heterophyllus* (1)	Delicious fruits; can be cooked in vegetable dishes
	Nephelium lappaceum (1)	Delicious fruits	*P. americana* (2)	Fruits locally available
	M. indica (1)	Delicious fruits	*Lansium domesticum* (3)	Delicious fruits
	Citrus reticulata (2)	Fruits are delicious and rich in Vitamin C		
Medicine (bark, leaves)	*Cinnamomum mercadoi* (1)	Curative ability; availability	*C. mercadoi* (1)	Curative ability; availability
			P. americana (2)	Traditionally proven effectiveness
	P. americana (1)	Availability; curative ability	*Anacardium occidentalis* (3)	Available; traditionally proven effectiveness
	Ficus balete (1)	Availability		
	Syzygium cuminii (1)	Curative ability		
	Caesalpinia sappan (2)	Proven effectiveness in curing cough		
	Citrus microcarpa (2)	Curative ability		
	M. indica (2)	Availability		
	Psidium guajava (2)	Curative ability		
	Croton tiglium (2)			
Fodder (leaves)	*L. leucocephala* (1)	Availability		
	Albizia lebbek (2)	Availability		
	G. sepium (3)	Good substitute for *L. leucocephala*		
Clothing Material (bark)	*Ficus latsoni* (1)	Availability, traditional use	*F. variegata* (1)	Availability; traditional use
	Ficus variegata (2)	Availability; traditional use		

Numbers in parentheses indicate priority for that use: 1 = highest priority, 2 = second priority, 3 = third priority.

The identified priority species in Banilad were *Paraserianthes falcataria, Leucaena leucocephala, Coffea* sp. (coffee), and *Shorea polysperma* (Table 1). For all these, the preferred characteristics for fuelwood was more branchiness. For *P. falcataria*, an added desired characteristics was straight boles. Because farmers lop dried coffee branches for fuelwood, they prefer short trees for easy lopping and harvesting of coffee berries.

S. polysperma is also the top priority species for house construction; thus taller trees with thick bark are preferred. The thick bark provides both fuelwood and walling material.

In both villages, respondents prefer fuelwood trees with more branches, larger-diameter stems, and greater height, as these characteristics yield more woody materials. Straight boles are preferred for easy chopping and splitting.

House Construction

Durable wood, resistance to ants and termites, hardness, and availability are primary considerations for wood house construction materials. In building houses, wood is used for posts, braces, and, to a limited extent, walling and flooring.

In Paitan, the priority species, in descending order, were *Beilschiedia glomerata, Phoebe sterculioides* and *Shorea polysperma*. For the first two, farmers preferred fewer branches and thinner bark. In Banilad, *S. polysperma* is the number one priority species.

Paitan farmers prefer fewer branches since they need long and straight boles for house construction, and thinner bark is more easily removed than thick bark. However, in Banilad, thick bark is used for walling materials and fuelwood, and is thus preferred.

Handicrafts

Durability, resistance to ants and termites, and availability are also the primary considerations for species used in handicrafts, in which the two most important tree parts used are the trunks and roots. Roots are used for tool handles; trunks are carved into scabbards, yokes, mortars, and pestles.

In Paitan, the top priority species for using roots in handicrafts are *Artocarpus heterophyllus* (jackfruit), *Shorea negrosensis, S. polysperma*, and *Duabanga moluccana*. Among these, farmers specified desired characteristics only for *D. moluccana*, for which they cited greater height and fewer branches as preferences.

In Banilad, the roots of *Mangifera indica* (mango), *P. factaria*, and *B. glomerata* are used for handicraft purposes. These first priority species are followed by *Persea americana* (avocado) and *Artocarpus odoratissima*. Jackfruit was chosen as third priority. The present characteristics of all these species are generally acceptable to the farmers for this purpose.

When Paitan farmers use trunks for handicraft, their priority species are the same as for house construction, in the same order. Respondents indicated no phenotypic modifications for these species.

As Table 1 shows, Banilad farmers prefer the same species when making handicrafts from tree trunks, but their ranking differs. They rate *S. polysperma* as first priority, *B. glomerata* as second, and *Phoebe sterculioides* and *Cinnamomum camphora* as third. For *Shorea polysperma*, farmers prefer straighter boles to facilitate wood carving.

Fodder

Of the two villages, only Paitan farmers have farm animals, which they use in their lowland rice farming. They were thus the only ones who indicated some preferred characteristics for fodder species, showing preference for shorter trees with more branches. Priority fodder species were *L. leucocephala, Albizia lebbek*, and *Gliricidia sepium*, all of which are locally abundant.

Food

Tree species used for food are primarily fruit-bearing trees: mango, *Euphoria didyma, Nephelium lappaceum* (rambutan), and avocado all ranked first in Paitan. *Citrus reticulata* registered as second priority species there. For these species,

Table 3. Planting niche and source of planting materials for priority species, Paitan.

Species	Planting Niche	Source of Planting Materials
Albizia lebbek	ISF farm	ISF farm
Artocarpus heterophyllus	ISF farm	ISF farm
Beilschiedia glomerata	Natural forest	Natural forest
Caesalpinia sappan	Natural forest	Natural forest
Cinnamomum camphora	Natural forest	Natural forest
Cinnamomum mercadoi	Natural forest	Natural forest
Citrus microcarpa	ISF farm	Purchased
Citrus reticulata	ISF farm	Purchased
Croton tiglium	Natural forest	Natural forest
Duabanga moluccana	Natural forest	Natural forest
Euphoria didyma	Natural forest	Natural forest
Ficus balete	ISF farm	Natural forest
Ficus latsoni	Natural forest	Natural forest
Ficus variegata	ISF farm	Natural forest
Gliricidia sepium	ISF farm, homegarden	ISF farm
Leucaena leucocephala	Home garden	DENR
Mangifera indica	ISF farm, homegarden	ISF farm
Nephelium lappaceum	ISF farm	ISF farm
Persea americana	ISF farm	ISF farm
Phoebe stereulioides	Natural forest	Natural forest
Pometia pinnata	Along creeks and streams	Natural forest
Psidium guajava	Homegarden	ISF farm
Shorea negrosensis	Natural forest	Natural forest
Shorea polysperma	Natural forest	Natural forest
Syzygium cuminii	Homegarden	ISF farm

ISF = Integrated Social Forestry; under this government program, forest occupants receive secure access to land through a renewable 25-year lease on public land that they occupy and cultivate, as well as technical assistance for sustainable agriculture. DENR = Government of the Philippines Department of Environment and Natural Resources.

the general preferred characteristics are shorter trees with dense and bushy branches.

Mango and jackfruit were the first priority species for food in Banilad. Farmers expressed desires for short trees (mango, jackfruit, guava, and *L. domesticum*) with crooked or bending trunks (avocado and *L. domesticum*), and many branches (all the priority species).

Farmers prefer short, crooked food trees for easier harvesting of fruits. Trees with many branches are also hoped to produce more fruits.

Medicine

Species used for medicinal purposes in Paitan included: *Cinnamomum mercadoi*, avocado, *Syzygium cuminii*, *Ficus balete*, *Citrus microcarpa*, *Psidium guajava* (guava), *Croton tiglium*, and *Caesalpinia sappan*. Farmers had specific preferences for only two of these species: from *Croton tiglium* they desired more branches; from *Caesalpinia sappan*, thinner bark. In Banilad, farmers use *Cinnamomum mercadoi*, avocado, and *Anacardium occidentalis* (cashew) for medicine.

Leaf and bark decoctions of avocado, *Syzygium cuminii*, mango, and guava are used to cure diarrhea. Heated barks of *Cinnamomum mercadoi*, *Ficus balete*, and *Croton tiglium* are used for sprains, and in the case of *C. tiglium*, also for stomach aches. These species have been used traditionally.

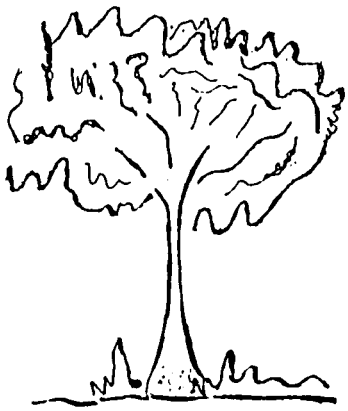
Clothing Material

In both villages, the bark of *Ficus* species is used to make the Mangyan women's traditional loincloths and are thus a part of Mangyan culture. The bark is pounded to extract the sap and then washed and dried. These species are suited for this purpose as they are.

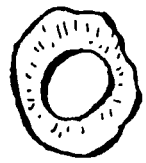
Table 4. Planting niches and source of planting materials for priority species, Banilad.

Species	Planting Niche(s)	Source of Planting Materials
Anacardium occidentalis	ISF farm	DENR
Artocarpus odoratissima	ISF farm	National forest, ISF farm
Artocarpus heterophyllus	ISF farm	ISF farm
Beilschiedia glomerata	Natural forest	Natural forest
Cinnamomum camphora	ISF farm	ISF farm
Cinnamomum mercadoi	Natural forest	Natural forest
Coffea spp.	ISF farm	Neighbors' lowland farms
Ficus variegata	ISF farm	Natural forest
Lansium domesticum	ISF farm, homegarden	ISF farm
Leucaena leucocephala	ISF farm	ISF farm
Mangifera indica	ISF farm, homegarden	ISF farm
Paraserianthes falcataria	ISF farm	DENR, nearby reforestation area
Persea americana	ISF farm, homegarden	ISF farm
Phoebe stereulioides	ISF farm	Natural forest
Shorea polysperma	Natural forest	Natural forest

ISF = Integrated Social Forestry; under this government program, forest occupants receive secure access to land through a renewable 25-year lease on public land that they occupy and cultivate, as well as technical assistance for sustainable agriculture. DENR = Government of the Philippines Department of Environment and Natural Resources.



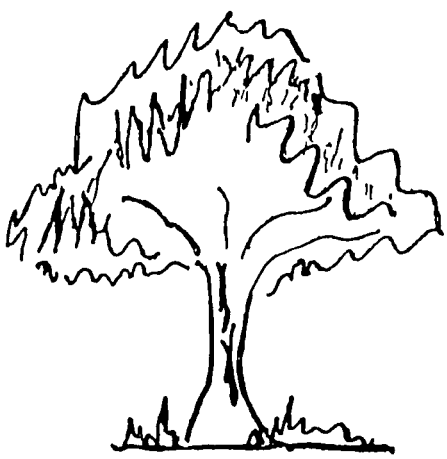
a. Tapering



cross-section

b. Cylindrical

cross-section



c. Fluted

cross-section

Figure 1. Line drawings used as aids to elicit farmers' preferences on stem form.

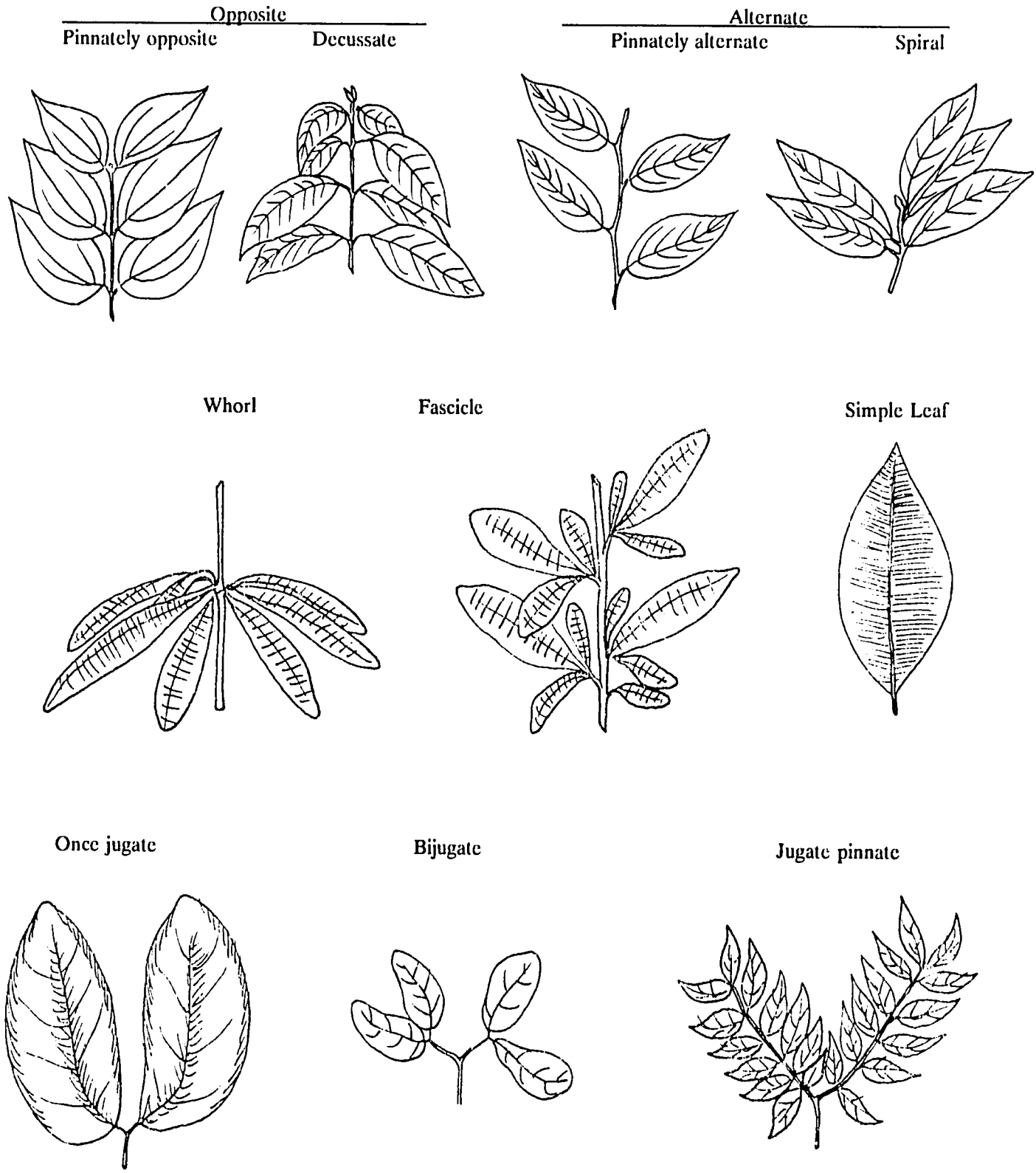


Figure 2. Line drawings used as aids to elicit farmers' preferences on leaf arrangement.

Appendix: Questionnaire Used in the Studv

MPTS IDEOTYPES FOR TREE IMPROVEMENT PROGRAMS

Interviewer : _____ Time Started: _____ Time Ended: _____

Date : _____ Research Site : _____

Name of Respondent : _____

1. Priority Ranking of Species by Product/Use

USE/PRODUCT *	PRIORITY 1st	2nd	3rd
1. Fodder			
2. Fuelwood			
3. Charcoal			
4. Fruit/Food			
5. Timber/Construction Materials			
6. Industrial use			
7. Handicrafts			
8. House construction			
9. Occasional Use			
10. Others, specify			

* Specify tree parts used e.g., leaves, buds, flowers, fruit, green branches, woody branches, bark, roots, exudate

2. Planting Niches, Desirable/Undesirable Characteristics and Source of Planting Materials

USE	SPECIES	RANK	DESCRIPTION OF PLANTING NICHES	DESIRABLE CHARACTERISTICS	UNDESIRABLE CHARACTERISTICS	SOURCE OF PLANTING MATERIALS
1. Fodder						
2. Fuelwood						
3. Charcoal						
4. Fruit/Food						
5. Timber/ Construction Materials						
6. Industrial use						
7. Handicrafts						
8. House construction						
9. Occasional use						
10. Others, specify						

3. Other Tree Species Not as Desirable/Reasons.

USE	TREE/FRUIT TREE SPECIES (Not as desirable)	REASONS
1. Fodder		
2. Fuelwood		
3. Charcoal		
4. Fruit/Food		
5. Timber construction materials		
6. Industrial use		
7. Handicrafts		
8. House construction		
9. Occasional use		
10. Others, specify		

Ideotypes (Line Drawings)

Use/Product: _____

a. Used Tree/Fruit Tree Species

_____

Rank : _____

b. Preferred Characteristics

Stem Form	Stem form
Branching habit	Branching habit
Leaf arrangement	Leaf arrangement

Additional form included space for drawing bark features, canopy shape, and height.

Tree-Breeding Objectives of Farmers in Laguna, Philippines

Bienvenido B. Maligalig

This brief report provides details of the Tree-Breeding Objectives study as conducted in the villages of Juan Santiago and Jose P. Laurel, Sta. Maria, Laguna, Philippines.

Methodology

The methodology distributed by the F/FRED study coordinators was followed closely, with a few methods introduced in the course of conducting the survey. Before the series of discussion on the ideotypes, I conducted a lecture and picture-drawing presentations of the different tree parts and attributes: canopy shape, stem form (tapering, cylindrical, fluted, single, multiple, straight, crooked), branching habit (many, few, small, large), bark features (smooth, fissured, scaly, flaky, thorny, pustuled, pocked), and leaf (single, compound) and leaf arrangements (alternate, opposite, sub-opposite, decussate, whorl, verticillate). Afterwards, the participating farmers and I went around the area to note these physical attributes of the trees.

After conducting Steps 2 through 7 of the methodology, an artist was hired to make line drawings of the ideotypes as described by the farmers for the priority species. The same artist was brought to the area to show the farmers how the tree would appear as described by them. The exactness of the description and necessary modifications were then discussed. The artist finalized the line drawings according to these clarifications by the farmers.

Substantial Findings

Results of the discussions with the participants revealed the priority species and preferred ideotypes shown in Tables 1 and 2.

Tree Improvement Work in the Area

No farmers in the study area are currently working on tree improvement. But if I were to embark on a program of tree improvement work with the farmers in my study area, I would focus on *Leucaena leucocephala* and *Gliricidia sepium*, since both trees have been in the study area long enough to establish land races, and they are ranked top priority by the farmers due to their various uses. Leucaena ranks first for fodder, fuelwood, and charcoal. *Gliricidia sepium* ranks second for fodder, medicine, mulch, and fuelwood.

Table 1. Ranks of priority species, according to uses, in Barangay Laurel (L) and Barangay Santiago (S).

	Uses									
	Fodder		Medicine		Mulch		Fuelwood		Charcoal	
Species	L	S	L	S	L	S	L	S	L	S
Leucaena leucocephala	1	1	-	-	2	2	1	1	1	2
Gliricidia sepium	-	2	2	3	1	3	2	3	-	-
Lagerstroemia speciosa	-	-	1	-	-	-	-	-	-	-
Coffea arabica	-	-	-	2	-	1	-	-	-	-
Dipterocarpus grandiflorus	-	-	-	-	-	-	3	-	3	-
Tristinia decorticata	-	-	-	-	-	-	-	-	-	1
Citrus nobilis	-	-	-	1	-	-	-	2	-	-
Lansium domesticum	-	-	3	-	-	-	-	-	-	-
Hopea acuminata	-	-	-	-	-	-	-	-	-	3
Cratoxylon blancoi	-	-	-	-	-	-	-	-	2	-

Table 2. Preferred tree ideotypes, by desired product. Numbers indicate priority ranking.

Use	Priority Species	Preferred Ideotype Features
Fruit	1. *Citrus nobilis*	umbrella or dome-shaped canopy with many branches; twisted pole about 2-3 m high
	2. *Cocos nucifera*	monopodial crown and tall and unbranched tree
	3. *Coffea arabica*	elongated crown with many branches and straight stem about 2 m high
Fuelwood/Charcoal	1. *Leucaena leucocephala* (native ipil-ipil)	wide, dense crown with many large branches; straight stem branches; straight stem about 2-5 meters high
	2. *Gliricidia sepium* (kakauati)	round to umbrella or dome-shaped crown; straight, long bole about 3 m in height
	3. *Dipterocarpus grandiflorus* (apitong)	obovoid or oblong crown with many branches; straight, cylindrical stem about 12 m high and a diameter of 180 cm.
	4. *Cratoxylon blancoi* (guyong-guyong)	an irregular open crown consisting of many branches; a small to medium size tree attaining a diameter of 60 cm; bole must be straight, short 6 m to 10 m long.
Lumber/Timber	1. *Shorea guisok*	relatively open crown, consisting of only a few far-spreading main branches; cylindrical bole 15 m high
	2. *Pentacme contorta* (white lauan)	irregular open crown with dull green foliage consisting of many branches; cylindrical bole 7 m high
	3. *Eugenia tripinnata* (malaruhat na pula)	irregular open crown consisting of few branches; short tree 3-5 m high
	4. *Hopea acuminata* (yakal)	obovoid or oblong crown consisting of a few strong main branches; straight stem
Fodder	1. *Leucaena leucocephala* (native ipil-ipil)	wide and dense crown with many large branches; straight stem about 2-5 m high
	2. *Gliricidia sepium*	round to umbrella- or dome-shaped crown; straight and long bole about 3 m in height
Leaves for Mulch	1. *Gliricidia sepium*	opposite, oblong-ovate slightly acuminate leaves
	2. *Leucaena leucocephala*	compound opposite leaves
	3. *Coffea arabica*	smooth bark with lenticels, oblong shiny opposite leaves
Leaves for Medicine	1. *Gliricidia sepium*	smooth bark; opposite oblong-ovate, slightly acuminate
	2. *Lagerstroemia speciosa*	even and unbroken surface or smooth bark; opposite usually oblong to elliptic ovate leaves
	3. *Lansium domesticum*	clear brown and coarse-grained; alternate leaves

Tree-breeding Ideotypes in Leyte, Philippines[1]

Eliseo R. Ponce, Lucylen B. Ponce, and Leonarda A. Maurillo

The definition of the ideal multipurpose tree varies among farmer groups. This study set out to develop ideotypes for tree-breeding according to characteristics preferred by farmers in two villages in Leyte, in east central Philippines.

Based on the characteristics preferred by respondents from both villages (one upland and one lowland), ideotypes were defined for primary production of fruit, fuelwood, lumber, and fodder.

The Study Sites

San Isidro is a lowland village in the municipality of Baybay, about 3.5 km from the town. Annual rainfall is 2,058 mm, evenly distributed throughout the year; average temperature is 27.1°C. The population of 1,400 consists of 220 households in four clusters or "sitios". The common source of income is farming; the lower areas are generally planted to rice, while higher elevations are planted to coconut, banana, root crops, and trees, including fruit trees.

An all-dirt road connects San Isidro to the national highway about 3 km away, which transverses Baybay and the city of Ormoc. Motorcabs and jeepneys regularly travel the route to Ormoc, where there are several market outlets for farm produce and a few variety stores carry basic items for family needs.

Public facilities are poor, limited to a chapel, health center, and basketball court, which also serves as the meeting place for village dances and drying palay. Children attend primary school in an adjacent village. Some pursue secondary education in Ormoc or at the Visayas State College of Agriculture.

San Miguel is a partially denuded upland village in northern Leyte in the municipality of San Isidro, 5 km from the town. Here the population of 733 also consists of 220 households, also distributed in four sitios. The village is predominantly hilly. Hillsides are nearly devoid of natural forest cover and good vegetation crops expect for patches of shrubs, bushes, and scattered trees, including leucaena woodlots. The clay soil is vulnerable to erosion during both rainy and dry periods. Soil fertility is low despite development efforts in the past five years.

Maize is the dominant crop, usually planted with mungbean, root crops, banana, a few coconut and fruit trees, and leucaena. Fallow areas are generally dominated by grass, but some are planted to leucaena to shorten the fallow period and supply fuelwood.

Unlike San Isidro, transportation and water supply are serious problems in San Miguel. The interior clusters are hardly accessible by vehicle, particularly during the rainy season. Only a few open-dug wells serve residents, and the water from them is generally unsafe and likely a major cause of epidemics during the rainy months.

Like farmers in San Isidro, those in San Miguel depend on the city of Ormoc for marketing their produce. Public facilities are nearly non-existent except for a public primary school, village clinic, farmers' center, and chapel. Homes are small and made mostly of bamboo, round timber, and nipa and cogon grass (*Imperata cylindrica*).

Study Methods

A complete list of households was obtained for both villages from village officials. In each village, a random sample of 50 respondents was selected,

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[1]This paper first appeared as "Farmers in Leyte express preferred tree characteristics," in *Farm Forestry News* 4(4):1-3.

from which background information and socio-demographic data were collected.

Using a second interview schedule, data on forest and tree-use practices were collected twice (August and November 1989, to account for seasonal differences) from 25 respondents randomly selected from the original group of 50. Respondents unavailable for the second interview were not substituted.

A third random sample of 10 respondents from the 25 chosen was selected for a case study of homegardens in each village. From these, five respondents were randomly selected to participate in the tree-breeding study.

Data for this study were obtained in three phases. An interview schedule in the local dialect was used to gather data in the initial two phases. In the last phase of data collection, the researchers convened the wives, then the husbands, and finally husbands and wives together.

Line drawings of tree canopy shape, stem form, rooting habit, and leaf form and size were used to elicit responses. Study participants were asked to choose commonly preferred characteristics for fruit, fuelwood, lumber, and fodder trees.

Results

Fruit Trees

As preferred by lowland respondents, the ideal fruit tree resembles *Artocarpus heterophyllus* (jackfruit)(Figure 1 and Table 1). Fully grown, its trunk is straight and it yields abundant fruit and hardwood lumber. It has a strong primary root that penetrates deep into the ground and large secondary or lateral roots, some of which are exposed, which can resist strong winds. The exposed seondary roots can be used to make tool handles. Its many large, strong branches form a large canopy that supports many big fruits. Its leaves are serrate, the size of *Chrysophyllum caimito* leaves, succulent, and palatable as fodder for ruminants and smaller animals. The fruits are resistant to rot and the fleshy, edible portions are thick, firm, and sweet. The tree is shade tolerant, fixes nitrogen, adapts to adverse soil conditions, tolerates both extreme drought and wet seasons, and resists diseases and insect pests.

Upland respondents identified an ideal fruit tree resembling *Mangifera indica* (mango). Its canopy is big and provides shade for people and animals. The large branches produce fuelwood. Like the lowland ideotype, it has a straight trunk

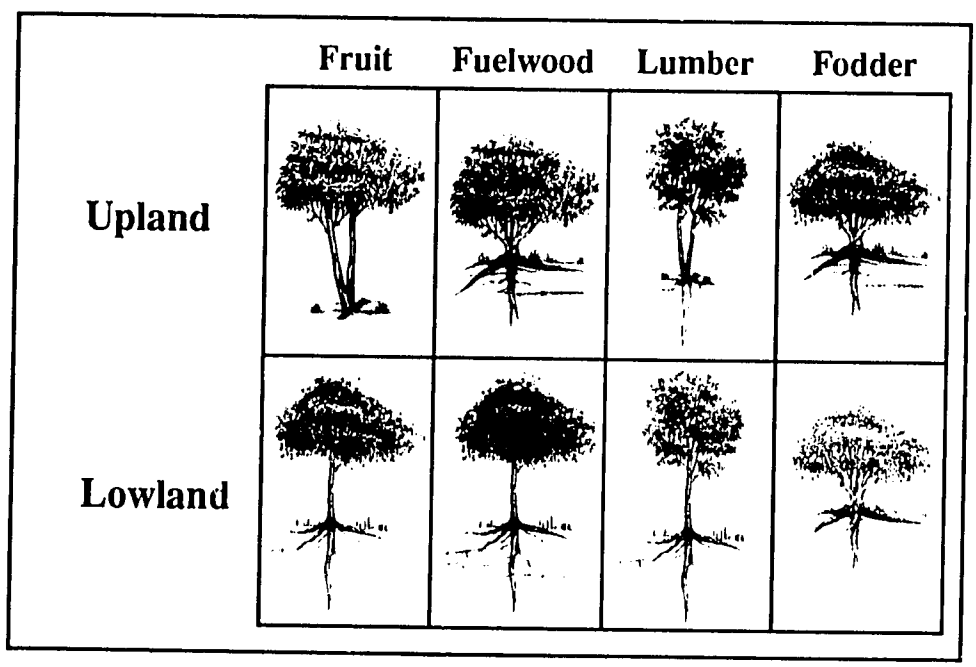


Figure 1. Ideotypes of upland and lowland species, by primary desired product. Source: Ponce et al. 1991a.

Table 1. Preferred species (first and second priority) for food, fuelwood, lumber, and fodder. Figures in each column represent percent of n: L = lowland (n = 5); U = upland (n = 5); T = total (n = 10).

	Food			Fuelwood			Lumber			Fodder		
	L	U	T	L	U	T	L	U	T	L	U	T
First priority												
A. heterophyllus	40	0	20				20	0	10			
Persea americana	20	40	30									
Mangifera indica	20	20	20									
Chrysophyllum caimito	0	20	10	20	0	10						
Psidium guajava	20	0	10									
L. leucocephala				20	100	60				40	100	70
				40	100	70						
Sandoricum koetjape				20	0	10						
*Cocos nucifera**				0	20	10						
*Bambusa spp.**				0	20	10						
Vitex parviflora							0	100	50			
Pterocarpus indicus							20	0	10			
Shorea guisok							40	0	20			
Shorea spp. (lauan)							20	0	10			
Second priority												
A. heterophyllus	20	20	20									
Persea americana	20	0	10									
Mangifera indica	20	0	10									
Chrysophyllum caimito	0	20	10	20	0	10						
Citrus maxima	20	20	20									
Cocos nucifera							20	0	10			
L. leucocephala				20	0	10	0	20	10			
Vitex parviflora				0	20	10						
Pterocarpus indicus				20	0	10						
*Ficus nota**				0	20	10						
Euphoria didyma							20	0	10			
Antiaris blancoi							20	0	10			
Shorea guisok							0	20	10			
S. malibato (yakal)							0	20	10			
Shorea spp. (lauan)							0	20	10			

For fuelwood, first line for the species indicates responses for use of branches; second line indicates response for use of trunks, except for (*), which were selected only for trunks. Source: Ponce et al. 1991b.

that provides good lumber if allowed to mature; a strong, penetrating primary root; and large, exposed lateral roots useful as tool handles.

Unlike the lowland ideotype, its leaves are elliptical, but like the other, they are succulent and palatable as fodder. The tree fixes nitrogen, minimizes erosion, tolerates drought, and is pest- and disease-resistant.

Fuelwood Trees

For both upland and lowland villages, the ideal fuelwood tree is *Leucaena leucocephala*. Both ideotypes have strong primary roots and large canopies. The lowland ideotype has large branches, and its hard wood produces high-quality heat and charcoal. Upland farmers prefer numerous small branches that can be split by women and younger household members. The lowland ideotype has elliptical leaves (15 x 5 cm). The upland ideotype has smaller serrate leaves (10 x 4 cm).

Lumber Trees

For lowland farmers in San Isidro, the preferred lumber species is *Shorea guisok*. This ideotype has a large, tall, straight trunk and numerous large branches high up the tree. Its strong, durable hard wood has a reddish grain, its leaf form is obovate (10 x 5 cm). Like the other ideotypes, it has large primary and secondary roots for support against strong winds.

Upland villagers in San Miguel selected an ideal lumber tree resembling *Vitex parviflora* with the same form as the lowland ideotype. It has a large, tall trunk with large branches high up the tree. It also has strong primary and secondary roots to protect against strong winds and erosion. It can also tolerate infertile, dry soils and resist pests and diseases.

Fodder Trees

For both upland and lowland farmers, the ideal fodder tree is *Leucaena leucocephala*, with the following modifications: a larger canopy shape and bushier stem form, with many small branches for more foliage production. Like leucaena, the ideotype's foliage is ovate (1.0 x 0.5 cm). Like the other ideotypes, its strong primary and secondary roots support the tree against wind and help control soil erosion.

Planting Niches

As shown in Table 2, respondents in both villages prefer to grow fruit trees in homegardens or around their homes for convenient harvest and to minimize theft of fruits, a problem in both areas. Fruit trees near the home also serve as windbreaks and provide shade for people and animals.

Farmers prefer to plant smaller fuelwood trees in homegardens or in field margins. They plant larger fuelwood trees in the farm and field margins to avoid crowding fruit trees and other plants in the homegarden.

Field margins is the preferred niche for lumber trees, where their shading effect on crops is minimized. Only one farmer said he would plant them in the farm if the tree were small enough and did not produce much shade. Farmers preferred to plant fodder trees as hedgerows in their contour farms.

Table 2. Preferred planting niches for tree types.

Tree type	Preferred Niche	Lowland (n = 5)	Upland (n = 5)	Total (n = 10)
Fruit	Homegarden	100	60	80
Fuelwood				
Branches	Homegarden	60	0	30
	Field margin	0	60	30
Trunk	Field margin	60	0	30
	Farm	0	60	30
Lumber	Field Margin	80	08	80
	Homegarden	40	0	20
	Farm	0	20	10
Fodder	Farm	0	40	20

Source: Ponce et al. 1991b.

Tree-Breeding Objectives of Farmers in Kavre District, Nepal

Kailash Pyakuryal

Introduction

This study, conducted in Kavre district, Nepal during 1989-1990, aimed to determine the tree ideotypes most preferred by farmers. This would then permit scientists to breed according to these tree-breeding objectives.

The principal researcher, a rural sociologist, was assisted by two biological scientists, a tree physiologist and a community forestry specialist. A team of three persons (one anthropologist and two agricultural graduates) was posted to the village sites for conducting the census and individual and group interviews. Surveys were conducted twice within one year in order to note any seasonal variations in forest- and land-use practices. Regular visits were made by the principal researcher and the consultants for supervising and backstopping the field work.

Methods

The census of all households in Kankre and Tusal, conducted for the regional study on Farm and Village Forest-use Practices (FVF), provided a socioeconomic and demographic profile of both villages. In-depth interviews were conducted with 25 households from each of the villages, first in the winter and the second during the summer season.

For defining tree-breeding objectives, 10 farmers (5 males and 5 females) from each village sample group were selected for interviewing. Responses collected from these 20 farmers were compiled and presented separately to the group of farmers in each village. Finally, the ideotypes of the most preferred species of MPTS were recorded.

Findings

Since the two villages are not far from each other, ecological differences were not remarkable. Nearly 70 tree species in the study area are used for fodder, fuelwood, timber, fruits, house construction, handicrafts, and other uses. Since the research was designed to investigate multipurpose tree species, the researchers attempted to isolate such species. Farmers identified 25 multipurpose tree species altogether (Table 1). Farmers were then asked to rank the more preferred tree species; 10 priority species were identified for Tusal and 9 for Kankre (Table 2).

Table 1. MPTS found in Tusal and Kankre.

Botanical Name	Local Name
Albizia procera	Siris
Alnus nepalensis	Utis
Arundinaria intermedia	Nigalo
Betula alnoides	Saur
Camellia kissi	Hinguwa
Castanopsis indica	Katus
Choerospondias axillaris	Lapsi
Curcuma longa	Halude
Dendrocalamus strictus, and other bamboos	Bans
Ficus nemoralis	Dudhilo·
Madhuca indica	Mahuwa
Melia azedarach	Bakaino
Myrsina capitellata/ Symolocos pyrifolia	Seti Kath
Pavetta indica	Kangiyo
Pieris ovalifolia	Angeri
Pinus roxburghii	Sallo
Prunus cerasoides	Paiyan
Pyrus pashia	Mayal
Quercus glacuca	Falant
Rhododendron arboratum	Gurans
Saurauia nepalensis	Gogan
Schima wallichii	Chilaune
Shorea robusta	Sal
Solanum indicum	Kanchinde
Syzygium cuminii	Jamun

Table 2. Priority species identified in each village.

Rank	Tusal	Kankre
1.	*Prunus cerasoides*	*Prunus cerasoides*
2.	*Quercus glacuca*	*Alnus nepalensis*
3.	*Betula alnoides*	*Schima wallichii*
4.	*Alnus nepalensis*	*Pinus roxburghi*
5.	*Melia azedarach*	*Quercus glacuca*
6.	*Castanopsis indica*	*Betula alnoides*
7	*Schima wallichii*	*C. indica*
8.	*Albizia procera*	*Ficus nemoralis*
9.	*Myrsine capitellata*	*Choerospondias axillaris*
10.	*Ficus nemoralis*	—

After identifying the priority species, lists of products obtained from these species were compiled (Tables 3 and 4).

For most of the priority species in both villages, main products used were leaves, green branches, woody branches, and wood. When asked to describe the planting niches they would like for these priority species (for example, homegardens, field margins, intercropped with annual staple crops), farmers in both villages cited privately owned forestry land, field margins, and scattered trees in fields.

Characteristics of the priority species disliked by the farmer-respondents included: wood cracking, shading, unpalatable leaves, crooked trunk, slow growth, insufficient wood production, and short bole.

The four most-preferred species for both villages were: *Prunus cerasoides*, *Alnus nepalensis*, *Betula alnoides*, and *Schima wallichii*. These tree species were most preferred by the farmers for some or all of the following reasons:

- good for timber — straight and good diameter growth
- abundant branches, good for fodder, fuelwood and timber
- good height and thickness

The most important sources of planting materials for these species were farmers' own farms and the natural forest. Transplanting of seedlings was the preferred method of planting.

Regarding ideotypes for each priority species, farmers generally wanted straight and tall trees, with profuse branching above a certain height (see Appendix 1). Branching lower on the trunk was not preferred because it would disturb nearby crops due to shading effect. Tall trees yield more timber, branches provide fuelwood, and leaves and green branches provide fodder. The ideotypes for these four species, as described by 20 farmers from both villages, were presented to several groups of farmers in both the villages separately. Overwhelmingly, the farmer groups expressed the same ideotypes identified individually, with the top four tree species and preferred ideotypes as described above.

Discussion

Wish lists by farmers for desired tree ideotypes may often be beyond the technical capacity of tree breeders. In a sense, too, farmers have long determined their own ideotypes in the way that they prune trees.

A problem of meaning equivalence was experienced by the researchers in defining "multipurpose tree". A multipurpose tree is not only a tree *used* for diverse purposes; it would appear that the term also relates to the fact that these trees are grown *intended* for multiple purposes. Although fruit trees may have multiple uses, the purpose of growing a mango or guava tree in Nepal is to harvest good fruits, not fuelwood or timber. Other uses are considered by-products. This perception led this researcher to exclude fruit trees from the category of multipurpose tree species.

Local cropping patterns appeared to influence farmers' choices concerning tree ideotypes. Since multipurpose fodder and fuelwood trees are usually scattered on the farm, farmers considered tree-crop interactions in selecting the particular tree ideotypes.

Line drawings depicting 16 different ideotypes were not found to be effective in reflecting farmers' choices of preferred ideotypes. Instead, farmers were more successful using verbal descriptions of the imagined ideotypes.

Table 3. Priority tree products identified in Tusal. Numbers in columns indicate frequency of response.

	Products									
Species	1	2	3	4	5	6	7	8	9	10
Prunus cerasoides	10	-	-	2	10	10	-	10	-	-
Alnus nepalensis	-	-	-	-	-	10	-	8	-	-
Betula alnoides	9	-	-	-	9	10	-	10	-	-
Ficus nemoralis	2	-	-	-	10	8	-	-	-	-
Schima wallichii	-	-	-	-	7	6	-	10	-	-
Quercus glacuca	-	-	-	-	6	9	-	10	-	-
Melia azedarach	5	-	-	-	9	9	-	9	-	-

Products: 1 = Leaves, 2 = Buds, 3 = Flowers, 4 = Fruits, 5 = Green Leaves, 6 = Woody Branches, 7 = Bark, 8 = Wood, 9 = Roots, 10 = Exudates.

Table 4. Priority tree products identified in Kankre. Numbers in columns indicate frequency of résponse.

	Products									
Species	1	2	3	4	5	6	7	8	9	10
Prunus cerasoides	10	-	-	1	10	10	-	10	-	-
Betula alnoides	10	-	-	-	10	10	-	10	-	-
Schima wallichii	-	-	-	-	-	10	-	10	-	-
Alnus nepalensis	-	-	-	-	-	10	-	10	-	-
Quercus glacuca	-	-	-	-	10	10	-	10	-	-
Ficus nemoralis	4	-	-	-	10	5	-	2	-	-
Castanopsis indica	7	-	-	-	1	10	-	10	-	-

Products: 1 = Leaves, 2 = Buds, 3 = Flowers, 4 = Fruits, 5 = Green Leaves, 6 = Woody Branches, 7 = Bark, 8 = Wood, 9 = Roots, 10 = Exudates.

The Tree-Breeding Objectives Study in Kaski District of Nepal

A.K. Das

The tree-breeding objectives (TBO) study conducted by scientists in the MPTS Research Network in conjunction with the regional study of farm and village forestry (FVF) practices, included the villages Rakhi and Lekhnath in Kaski District, Nepal.

Rakhi and Lekhnath are located west of Kathmandu in the midhills of Kaski District, which consists mostly of hills and rolling plains. Land area of Rakhi is 933 ha, of which 16% is forest cover. Lekhnath's land area is 1320 ha, of which 26% is forested. Land area devoted to agriculture is 60% for Rakhi, 66% for Lekhnath. The two villages are close to each other and have much in common. However, in Rakhi private trees are found primarily on common lands, while in Lekhnath homegardens and homesteads contain relatively more fodder, fuelwood, and fruit tree species.

Methodology

The TBO study was conducted through three visits to each village. Two visits were made for the FVF study; a third visit to the same sites took place later. After the first visit, a list of priority species and tree products was compiled based on the household data.

During the second visit, researchers interviewed five males and five females from the participating households of each village regarding tree-breeding objectives, planting niches, disliked tree characteristics, etc. The data collected from these 20 respondents were tabulated and summarized.

The summary was then presented in group meetings with the villagers during the third site visit. Discussion of the summary was intended to obtain consensus on the ideotypes.

Findings

About 30 tree species found in the area are used for single or multiple purposes. Of these, 11 species are preferred by most households (Table 1). For most of these priority species, the used products are leaves, fruits, woody branches, and wood. The most preferred species were: *Castanopsis indica*, *Schima wallichii*, *Ficus lacor*, and *Ficus glaberrima*.

These species were chosen due to their widespread presence in the area and the utility of their leaves, woody branches, and timber. They possess more branches, leaves, and wood than other species, and are easily propagated locally.

Disliked characteristics of these species indicated by the respondents include: slow growth, too much shade, short trunk, wood not of high quality, and low wood production.

Farmers identified planting niches of common lands, trees scattered on farmland, homegardens, and private forests. Preferred sources of planting materials were their own or neighbors' farm, and natural forest. Propagation takes place both by vegetative techniques and from seedlings.

Ideotypes

The respondents view on ideotypes of the priority species focussed on their branching habit, tree height, and leaf production. Farmers chose to have large, straight trees with more leaf and wood production, low shade, and fast growth. In the group discussions intended to obtain consensus, the groups' expressions on the ideotypes were similar to the earlier household responses.

Apart from these four preferred species, farmers also assign priority to *Mangifera indica* (mango) and *Artocarpus heterophyllus* (jackfruit). The cash value of fruits from both species, along with the timber and fodder values of jackfruit, are

the farmers' reasons for this high priority. For these species, factors to consider in breeding ideotypes are: abundance of large fruits; big, straight stem; large branches; and deep roots.

Table 1. Priority species and their products in Rakhi and Lekhnath.

Rank	Species	Products				
		Leaves	Woody branches	Wood	Fruit	Bark
1	*Castanopsis indica*	*	*	*	*	
2	*Schima wallichii*	*	*	*		
3	*Artocarpus heterophyllus*	*		*	*	
4	*Artocarpus lakoocha*	*		*		
5	*Ficus lacor*	*	*	*		*
6	*Ficus glaberrima*	*	*	*		
7	*Bombax ceiba*		*	*		
8	*Polygonum mole*	*	*	*		
9	*Litsea monopetala*	*	*	*		
10	*Myrica nibra*		*		*	
11	*Erythrina arborence*	*	*	*		

Next Steps

Barefoot Tree Breeders: Farm Resources in Tree Improvement[1]

Kenneth G. MacDicken and Suree Bhumibhamon

Tree improvement efforts by forest geneticists have focussed on industrial use of plantation species. Some farmers have undertaken parallel efforts on multipurpose species, using the same plant-breeding skills of selection that they have traditionally used with other crops. The gene pool represented by these farmer selections is not well-represented in current scientific breeding work, but could be used to obtain more rapid genetic gains for commonly used multipurpose tree species (MPTS). Working with farmer/technicians, or "barefoot tree breeders," forest geneticists can identify, collect, and evaluate germplasm from these on-farm seed sources.

Most tree-breeders are likely to remain focussed on the demand for improved plantation species for industrial use. Rapid improvement of MPTS, therefore, will require the creation of a new cadre of tree improvement workers oriented to farmers' agroforestry needs. Such cadres of barefoot tree-breeders can apply simple selection and breeding techniques learned from forest geneticists to locally available or popular species for agroforestry.

The Farmer as Plant Breeder

Experience and Potential

Farmers have selected and domesticated plant and livestock species for thousands of years. Many varieties used in the breeding programs of international agricultural research centers were those selected and maintained by farmers (Rhoades 1989). In Thailand, most well-known fruit tree varieties of *Tamarindus indicus* (tamarind), *Mangifera indica* (mango), and *Durio zibethinus* (durian) are products of farmers' selection, not those of agricultural scientists.

One reason for this farmer-driven selection process is adequate incentives, often economic. Such incentives may be better market prices for higher quality fruit, or greater income from increased crop yields. In the case of fruits in Thailand, tax incentives were provided during the reign of King Chulalongkorn nearly 100 years ago to farmers who produced higher quality fruit. The practice of improvement thus encouraged has continued to the present. Farmers in Nakhon Srithamarat and Trang provinces select superior trees of *Azadirachta excelsa* in homegarden production systems for more valuable furniture wood. In southern Thailand, *Parkia speciosa* has been selected for better taste, and is grown widely as a homestead species for cash income and home consumption.

Another factor in farmer-driven selection is the ability to recognize desirable plant traits. For cereals, staple crops and fruit trees, farmers can readily recognize traits such as taste, yield, and ease of management. A keen-eyed grower may locate an unusual seedling or even bud sports that produce unusual fruits and can be used as the vegetative basis for new varieties. The immensely successful Red Delicious apple originally came from a chance seedling in the state of Iowa, United States; it was then bud-grafted onto thousands of other trees to form a new variety. The pink-fleshed grapefruit was a bud sport of a single branch of one of thousands of white-fleshed grapefruit trees in one orchard. Farmers also commonly and easily select seed from the largest panicle of rice or ear of maize. Easily recognized traits help make the improvement process efficient and profitable.

Obstacles

Just as economic incentives can drive the tree improvement process, disincentives can pose obstacles. In mainland China, farmers growing

[1]This paper is an abridged version of MacDicken and Bhumibhamon (1990).

Paulownia in agroforestry plantings receive the same price for their trees, regardless of form or wood quality (Zhu 1988). This results in low prices overall, as buyers are able to use only a small proportion of the purchased wood for high-value timber products.

Likewise, species that produce fuelwood as a primary crop are unlikely to find acceptance by farmers where illegal fuelwood collection is still possible and fuelwood prices remain low, as in Thailand. Until such disincentives are removed, farmers are not likely to spend limited resources improving non-fruit tree species.

Another obstacle in farmer selection of plus trees is the lack of awareness of how to improve trees for more than one feature. A survey of fruit-tree farmers in Chantaburi Province showed that while farmers grow durian with good to excellent tree form, and durian wood is often sold to furniture factories and used for flooring, farmers still select only for fruit production and do not consider wood as an important characteristic for improvement. In such cases, farmers may have both economic incentives and the ability to recognize desirable traits in plus trees, but they lack the skills to make improvements for both fruit and wood quality.

A third obstacle is limited information about the added value of improved products from multipurpose species, such as the higher price of knot-free wood. In many areas, state agencies offer free, unimproved seedlings from seed sources of poor or unknown quality. This encourages the mistaken idea that one tree is no better than another for that species, and that there is no advantage to selection.

Barefoot Tree Breeders

Along the lines of the "barefoot doctor" concept successful in China in providing basic health care to rural communities, Chuntanaparb and MacDicken (1991) proposed a cadre of "barefoot tree breeders" who would do the same for tree improvement of agroforestry species in rural areas. These breeders would emphasize indigenous tree and shrub species neglected by conventional tree improvement programs. Barefoot tree breeders would require a very basic knowledge of dendrology, genetics, seed handling, access to well-trained forest geneticists, and a strong dose of common sense.

In cases where trees growing in farmers' homegardens have been selected and propagated from mother trees, as in the Thai cases mentioned above, the barefoot tree breeder has an available base population already based on selection.

The cooperation of trained tree breeders in developing this new group of barefoot tree breeders is essential. Table 1 provides an example of the division of responsibilities between conventional and community-based tree breeders.

Table 1. Duties of trained tree breeders and farmer tree breeders in improving agroforestry species.

Trained tree breeder	Barefoot tree breeder
Study breeding systems for selected species	Identify suitable agroforestry species for improvement
Assist with taxonomy of selected species	Select and clone plus trees into clonal orchards
Know hand pollination techniques	Train farmers in selection of ideotypes and seed collection
Maintain collections from a broad geographic area	Supervise early field testing of progeny from improvement programs

Source: Chuntanaparb and MacDicken 1991.

This has been employed with forestry plantation workers and part-time farmers in eastern Thailand.

A number of different approaches might be taken to achieve this cooperation. Ashby et al. (1989) asked farmers to rank 10 bush bean varieties in Colombia, then asked a trained plant preeder from the Internantional Center for Tropical Agriculture (CIAT) to do the same. The final ranking of bean varieties by farmers and the plant breeder in this pre-screening were similar, differing primarily because farmers felt the most important criterion for selection was grain size. The plant breeder ranked the varieties in terms of anticipated acceptability to farmers.

Table 2 shows the steps in this process as tested with farm workers from the Thai Plywood Company on the Lad Krating plantation in eastern Thailand. Farmers were asked to identify plus trees of *Eucalyptus camaldulensis*; the same population of trees was then screened by a trained forest geneticist.

Conclusion

Farmers are proven breeders of food, fruit, and tree crops. This resource has generally not been tapped for the improvement of multipurpose trees. This paper has briefly outlined how genetic tree breeders can work with farmers for accelerated improvement of these species, recognizing and combining the knowledge of the scientist and the farmer/practitioner.

Table 2. General steps required to effectively combine skills of farmers and forest geneticists for MPTS improvement.

Step	Farmer/Barefoot tree breeder	Forest geneticist
Pre-screening		
What species are appropriate for farm level tree improvement?	Knowledge of species with potential value for local use, for which local genetic resources exist.	Knowledge of species or genetic resources that might meet farmers' expressed needs but are unknown to them.
Has any improvement or selection already been done, either by farmers or tree breeders?	Knowledge of locally available trees and indigenous knowledge of other farmers.	Case studies of improvement work from scientific and technical literature.
What genetic resources are available?	Knowledge of potential mother trees for improvement.	Access to germplasm collections made elsewhere, plus knowledge of breeding systems and genetic resources.
On-farm selection and improvement		
Identify practical, achievable ideotypes of the priority species.	Ideas on the type of tree that would best fit local needs and markets.	Knowledge of how attainable the desired ideotype may be.
Select parent trees for first/next stage of testing.	Knowledge of and access to local base populations.	Experience in identifying plus trees based on pre-defined criteria.
Collect propagules from parent trees.	Experience in handling plant materials. Easy access to trees in the local area.	Knowledge of vegetative propagation techniques that may not be known by local farmers.
Distribute propagules among core group of tree breeders and farmers for planting and evaluation.	Access to sites for evaluation of improved materials likely to be representative of other farmers' conditions.	Access to experiment station sites and other trained tree breeders who can provide additional evaluations of selected materials.

Source: MacDicken and Bhumibhamon 1990.

Community-Based Tree Improvement:
A New Series of Research Activities Beginning with the Artocarpus Network

John B. Raintree

Background

In an FAO Regional Consultation on Forestry Extension held in Bangkok in 1988 and co-sponsored by the F/FRED Project, the key paper on extension-research linkages argued that the rapid pace of change in social forestry over the previous decade had created a new situation for extension programs (Raintree and Hoskins 1988). It maintained that most extension projects would need at least a minimal research component in order to verify and adapt locally untried technical innovations in the growing agroforestry repertoire of the "new forester". The consultation endorsed this viewpoint and recommended formal recognition and support for the proposed Extension Research and Development (ER&D) approach. ER&D is an interdisciplinary methodology which combines elements of extension with on-farm research through community-based R&D activities.

ER&D in F/FRED Phase 2

Meanwhile, in response to mounting interest within the MPTS Research Network in both extension and on-farm research, the Network's Steering Committee endorsed a plan to incorporate ER&D into the workplan for F/FRED's second five-year phase (1990-1995). In 1990, the Project found itself in a position to contribute significantly to the development of the ER&D approach.

Project staff felt that a strategy for implementing this mandate would need to focus closely on those extension-research activities for which the Network possessed a comparative advantage: improvement and management of multipurpose tree species. For this reason, it was decided that the planned ER&D activity would build upon the "barefoot tree-breeder" concept already developed within the MPTS Research Network (MacDicken and Chuntanaparb 1991, MacDicken and Bhumibhamon 1990, MacDicken and Mehl 1990). The activity would develop its primary focus around tree improvement activities by farmers and rural communities. This kind of action-oriented research was also considered to be a natural next step following the Tree-Breeding Objectives study.

As stated in the ER&D program strategy, the objectives of the Community-Based Tree Improvement work were to:

- Explore the indigenous technical knowledge base underlying traditional tree breeding and management practices and expand regional understanding of the local-level institutions and processes on which these activities are based.

- Refine and develop methodologies for providing effective support to tree breeding and tree management innovations by small farmers and communities and for extending the fruits of these informal sector research processes to other farmers and communities.

- Initiate and facilitate pilot projects within a number of communities in the region with the goal of producing genetic improvements in one or more multipurpose tree species for farmer defined purposes; later, to provide support for the expansion of a collaborative projects along these lines.

- Contribute, through the above activities, to the further development of the Extension R&D approach and to maintain contacts with other regional institutions using similar action research methodologies in social forestry and agroforestry.

- Institutionalize communication linkages among "barefoot breeders," other farmer-researchers, local communities, extension workers, NGOs, scientists, and formal sector research institutions so as to ensure sustained support for community-based research and development initiatives.

These are ambitious objectives. It remains to be seen how many of them can actually be accomplished within the five-year timeframe. Funding may well become a constraint early in the program, although ER&D might attract additional funding from other sources. The program is based on the premise that it is better to set one's sights too high than too low.

The Artocarpus Network

In keeping with the principle, well demonstrated within the MPTS Research Network, that a species focus maximizes the coherence of proposed activities, the new sub-network selected *Artocarpus heterophyllus* (jackfruit) as a priority species. To understand why jackfruit emerged as the inevitable choice, given the socioeconomic orientation of this program, requires only a glimpse at the findings of the Farm and Village Forestry study conducted in 1989.

Farmers in the 26 study villages were asked to specify which species they prefer for each of several use categories. Table 1 ranks the most frequently mentioned species.

According to these findings, trees that produce food are prominent among the multipurpose trees most preferred by farmers in Asia. Four of the 10 — including the top three — are well known fruit trees and all but 3 of the 10 were reported as having at least locally important food uses by farmers in the FVF study.

Table 1. The 10 species most frequently mentioned in the FVF study as first or second choice for any of 10 purposes. Source: Raintree 1991.

Rank	Species
1	*Mangifera indica*
2	*Artocarpus heterophyllus*
3	*Cocos nucifera*
4	*Paraserianthes falcataria*
5	*Shorea robusta*
6	*Leucaena leucocephala*
7	*Castanopsis indica*
8	*Prunus cerasoides*
9	*Schima wallichii*
10	*Psidium guajava*

Network activities in Phase 1 placed a heavy emphasis on fast-growing nitrogen fixing trees, the archetype of a multipurpose tree in many people's minds. What the FVF study brought to light was that from the standpoint of small farmers in Asia, this kind of multipurpose tree — as important as it might be — is overshadowed in significance by another class of MPTS: multipurpose food trees.

Table 2 shows clearly that these food trees are in fact used by farm families for multiple uses. They are indeed multipurpose trees.

Given small farmers' concerns for family food security and limited land resources, their

Table 2. Rank order of uses and frequency as first or second choice for that use. Source: Raintree 1991.

Mango		Jackfruit		Coconut	
Food	558	Food	387	Food	229
Fodder	117	Fodder	166	Fuelwood	222
Fuelwood	117	Timber/const.	95	Handicrafts	99
Timber/const.	79	Fuelwood	49	Timber/const.	94
Charcoal	26	Industrial	26	Charcoal	81
Industrial	7	Handicrafts	8	Industrial	41
Handicrafts	4	Charcoal	7	Fodder	31
Other	17	Other	24	Other	3

preference for a timber tree that also produces food is a natural one. While the MPTS Research Network's emphasis on fast-growing, nitrogen-fixing and timber trees is a legitimate concern, it clearly needed to be balanced by an added emphasis on multipurpose food trees in order to address more completely small farmer concerns.

To select a priority species for community-based tree improvement activities, the Network considered the top three MPTS identified by the farmers in the FVF study. The Network could contribute little to coconut research, which has already received much research attention. Mango has received less attention, but national proprietary interests in mango fruit varieties pose a potential obstacle to international sharing of germplasm. In the study, jackfruit ranks second only to mango as a multipurpose food tree, yet it is not a particularly sensitive subject for intercountry germplasm exchange. Furthermore, it has been grossly neglected as a subject for scientific research and improvement. A staple food in many countries, it is extremely important to regional food security. It is also an important timber in some countries, as well as fodder, etc. It seemed an obvious choice. The proposal has met with enthusiastic support throughout the Network.

Other members of the Artocarpus genus, such as *A. altilis* (breadfruit) and *A. integer* (chempedak), are also important and may have considerable development potential in their own right. While jackfruit was selected as the primary focus of network activities, the network was dubbed the "Artocarpus network" to leave scope for subsequent work on other members of the genus.

Pilot Project on Jackfruit Tree Improvement

The island of Cebu in the Philippines is the center of an exceptionally vigorous and varied commercial interest in jackfruit production, processing, and marketing. It was thus felt to be a good focal point for the first pilot project in the Artocarpus network. In December 1990 a group of scientists from the Visayas State College of Agriculture met in Manila with two representatives of the F/FRED Network Secretariat to develop the following plan for the project. The last paper in this report is a first progress report of this initiative.

PROJECT OVERVIEW

This project is conceived as a multi-phase, multi-component, activity which will span a minimum duration of four years. Since tree improvement by farmers and local paraprofessionals is a new area of organized research, details of the methodology and activity plan for the project will evolve over the course of the project as experience is acquired. A methodology for collaboration with farmers in tree improvement work will be one of the main outputs of the project. The overall framework envisaged for the project is as follows:

Phase 1	Preliminary survey of jackfruit production, utilization and marketing in the Central Visayas
Phase 2	Quantitative assessment of jackfruit baseline population, marketing potentials, and breeding objectives for target user groups in the Central Visayas
Phase 3	Identification and collection of superior jackfruit germplasm
Phase 4	Tree improvement work with farmers and community-based paraprofessionals

The phasing of research activities is based on a logical, stepwise progression in which the research activities in one phase fulfill the information requirements for detailed planning of the next phase of research. Thus, the overall objective of Phase 1 activities is to define the baseline situation with respect to jackfruit germplasm, production, utilization and marketing in the Central Visayas, which sets the stage for Phase 2 activities aiming at a more quantitative inventory of the jackfruit baseline population, assessment of marketing potential, and definition of tree improvement objectives, which is a precondition for Phase 3 germplasm exploration and collection and Phase 4 tree improvement work with farmers.

The scope of tree improvement work covered by the project include will include genetic tree improvement as well as non-genetic tree improvement by management. Thus, in addition to long-term gains through tree breeding, the project will also target short-term improvements through various forms of grafting, budding, pruning, arching, etc.

Research Plan for Phase I

Phase 1 will contain three coordinated research components, each to be administered under a separate professional services agreement: 1) documentary survey, 2) survey of jackfruit production areas and user groups in the Central Visayas, 3) survey of jackfruit utilization and marketing.

1. Documentary Survey

Objectives: To conduct a documentary survey and analysis of material from archival sources in Manila, Cebu and Davao, covering botany and breeding system, origin and domestication, varietal evolution, movement of germplasm, economic importance, soil and climatic requirements, biomass development, cultural requirements and practices, and state of jackfruit research with particular attention to tree improvement work. The primary focus of this survey will be on *Artocarpus heterophyllus* (jackfruit) but information will also be collected on other members of the *Artocarpus* genus.

2. Survey of Jackfruit Production Areas and User Groups in the Central Visayas

Objectives: To identify and map the main jackfruit production areas and "hot spots" in the Central Visayas, where farmers are keen on jackfruit and where jackfruit production has a significant growth potential. To identify and characterize the main jackfruit user groups, as differentiated by socioeconomic characteristics and/or objectives vis-a-vis the production, processing or end-use of jackfruit products. Finally, to identify the jackfruit ideotypes and preferred characteristics relevant to the different uses and user groups, with attention not only to such visible (drawable and photographable) characteristics as size, growth form, branching, habit, leaf shape, etc., but also to age and season of fruit bearing, and other characteristics associated with fruit and wood quality.

Methodology: Details of the methodology for this survey will be worked out by the project implementors, but may be expected to include such techniques as windshield survey, informal survey and interviews with key informants, farmers, processors, marketers and users of the different jackfruit products; drawings, photographic records; etc. Methodological innovations are encouraged and expected. The researchers will coordinate their activities closely with researchers responsible for the utilization and marketing survey.

3. Utilization and Marketing Survey

Objectives: To describe and assess current supply and demand for jackfruit (mainly fruit and lumber) in the Central Visayas, to describe the marketing system, market structure and commodity flow of jackfruit raw materials and products; to identify production and marketing problems associated with the different

components of jackfruit use; and to arrive at a precise qualitative definition of the specific biological characteristics associated with different components of current market preference and demand.

Methodology: Details of the utilization and marketing survey will be worked out by the survey researchers. The marketing researchers will coordinate their work with researchers conducting the survey of jackfruit production areas and user groups and will work closely with a consultant (K.G. MacDicken) on technical aspects of jackfruit utilization in order to arrive at an understanding of the market demand for specific biological characteristics which could become the focus of tree improvement efforts in a later phase of the project. Whereas, Phase 2 research will try to give a more precise quantitative definition of improvable biological characteristics and make a quantitative projection of market demand for such improvements, in Phase 1 the main concern is to arrive at a qualitative appreciation of relevant jackfruit characteristics, as a prerequisite for inventory of the baseline jackfruit population and preliminary definition of possible tree improvement objectives.

Jackfruit Tree Improvement by Farmers in the Philippines:
A First Progress Report, June - November 1991

Eliseo Ponce, Antonio Acedo, Belita Vega, Casimiro Carcallas,
Analita Salabao and Joselito Loyola

Introduction

Jackfruit is among the most-preferred multipurpose trees in the Philippines. Although it is grown all over the country, the center of a vigorous and varied commercial interest in jak production, processing, and marketing is in Cebu, the heart of the Philippines. Cebu is situated in the Central Visayas region together with three other provinces: Bohol, Siquijor, and Negros Oriental. According to 1986 data, the region ranks fourth in terms of the country's jackfruit production.

The strategic importance of jak in Cebu, and in the Asia region generally, influenced the MPTS Research Network to establish this project. It aims to promote the production of this multipurpose species, and at the same time develop farmers' participation in tree breeding. The jackfruit tree improvement project is multidisciplinary, composed of four phases planned to be undertaken in four years.

This progress report covers the first phase of research activities: (1) documentary survey, (2) survey of jackfruit production areas and user groups, (3) survey of jackfruit marketing and utilization.

Documentary Survey

One objective of the project's first phase was to conduct an archival survey and analysis of: jak's botany and breeding system, origin and domestication, varietal evolution, movement of germplasm, economic importance, soil and climatic requirements, cultural practices, and state of jak research, with particular attention to tree improvement.

Literature was gathered on the different aspects of jak research in the Philippines (see Acedo 1992). The major data sources were the University of the Philippines at Los Banos, the Philippines Council for Agriculture and Resources Research and Development, the Institute of Plant Breeding, the National Library, and the Department of Agriculture (DA) in Cebu.

The documentary survey uncovered information on jak studies (especially on germplasm collection and indexing) conducted at the DA-Cebu's Mandaue Experimental Station. The station continues to produce and sell grafted jak for wide propagation, although it has discontinued its jak research project.

Survey of Jackfruit Production Areas and User Groups in the Central Visayas

This survey set out to:

1. Map the main jackfruit production areas and "hot spots" in the Central Visayas.

2. Identify and characterize the major jackfruit user groups, as differentiated by socioeconomic characteristics and/or objectives *vis-a-vis* the production, processing or and use of jackfruit products.

3. Identify the jackfruit ideotypes and preferred characteristics relevant to the different uses and users' groups, with attention to phenotypic or visible characteristics.

The survey employed the methods of windshield survey, informal survey, and interviews with key informants, farmers, processors, traders, and users of different jackfruit products.

Preliminary Findings

1. Mapping of jackfruit production areas

1986 data from the Central Bank of the Philippines report that the country exported 3,441 kg of fresh jak fruit valued at US$5,136.00 (FOB) and jak syrup export totalling 184,975 kg with $378,244 FOB value. This suggests that jak has the potential to become one of the country's non-traditional export crops.

While jak is found virtually all over the country, the most significant production areas outside the Central Visayas are the Western Visayas, Bicol, and Southern Tagalog. Among the four provinces in the Central Visayas, Bohol leads in terms of area planted to jak trees, followed by Negros Oriental, Cebu, and Siquijor (Figure 1). However, 1988-1990 data on jak production show Negros Oriental as the province with most jak, although the three-year trend indicates a significant decrease (Figure 2). The same data indicate Cebu's more or less stable jak production. Bohol has displayed a lower production trend, considering that it has comparatively the highest hectarage devoted to jak. Researchers from the National Agricultural Statistics Office hinted that the discrepancy between the data for Bohol and the other provinces might be due to differences in plant density. We will try to cross-check this discrepancy in our surveys.

The Cebu survey identified at least 14 municipalities as major jak-producing areas (Figure 3). Plantation-style jak production units are few but can be found in the towns of Bantayan, Carmen, and Argao. Most of these jak growers are conversant with the different jak varieties, and one of them is planting grafted jak trees.

Cebu guitarmakers identified the towns of Consolacion, Liloan, and Cordova (Mactan) as the best production sources of jak materials. The sources of vegetable and fresh jak regularly traded in the Cebu City's Carbon Market come from Argao, Santander, San Fernando, and Carcar. However, according to one of the four Cebu jak shippers, at present their supply of jak (for transport to Manila) comes from Dumaguete City (Negros Oriental), Bohol, and Iligan City (northern Mindanao).

Bohol data indicate that jak is the most valued fruit tree there because of its multiple uses. At least 10 towns (including some districts in Tagbilaran City) are "hot spots" in jak production (Figure 4). The key informants in Bohol have also noticed the commercial value of jak. One farmer/trader in the central part of the province currently maintains a 12-ha farm of more than 14,000 jak trees.

In both Cebu and Bohol, topography is an important variable in assessing jak's production areas. Few jak trees were observed in the highlands and rolling areas, but they become more abundant in the lowland and coastal areas. Where do the best jak (usually the sweet-tasting, big-flesh varieties) grow? Farmers/users can readily pinpoint particular areas in each province with some qualifying description. For instance, vegetable retailers of jak in Bohol usually associate the best ("whitish") jak with the towns of Panglao and Dauis. Our local key informants suspect that the soil ("Bolinao clay") and climate have some bearing on the quality of jak they produce. Guitarmakers in Mactan, Cebu prefer jak grown on rugged ("stony") terrain because jak lumber from these areas is more durable and has fine texture.

2. Identification of jak uses and user groups

The compiled Cebu and Bohol data show that jak exhibits a tremendous usefulness for farm and home use as well as for commercial purposes. Figure 5 illustrates the uses of jak and the different user groups. One finding from the key informant survey was the information that fresh jak for vegetable use are shipped (weekly at least 10,000 pieces) to industrial processors in Manila (for example, Lorenzana Patis) which in turn process the jak for export as "frozen" vegetable slices.

The use of jak leaves as fodder for cattle and goats is not widely practiced in Cebu, but is popular in Bohol (the Dauis and Panglao areas), and not only during drought months.

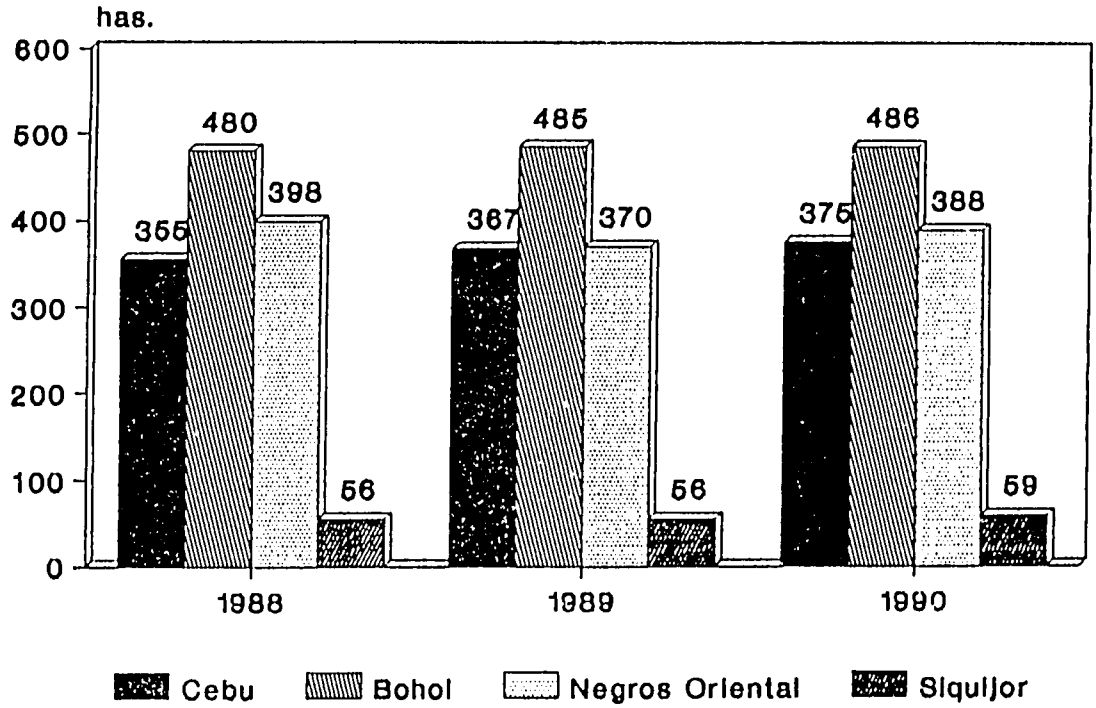


Figure 1. Jackfruit production area (ha) in the Central Visayas. Source: National Agricultural Statistics Office, Cebu Province.

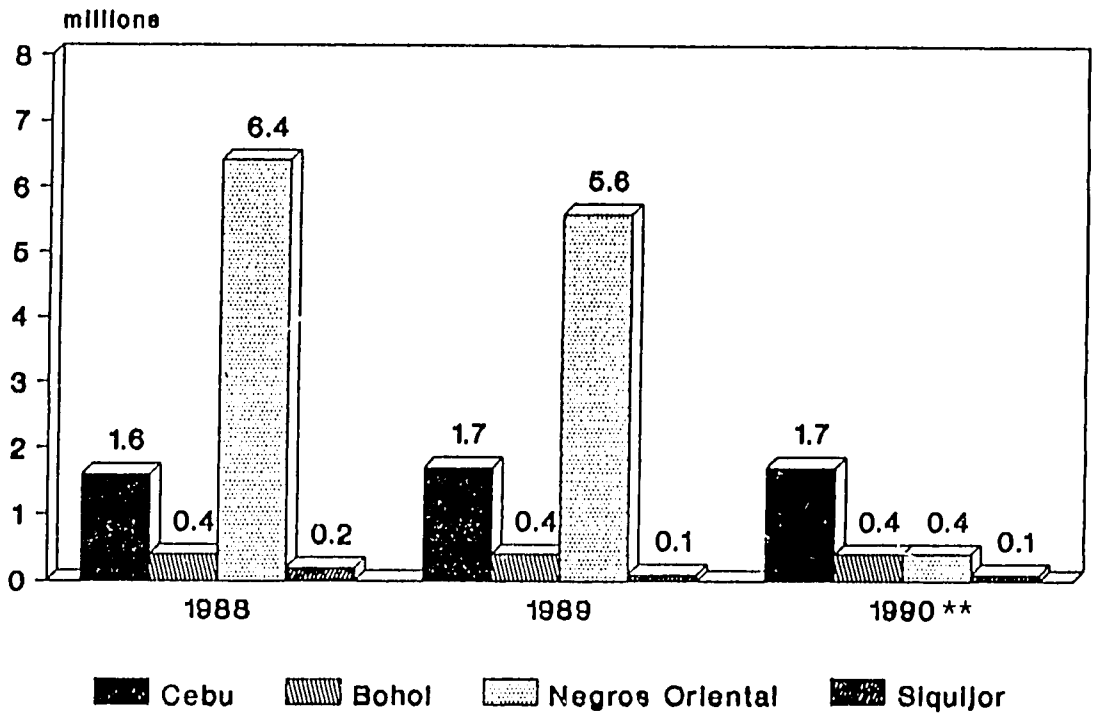


Figure 2. Jackfruit production in the Central Visayas (kg/ha). Source: National Agricultural Statistics Office, Cebu Province. **Typhoons in 1990 may have influenced decline in production. Data for Negros Oriental may be underestimated.

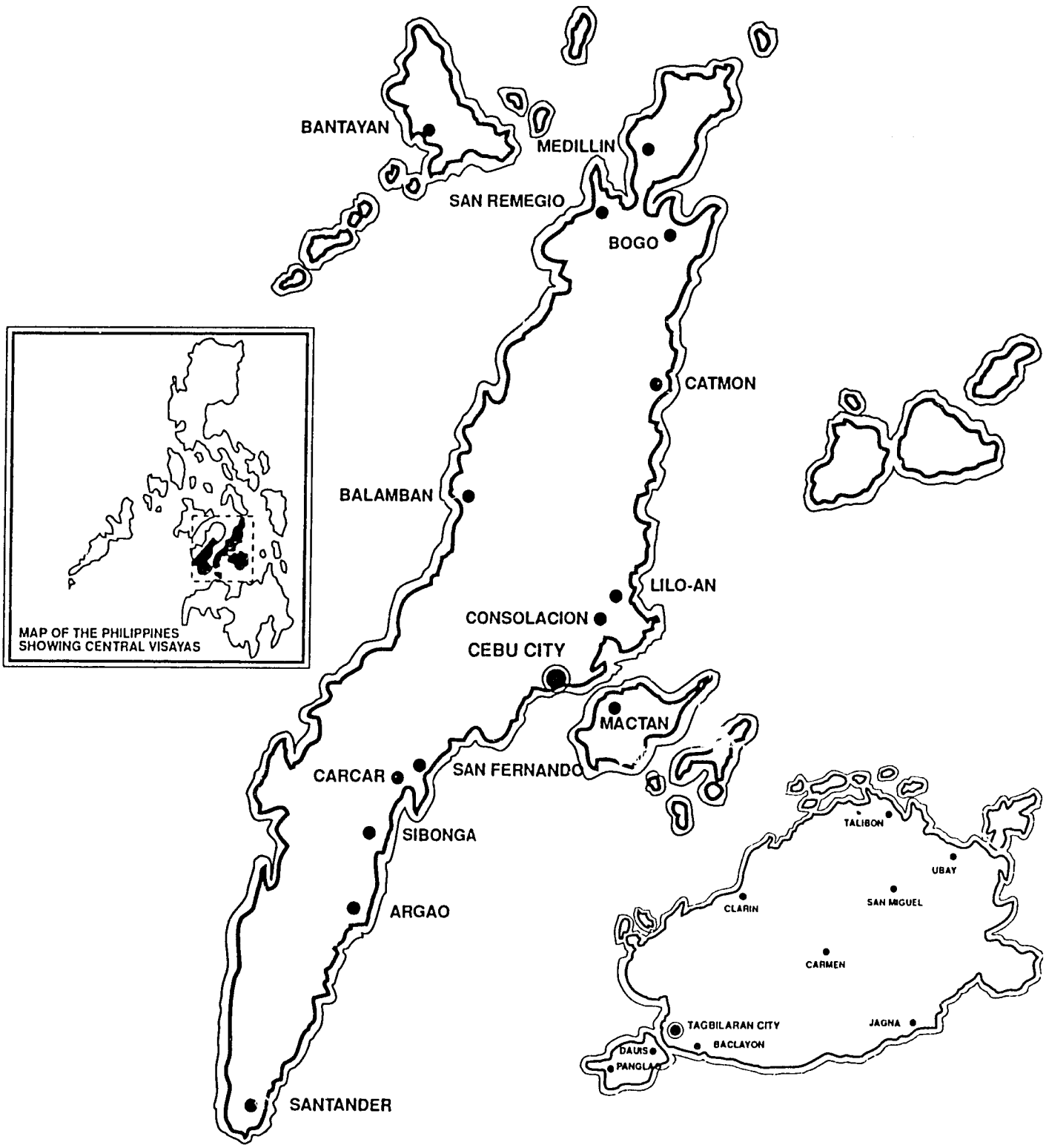


Figure 3. Map showing major jackfruit production areas in Cebu and Bohol, Philippines.

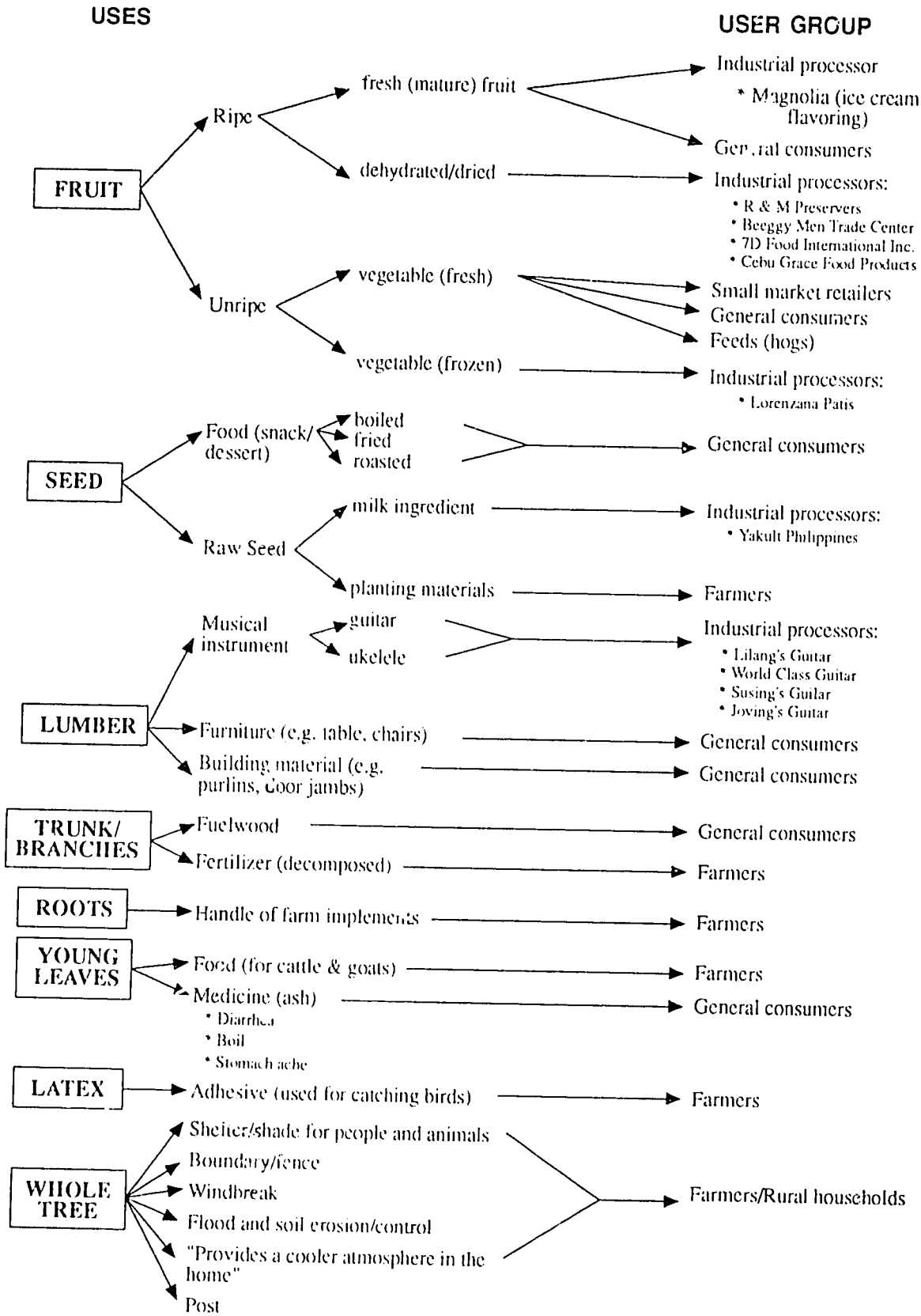


Figure 4. Uses and user groups of jackfruit in the Central Visayas.

3. Identification of jak's preferred characteristics

The following list is a preliminary compilation of jak's preferred characteristics based on partial survey results:

fruit morphology
- size:length, weight, diameter
- form or shape
- quality:flesh/pulp color, flesh/pulp shape, aroma, flesh/pulp texture
- seed shape and size

growth habits
- canopy architecture
- branching habit
- leaf size

fruiting characteristics
- age of fruiting
- season of fruiting
- fruit density

wood quality
- texture
- color
- sound quality
- durability:(quality to withstand extreme heat and cold)

Marketing and Utilization of Jackfruit

This set of activities aimed to:

1. Describe and assess current supply and demand for jackfruit.

2. Describe the marketing system, market structure, and commodity flow of jackfruit raw materials and products.

3. Identify production and marketing problems associated with the different components of jackfruit use.

4. Arrive at a precise, qualitative definition of the specific biological characteristics associated with the different components of current market preference and demand.

Methods used included informal interviews, actual observations of jackfruit marketing and processing, informal survey of producers, middlemen, and processors.

Preliminary Findings

The informal survey covered a total of 58 producers and 39 "middlemen" respondents from the four provinces of Central Visayas. Most of the respondents come from Cebu.

1. Marketing

Fruit

At the farm level, fruit marketing is dominated by assembler-wholesalers who either operate independently or are financed by wholesalers. These buyers buy small volumes of fruits from farmers; when they have accumulated a sizable amount, they sell the fruits to the wholesalers, wholesaler-retailers, and shippers. Shippers transport the fruits to Manila, while wholesalers and wholesaler-retailers sell the fruits to other traders or direct to the consumers (Figure 5).

Wood

Jackfruit wood is mainly traded in Central Visayas for the manufacture of guitars and ukeleles. The marketing of jak wood for these products generally involves a direct sale between the producer and processor. Processors directly contact the tree owners and negotiate for the sale of the tree. Trees used for this purpose are either no longer fruit bearing or "damaged" (i.e., with broken branches or partially uprooted).

Trees are sold on a "per trunk" basis. Prices offered by the buyers vary according to the size and length of the trunk and quality of the wood. Damaged trees are usually priced lower. When a sale is concluded between the processor-buyer and the tree owner, the latter is responsible for cutting the tree.

Processors make pre-finished guitar and ukelele products from the wood. The pre-finished products are then sold to another processor (commonly a guitar factory) which applies the finishing touches (e.g., putting on the strings).

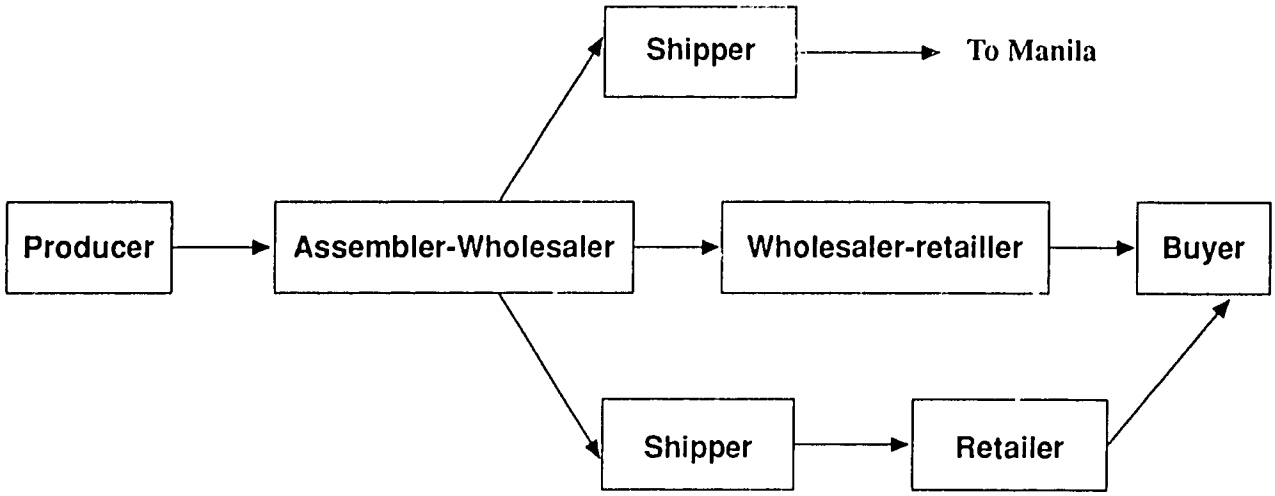


Figure 5. Common marketing channels for fruits of *Artocarpus heterophyllus*.

From the guitar factories, the finished products are sold to buyers (Figure 6).

2. *Utilization*

In Central Visayas, jackfruit tree products are used in the home as food, fuel, medicine, and fertilizer. The fruit is mainly used for food; mature fruits are consumed as fresh fruit or processed for dessert, and the immature ones as vegetables. Leaves are used as feeds and as medicine. As mentioned above, jak wood is generally used in the manufacture of guitars and ukeleles. Wood cuts and slices from guitar/ukelele-making are used mainly for fuel. Jak industrial food products include dried jak, ice-cream flavoring, and health drink ingredient.

At the household level, jak is processed by various techniques for desserts, candies, and vegetables. Processing is mainly performed by women. In the course of our surveys, we have also learned of the different indigenous ways of preparing jak for food.

Problems Encountered

The field researchers had difficulty gathering data from the industrial processors (for example, Magnolia Ice Cream, Yakult Philippines). The team is still seeking an effective methodology for solving this problem.

A second difficulty has been the consecutive occurrence of typhoons, which greatly affected data gathering and analysis.

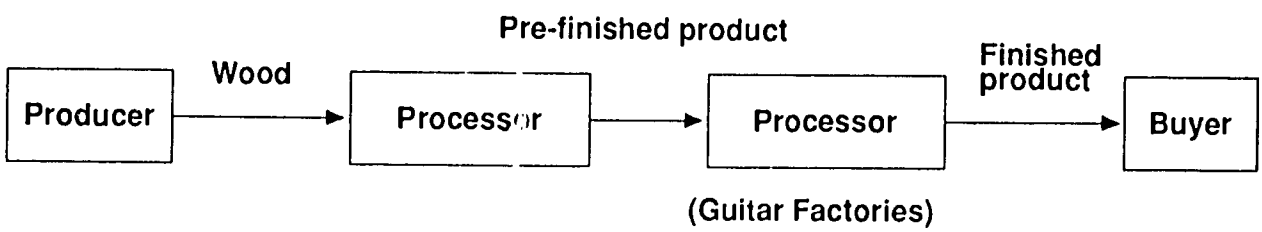


Figure 6. Common marketing channel for jackfruit wood used to make guitars and ukuleles.

Glossary

acuminate - Tapered to a slender point.

bole - The main stem of a tree of substantial diameter, capable of yielding timber, veneer logs, and large poles.

cultivar - a cultivated variety or species for which there is no known wild ancestor.

decussate - Of the arrangement of leaves, occurring in alternating pairs at right angles.

genotype - The entire genetic constitution, expressed or latent, of an organism or group of organisms.

geotropic - Tendency of a plant (or component) to grow toward the earth's center of gravity.

ideotype - A form denoting an idea; an "ideotype tree" is a plant model designed to yield products of greater quality and quantity than a conventional cultivar or wild plant (Dickmann 1985).

lenticel - A loose-structured opening in the periderm beneath the stomata in the stem of many woody plants that facilitates gas transport.

monopodial - Stem branching in which there are lateral shoots on a primary axis.

morphology - The structure and form of an organism*; in this case, of a tree.

obovate - Ovate with the narrower end basal.

opposite - Of leaves, being in pairs on an axis with each member separated from the other of the pair by half the circumference of the axis.

phenotypic - Related to the visible properties of an organism that are produced by the interaction of the genotype and the environment.

phyllotaxy - The arrangement of leaves on a stem.

plus tree - A phenotype judged (but not proved by test) to be unusually superior in some quality or qualities (e.g., exceptional growth rate relative to site, desirable growth habit, high wood quality, exceptional apparent resistance to disease and insect attack or to other adverse locality factors).

provenance - The ultimate natural origin of a tree or group of trees, usually considered synonymous with geographic origin.

respondent - Person interviewed in the course of a study.

specific gravity - As applied to wood, the ratio of the oven-dry weight of a sample to the weight of a volume of water equal to the volume of the sample at some specific moisture content.

verticillate - Whorled, in an arrangement resembling the spokes of a wheel.

whorl - An arrangement of leaves in a circle around a point on an axis.

Appendices

Ideotype Specifications

The following 82 ideotypes first appeared in Chuntanaparb and Ranganathan (1990). Each contains a description of the species as found locally (including products and services required, most important listed first), followed by a description of the ideotype expressed by farmer-respondents. As explained in the earlier report, although some of the ideotypes for different localities are very similar, different environments and cultural practices require different models. There is no universal ideotype suitable for all sites and end uses.

Northwestern Bangladesh

Artocarpus heterophyllus

Products and services required
Fruit, timber, fodder and fuelwood.

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

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

Ideotype Description

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

Stem: Straight single stem

Roots: Strong taproot with few lateral roots

Deciduousness: Short period of leaflessness

Response to management
Regrowth after branch pruning, shade tolerant

Discussion

The given priorities for fruit and timber, followed by fodder, would be satisfied by vigorous growth.

Mangifera indica

Products and services required
Fruits, fuel, fodder and timber.

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

Other information
Tolerates drought but not 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

Roots: Strong taproot with few lateral roots

Deciduousness: Short period of leaflessness in the winter

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

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.

Swietenia mahogani

Products and services required
Timber, fodder.

General selection criteria
Vigor, pest and disease free.

Other information
Tolerates flooding and drought, grows straight, pruning possible.

Required
Fodder value information.

Ideotype Description

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

Stem: Long, straight cylindrical bole

Roots: Strong, deep taproot

Deciduousness: Evergreen type preferred

Response to management
Not specified

Discussion

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

Tamil Nadu and Maharashtra, India

Azadirachta indica

Products and services required
Timber for construction of houses and agricultural 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.

Other information
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 pleading, 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

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

Deciduousness: Evergreen

Response to management
Prolific regrowth after lopping for mulch.

Discussion

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

Acacia nilotica var. *indica*

Products and services required
Wood and woody branches for fuelwood, wood for timber and construction purposes, agricultural implements and bullock carts, leaves and pods forage for goats and sheep, gum.

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

Other information
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

Deciduousness: Evergreen preferred

Response to management
Not specified.

Discussion

Selection criteria should be biomass production.

Thespesia populnea

Products and services required
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.

Other information
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.

Ideotype Description

Crown: Large, with many branches and dense foliage

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

Roots: Geotropic

Deciduousness: Evergreen preferred

Response to management
Prolific regrowth on pollarding.

Discussion

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

Prosopis juliflora

Products and services required
Wood and woody branches and roots for fuelwood, wood for charcoal, pods for forage, wood for agricultural implements, thorny branches at fences.

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

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

Ideotype Description

Crown: Medium to large with many branches

Stem: Single or multiple stems with many branches

Roots: Prefer big, shallow or lateral roots

Fruit: Many pods, big and fleshy

Deciduousness: Not specified

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

Response to management
Not specified.

Discussion

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

Tamarindus indica

Products and services required
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.

Required
Fodder value of leaf.

Ideotype Description

Crown: Round, large canopy with many branches for greater fruit production.

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.

Deciduousness: No modification

Response to management
Not specified.

Discussion

Selection criteria should be increased fruit yield and size of pods.

Mangifera indica (also for Sukhomajri)

Products and services required
Fruit, wood for timber and fuelwood, leaves as fodder.

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

Other information
Well known species with wide range of distribution and arrays of varieties to select for.

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.

Deciduousness: No modification

Response to management
Not specified.

Discussion

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

Tamil Nadu, India

Delonix elata

Products and services required
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.

Other information
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.

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

Deciduousness: Evergreen preferred

Response to management
Rapid, profuse regrowth after pollarding.

Discussion

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

Albizia lebbek

Products and services required
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.

Other information
Wood is valuable but not for house construction. Leaves used as fodder only in the summer months. Pollarding and coppicing possible.

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

Deciduousness: Shorter period of leaflessness (presently about 30 days)

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

Discussion

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

Ailanthus excelsa

Products and services required
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.

Other information
Pollarding and coppicing possible

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

Deciduousness: Evergreen preferred

Response to management
Rapid regeneration after pollarding.

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.

Albizia amara

Products and services required
Wood and woody branches for doors, windows and firewood, leaves for fodder.

General selection criteria
Vigor, woody biomass, resistance to insects and pests.

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

Required
Fodder quality values

Ideotype Description

Stem: Single or multiple stems

Foliage: Leaves should be larger for use as mulch

Roots: Deep rooting

Deciduousness: Evergreen preferred

Response to management
Not specified.

Discussion

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

Borassus flabellifer

Products and services required
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.

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

Required
Information on natural and artificial regeneration.

Ideotype Description

Crown: No modification

Stem: Straight, long cylindrical bole with good wood properties

Roots: Geotropic

Deciduousness: No modification

Response to management
Not specified.

Discussion

Selection criteria should focus on fast growth, stem form, and early fruit set.

Acacia leucophloea

Products and services required
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.

Other information
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 information.

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

Roots: Not specified

Deciduousness: No modification

Other: Less thorns

Response to management
Not specified.

Discussion

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

Cocos nucifera

Products and services required
Fruit, wood for house construction, leaves for thatching and weaving, other minor products.

General selection criteria
Vigor, fruit yield.

Other information
Well known species with wide range of distribution and many varieties and forms.

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

Deciduousness: No modification

Response to management
Not specified.

Discussion

Early fruit set and yield are major considerations for selection.

Pithecellobium dulce

Products and services required
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.

Other information
Tolerates drought and grows on a variety of soils.

Ideotype Description

Crown: Large with many branches

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

Roots: Deep roots

Fruit: Big pods, sweet in taste

Deciduousness: Not specified

Response to management
Rapid, profuse regrowth when lopped.

Discussion

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

Maharashtra, India

Acacia nilotica var. *cupressiformis*

Products and services required
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.

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

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

Deciduousness: No modification

Response to management
Not specified.

Discussion

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

Leucaena leucocephala

Products and services required
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.

Other information
Fast growing, drought tolerant, grows well at altitudes up to 2,800 m, prefers moist, deep soils that are well drained and will grow on slightly acidic soils. Coppices well.

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

Deciduousness: No modification

Response to management
Rapid, profuse regrowth on lopping.

Discussion

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

Sesbania sesban

Products and services required
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.

Other information
Fast growing, drought tolerant and grows on variety of soils. Short lived when lopped regularly for fodder.

Ideotype Description

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

Stem: Single or multiple stems with branches low on the stem(s)

Deciduousness: Short period of leaflessness

Other: Improved burning quality of wood

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

Discussion

Selection criteria should be vigor and improved wood quality.

Melia azedarach

Products and services required
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 disease.

Other information
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.

Ideotype Description

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 criteria should be vigor and stem form.

Zizyphus mauritiana

Products and services required
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.

Other information
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.

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 to consider.

Syzygium cuminii (also for Sukhomajri)

Products and services required
Fruit, wood and woody branches for fuelwood, wood for timber, house construction.

General selection criteria
Vigor and fruit quality

Other information
Found mostly on wastelands and common lands.

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 ont he average tree.

Response to management
Not specified.

Discussion

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

Sukhomajri, India

Morus serrata

Products and services required
Wood and woody branches for fuelwood, fruit, green branches for weaving baskets.

General selection criteria
Vigor and stem form.

Other information
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 common lands, wastelands and in natural forests. Also grown as a plantation crop in areas where agriculture is practiced.

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 ont he average tree.

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

Discussion

Selection criteria should be for stem form.

Carissa spinarum

Products and services required
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.

Other information
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.

Ideotype Description

Not given.

Discussion

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

Prosopis spicigera

Products and services required
As vegetative barriers against soil erosion, wood for fuelwood, wood for making agricultural implements, leaves for fodder.

General selection criteria
Vigor and stem form.

Other information
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.

Ideotype Description

Not given.

Discussion

Selection should be based on vigor.

Dalbergia sissoo

Products and services required
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.

Other information
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.

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 should be vigor and stem form.

Kavre District, Nepal

Prunus cerasoides

Products and services required
Leaves and green branches for fodder, woody branches for fuelwood, and wood for timber, making pegs, supports, etc.

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

Other information
Also planted as avenue trees, colorful flowers in winter.

Required
Information on 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

Roots: Not specified

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

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.

Alnus nepalensis

Products and services required
Woody branches for fuelwood, wood for timber for house construction.

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

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

Required
Wood properties information.

Ideotype Description

Crown: Narrow, with branches high on the stem

Stem: Single, straight bole

Roots: Geotropic

Deciduousness: Evergreen

Response to management
Rapid branching after lopping.

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.

Betula alnoides

Products and services required
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.

Other information
Wood quality is not good, warps and cracks on exposure.

Ideotype Description

Crown: Narrow crown with branches high on the stem

Stem: Single, straight bole

Roots: Geotropic

Deciduousness: Evergreen

Response to management
Rapid branching after lopping.

Discussion

Selection criteria should be wood properties, and wood, branch and leaf biomass.

Schima wallichii

Products and services required
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.

Other information
Bark causes itching.

Required
Information on 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

Roots: Geotropic

Deciduousness: Evergreen

Response to management
Rapid branching after lopping.

Discussion

Improvement should focus on rapid growth, and coppicing and spouting ability, with particular emphasis on improvement of stem and crown forms.

Kaski District, Nepal

Castanopsis indica

Products and services required
Food, fodder, fuelwood and timber.

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

Other information
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
Information on mechanical and strength properties.

Ideotype Description

Crown: Narrow, small branches at the top

Stem: Round, single straight bole

Roots: Deep taproot system with lateral rooting

Deciduousness: Short period of deciduousness in dry season

Response to management
Profuse branching after lopping.

Discussion

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

Ficus glaberima

Products and services required
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.

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

Required
Wood properties data.

Ideotype Description

Crown: Round, medium size with many branches

Stem: Round straight stem

Roots: Deep taproot with lateral branching

Deciduousness: Evergreen type preferred

Response to management
Good natural pruning of branches.

Discussion

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

Schima wallichii

Products and services required
Woody branches and stem are used for fuelwood, leaves for cattle bedding.

General selection criteria
Vigor, wood and leaf biomass.

Other information
Important species for the area, grows and adapts well on hill slopes. Lopping and pruning possible. Minimum pest and disease disturbance.

Required
Wood properties data.

Ideotype Description

Crown: Oval shape with many branches and leaves

Stem: Round, straight long bole

Roots: Deep taproot with lateral rooting

Deciduousness: Evergreen

Response to management
Profuse sprouting after lopping.

Discussion

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

Kandy District, Sri Lanka

Artocarpus heterophyllus

Products and services required
Fruit, branches for fuelwood, bole for timber.

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

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

Ideotype Description

Crown: Medium, with branches high on the stem

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

Roots: Prefer strong proot 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.

Deciduousness: No improvement needed

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

Discussion

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

Mangifera indica

Products and services required
Fruit and branches for fuelwood, bole for timber.

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

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

Ideotype Description

Crown: Narrow to medium canopy

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

Roots: Strong, deep taproot with few lateral roots

Deciduousness: No improvement needed

Response to management
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.

Gliricidia sepium

Products and services required
Support for pepper vines, poles for construction, green manure, fodder, fuelwood, soil erosion control, food.

General selection criteria
Vigor, pest and disease free.

Other information
Nitrogen-fixing, 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

Roots: Deep, strong taproot

Deciduousness: Short period of dry-season leaflessness

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

Discussion

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

Madhuca longifolia

Products and services required
Fruits, branches for fuelwood and bole for timber.

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

Other information
Regenerates naturally, tolerates shallow infertile soils

Required
Information on 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

Roots: Deep, strong taproot to withstand wind

Deciduousness: No improvement needed

Response to management
No improvement needed.

Discussion

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

Artocarpus altilis

Products and services required
Fruits, bole for timber and branches for fuelwood.

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

Other information
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

Roots: Prefer strong taproot to withstand the wind

Deciduousness: No improvement needed

Response to management
Not specified.

Discussion

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

Psidium guajava

Products and services required
Fruits, branches for fuelwood, stem for tool handles and fuelwood.

General selection criteria
Fruit and wood biomass.

Other information
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.

Ideotype Description

Crown: Narrow, low canopy

Stem: Multiple branching from the lower level of the stem

Roots: Strong deep taproot with few lateral roots

Deciduousness: No improvement needed

Response to management
Natural branch pruning.

Discussion

With fruit as a major priority, selection criteria should follow traditional fruit tree improvements. Genetic improvements of the fruits (i.e., larger size, more flesh and sweetness) could be considered.

Tamarindus indica

Products and services required
Fruit, branches for fuelwood, bole for timber.

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

Other information
Tolerates poor soil, low water consumption, regenerates naturally. Maintained on common lands, in homegardens and along roadside.

Ideotype Description

Crown: Medium, with branches high on the stem

Stem: Straight stem with multiple branches high on the stem

Roots: Prefer strong taproot with few lateral roots

Deciduousness: No improvement needed

Response to management
Not specified.

Discussion

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

Persea gratissima (Madugalla only)

Products and services required
Fruit, branches for fuelwood.

General selection criteria
Fruit and wood biomass.

Other information
Generally planted in homegardens, tolerates poor soil.

Ideotype Description

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

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

Roots: Deep taproot with a few lateral roots

Deciduousness: No improvement needed

Response to management
Not specified.

Discussion

With fruit as the major priority, better quality fruit production should be aimed for.

West Java (eastern part), Indonesia

Paraserianthes falcataria

Products and services required
Wood for timber, branches and wood for fuelwood, leaves for fodder.

General selection criteria
Vigor, pest and disease free.

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

Ideotype Description

Crown: Large, with many branches and dense foliage

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

Roots: Deep taproot

Deciduousness: Not specified

Response to management
Prolific sprouting after lopping. Should regenerate quickly and profusely.

Discussion

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

Artocarpus heterophyllus

Products and services required
Fruit, wood for timber, leaves as fodder.

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

Other information
Planted in gardens/homegardens and sometimes intercropped with perennial. Shading under other perennial 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.

Ideotype Description

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

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

Roots: Deep taproot

Deciduousness: No modification needed

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

Discussion

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

Maesopsis eminii

Products and services required
Wood for timber, wood and woody branches as fuelwood and leaves as fodder.

General selection criteria
Vigor, disease and pest free.

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

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

Roots: Deep taproot

Deciduousness: Evergreen preferred

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

Discussion

Selection criteria should follow products and services required.

Parkia speciosa

Products and services required
Fruit and fuelwood.

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

Other information
Nitrogen-fixing, planted in gardens, intercropped with perennial and annuals.

Ideotype Description

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

Stem: Single stem, large straight bole with many branches

Roots: Deep taproot

Deciduousness: Not specified

Response to management
Not specified.

Discussion

Selection criteria should be crown volume and stem form.

Albizia procera

Products and services required
Wood for timber and fuelwood, leaves for fodder.

General selection criteria
Vigor, pest and disease free.

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

Ideotype Description

Crown: Medium to large dense canopy with many branches

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

Roots: Not specified

Deciduousness: Not specified

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

Discussion

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

Achras zapotta

Products and services required
Fruit, and wood for making kitchen utensils after decline of fruit production.

General selection criteria
Vigor, fruit production.

Other information
Grows on well drained and fertile soils. Requires good care.

Ideotype Description

Crown: Large canopy with many branches and dense foliage

Stem: Short, multiple stems

Roots: Not specified

Deciduousness: No modifications needed

Response to management
Adaptability to wide range of soil conditions.

Discussion

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

Philippines

Baybay, Leyte

Artocarpus heterophyllus (for San Isidro)

Products and services required
Fruit 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.

Other information
Deeply rooted, straight stem, relatively thick leaves.

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

Roots: Deep, strong taproot

Leaves: Improve quality for fodder

Deciduousness: No modification

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

Discussion

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

Leucaena leucocephala (for San Isidro and San Miguel)

Products and services required
Leaves for fodder/fertilizer, woody branches for fuelwood, and stem for poles.

General selection criteria
Vigor, pest and disease free.

Other information
NFT, deeply rooted compared to Gliricidia, low resistance to psyllid infestation, fast growth.

Ideotype Description

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

Stem: Several branches

Roots: Deeply rooted for effective erosion control

Deciduousness: Evergreen preferred

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

Discussion

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

Pterocarpus indicus (for San Isidro)

Products and services required
Stem for timber, woody branches for fuelwood, nitrogen fixing.

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

Other information
Nitrogen-fixing, high-quality timber.

Required
Information on natural and artificial regeneration.

Ideotype Description

Crown: Round canopy with branches high on the stem

Stem: Single, straight long clear bole

Roots: Strong taproot

Deciduousness: Non-deciduous

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

Discussion

Breeding should focus on improved rate of growth, stem and crown form, and rate of nitrogen fixation.

Vitex parviflora (for San Miguel)

Products and services required
Stem for lumber, woody branches for fuelwood.

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

Other information
Hardwood, thrives on marginal soils, slow growth.

Required
Information on natural and artificial regeneration and growth habits.

Ideotype Description

Crown: Round, with many branches

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

Roots: Strong taproot

Deciduousness: Non-deciduous

Response to management
Thrives in marginal soils, requires little maintenance.

Discussion

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

Persea americana (for San Miguel)

Products and services required
Fruits for food, stem for poles, woody branches for fuelwood, leaves for medicine.

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

Other information
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 - 1,200 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

Roots: Deep, strong taproot

Deciduousness: Non-deciduous

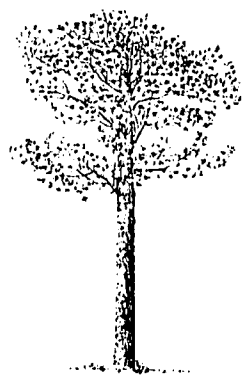
Response to management
Require little or no maintenance, resistant to pests and diseases, thrives in marginal soil, not easily uprooted by typhoons.

Discussion

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

Bauko, Philippines

Pinus kesiya (for Bila)



Products and services required
Timber, lumber, fuelwood, and handicrafts (pine needles for pottery).

General selection criteria
Vigor, fire, disease and pest resistance.

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

Ideotype Description

Crown: No modification

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

Roots: Geotropic

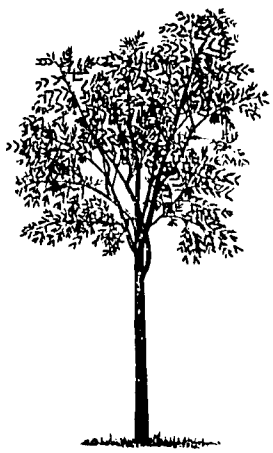
Deciduousness: Not specified

Response to management
Not specified.

Discussion

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

Leucaena leucocephala (for Bila)



Products and services required
Fuelwood, fence posts, fodder, medicine (raw leaves).

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

Other information
Nitrogen-fixing, 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 values.

Ideotype Description

Crown: No modification

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

Roots: Geotropic

Deciduousness: Short period of dry season leaflessness

Response to management
Prolific regrowth after lopping.

Discussion

Selection criteria must be stem form and branching characteristics.

Pterocarpus indicus (for Bila)

Products and services required
Timber, lumber, and fuelwood.

General selection criteria
Vigor, pest and disease free.

Other information
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.

Ideotype Description

Crown: No modification

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

Roots: Geotropic

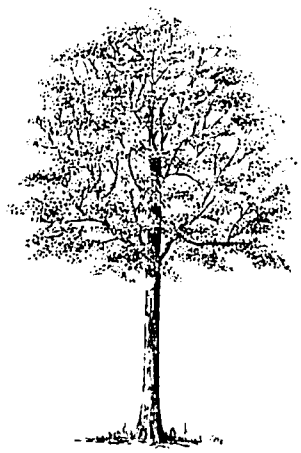
Deciduousness: Not specified

Response to management
Not specified.

Discussion

Selection criteria should be vigor and improved stem form.

Eucalyptus camaldulensis (for Bila)



Products and services required
Lumber, timber, poles, construction materials and leaves for medicine.

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

Other information
Grown at a wide range of altitudes from sea level to 2,000 m. Tolerates temperatures from 10°C - 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.

Roots: Deep taproot

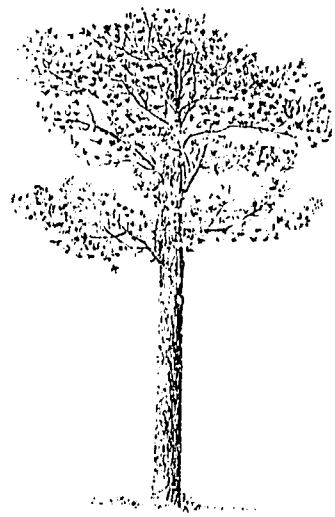
Deciduousness: Not specified

Response to management:
Not specified.

Discussion

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

Pinus kesiya (for Guinzadan)



Products and services required
Timber, lumber, fuelwood, and handicrafts (pine needles).

General selection criteria
Vigor, fire, disease and pest resistance.

Other information
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.

Ideotype Description

Crown: No modification

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

Roots: Geotropic

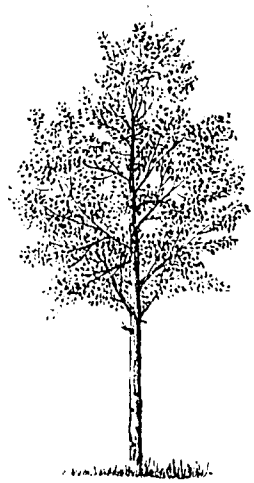
Deciduousness: Not specified

Response to management
Not specified.

Discussion

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

Alnus maritima (for Guinzadan)



Products and services required
Fuelwood, shade, live fence, windbreak, fertilize (leaves).

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

Other information
Small 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 information.

Ideotype Description

Crown: Wide crown

Stem: Straight, long bole but with many branches

Roots: Geotropic

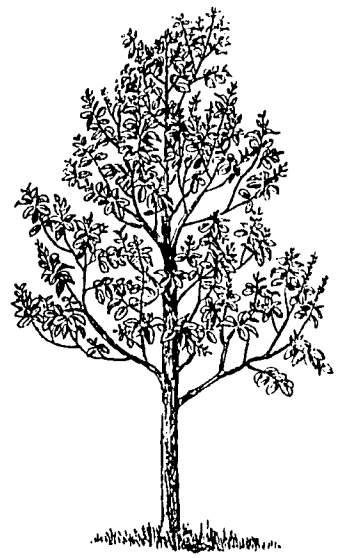
Deciduousness: Not specified

Response to management
Not specified.

Discussion

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

Persea americana (for Guinzadan)



Products and services required
Fruit, fuelwood, medicine (leaves).

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

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

Ideotype Description

Crown: Large dense crown

Stem: Single or multiple stems are acceptable with profuse branching

Roots: Geotropic

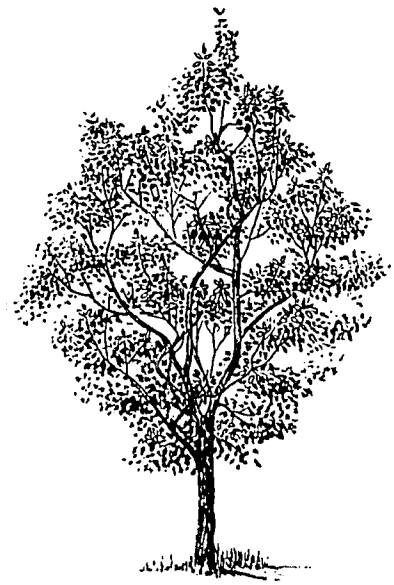
Deciduousness: Not specified

Response to management
Adaptability to wide range of environmental conditions.

Discussion

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

Psidium guajava (for Guinzadan)



Products and services required
Fruit, fuelwood, farm tool handles, medicine (leaves).

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

Other information
Small multistemmed tree, drought tolerant, coppices well.

Ideotype Description

Crown: Wide crown

Stem: No modification needed

Roots: Geotropic

Deciduousness: Not specified

Response to management
Not specified.

Discussion

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

Oriental Mindoro, Philippines

Phoebe sterculioides

Products and services required
Timber for house construction and handicrafts.

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

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

Required
Information on 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.

Roots: No modification needed

Deciduousness: No modification needed

Response to management
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.

Persea americana

Products and services required
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.

Other information
Although it is known to prefer moist, well drained, deep soils, it can withstand up to 4-5 dry months. Rainfall requirements: 750-1,000 mm. Tolerates a wide range of temperatures, from -2 to 40°C, and yields 500 - 1,200 fruits/tree/yr.

Required
Information on 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.

Roots: No change

Deciduousness: Not specified

Response to management
Not specified.

Discussion

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

Leucaena leucocephala

Products and services required
Leaves as fodder, branches and wood as fuelwood.

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

Other information
Drought resistant, grows on poor acidic soils. Nitrogen fixing, good coppicing ability.

Required
Information on yield and fodder value of leaves and flowers.

Ideotype Description

Crown: Moderately sized with many branches

Stem: Single or multiple stems

Roots: Strong taproot with few lateral roots

Deciduousness: Short period of dry season leaflessness

Response to management
Profuse and rapid regeneration after lopping.

Discussion

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

Gliricidia sepium

Products and services required
Branches and stem as fuelwood and for handicrafts, leaves for fodder and mulch).

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

Other information
Fixes nitrogen, adaptable to both moist and dry soils, good coppicing ability. Has other uses such as for tannin, shade, hedges, and bee forage.

Required
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

Roots: Deep taproot

Deciduousness: Short period of dry season leaflessness

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

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 this species in Sri Lanka.

Mangifera indica

Products and services required
Fruit, branches for fuelwood, bole for timber.

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

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

Ideotype Description

Crown: Narrow to medium canopy

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

Roots: Deep strong taproot with few lateral roots

Deciduousness: No improvement needed

Response to management
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.

Artocarpus heterophyllus

Products and services required
Fruit, branches for fuelwood, bole for timber.

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

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

Ideotype Description

Crown: Medium, with branches high on the stem

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

Roots: 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.

Deciduousness: No improvement needed

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

Discussion

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

Paraserianthes falcataria

Products and services required
Fuelwood, and roots for handicrafts.

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

Other information
Drought resistant but needs well-drained, deep, fertile soils. Good coppicing ability.

Required
Seed production and vegetative propagation information.

Ideotype Description

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

Stem: Single, straight bole

Roots: Deep taproot

Deciduousness: Not specified

Response to management
Not specified.

Discussion

Other uses include pulpwood, shade, tannin and timber.

Laguna, Philippines

Coffea arabica

Products and services required
Fruit, fuelwood, mulch and medicine.

General selection criteria
Vigor, free of pest and disease.

Other information
Shade tolerant plant but can not withstand frost. Grows at altitudes of 900-1,500 m.

Ideotype Description

Crown: Narrow with many branches

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

Bark: Smooth with lenticels

Deciduousness: Not specified

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.

Discussion

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

Dipterocarpus grandiflorus

Products and services required
Fuelwood, charcoal, timber

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

Other information
A primary forest species found at low and medium altitudes in dipterocarp forest.

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.

Roots: Deep taproot

Deciduousness: Normal

Response to management
Should grow well in homegarden and field.

Discussion

Improvement must stress heavy branching and good stem characteristics.

Thailand

Kalasin (Northeastern region)

Shorea obtusa

Products and services required
Construction materials, fuelwood, charcoal, soil erosion control.

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

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

Required
Information on induced seed production, vegetative propagation.

Ideotype Description

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

Roots: Strong taproot with few lateral roots

Deciduousness: Short period of dry season leaflessness

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

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.

Shorea siamensis

Products and services required
Construction materials, fuelwood, charcoal, soil erosion control.

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

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

Required
Information on 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.

Roots: Strong taproot with few lateral roots.

Deciduousness: Short period of dry season leaflessness.

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

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.

Dipterocarpus tuberculatus

Products and services required
Construction materials, fuelwood, charcoal, soil erosion control.

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

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

Required
Information on 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.

Roots: Strong taproot with few lateral roots

Deciduousness: Short period of dry season leaflessness

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

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.

Dipterocarpus obtusifolius

Products and services required
Construction materials, fuelwood, charcoal, soil erosion control.

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

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

Required
Information on 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. A long bole is important.

Roots: Strong taproot with few lateral roots

Deciduousness: Short period of dry season leaflessness

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

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.

Leucaena leucocephala

Products and services required
Fodder, fuelwood, food, windbreaks, shade, green manure.

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

Other information
Fixes nitrogen, 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
Data on 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

Roots: Strong taproot with few lateral roots

Deciduousness: Short period of dry season leaflessness

Response to management
Prolific regrowth after branch pruning, pollarding.

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.

Sesbania grandiflora

Products and services required
Food (leaves and flowers), soil improvement, fuelwood.

General selection criteria
Pest and disease free, vigor.

Other information
Nitrogen-fixing, tolerates poor soil, dry season and shade; ample seed production; lopping and pruning possible; poor burning quality.

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

Roots: Geotropically angled rather than horizontal lateral roots

Deciduousness: Short period of dry-season leaflessness

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

Discussion

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

Ceiba pentandra

Products and services required
Cotton-like material, fuelwood.

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

Other information
Tolerates poor soil, drought; vegetative propagation not easy, amble seed production; lopping and pruning possible.

Required
Data on vegetative propagation, wood characteristics needed.

Ideotype Description

Crown: Light crown with heavy branching, heavy fruiting

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

Roots: Deep, strong taproot

Deciduousness: Preferably long period of dry-season leaflessness

Response to management
Heavy fruiting under extensive management.

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.

Chachoengsao (Eastern Thailand)

Dipterocarpus alatus (for Nong Yang)

Products and services required
Timber and fuelwood.

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

Other information
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 information.

Ideotype Description

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

Stem: Long clear bole

Roots: Deep taproot

Deciduousness: Evergreen

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

Discussion

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

Irvingia malayana (for Nong Yang)

Products and services required
Timber, fuelwood and charcoal.

General selection criteria
Vigor, long straight stem.

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

Required
Data on natural and artificial regeneration, wood properties.

Ideotype Description

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

Stem: Long clear bole

Roots: Deep taproot

Deciduousness: Evergreen

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

Discussion

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

Pterocarpus macrocarpus (for Nong Yang)

Products and services required
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.

Other information
Tree grows in evergreen and mixed deciduous forests, prefers moist, deep soil. Survival rate of natural regeneration is low. Very slow growing tree.

Required
Information on natural and artificial regeneration and growth habits.

Ideotype Description

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

Stem: Long, clear bole

Roots: Deep taproot

Deciduousness: Evergreen

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

Discussion

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

Cotylelobium melanoxylon (for Nong Yang Village)

Products and services required
Timber for construction, branches for farm implements and fuelwood/charcoal.

General selection criteria
Vigor, long straight stem.

Other information
Normally left growing on farmland, prefers good sites. Low survival rate for naturally regenerated seedlings. 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

Roots: Deep taproot

Deciduousness: Evergreen

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

Discussion

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

Azadirachta indica (for Komo 7 Village)

Products and services required
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.

Other information
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 t height of 5 m. A long bole is very important.

Roots: Deep taproot with few lateral roots

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

Deciduousness: Evergreen

Response to management
Prolific regrowth after lopping for mulch.

Discussion

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

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Workshop Participants

Not all of the original study participants could attend the meeting. However, in addition to the original six study participants from the Philippines, three additional Philippine scientists were invited because of their participation in the Community-based Tree Improvement project in Cebu.

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Mr. Kachan Chopa (absent but sent paper)

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