Tree Improvement and the MPTS Research Network

A progress report, May 1990 - May 1991

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

Tree Improvement and the MPTS Research Network:
A progress report, May 1990 - May 1991

by David Taylor

Winrock International Institute for Agricultural Development

supported by the U.S. Agency for International Development

Contents

Tables

Figures

Preface

This is a first interim progress report of the cooperative agreement between the U.S. Agency for International Development and Winrock International for development of the Multipurpose Tree Species (MPTS) Research Network. The cooperative agreement, effective May 1990, is the second phase of the 10-year Forestry/Fuelwood Research & Development (F/FRED) Project, which began in 1985.

The MPTS Research Network is a group of scientists and institutions in Asia with the shared goal of improving the production of trees to meet the needs of small-farm households. The Network brings together research experts from national institutions in forestry, agriculture, and the social sciences. The Network also seeks to enhance the capacity of national programs to address research problems related to MPTS for small farms.

Since 1986, the MPTS Research Network has grown to include scientists in Bangladesh, India, Indonesia, Malaysia, Nepal, Pakistan, Papua New Guinea, Philippines, Republic of China (Taiwan), Sri Lanka, and Thailand. The Network's research activities are complemented by short training courses, network development meetings, and publications. The Network is managed by a Secretariat located with the Faculty of Forestry at Kasetsart University in Bangkok, Thailand.

F/FRED staff at Winrock's office in Arlington, Virginia, U.S.A., develop the project's global research system software, produce key project publications, and review with A.I.D./Washington issues regarding project management.

Introduction

This report of the Forestry/Fuelwood Research & Development (F/FRED) Project describes activities from May 1990 to May 1991 related to tree improvement. Improvement of multipurpose tree species (MPTS) is one of three target research areas cited in the five-year project workplan approved by the Steering Committee of the MPTS Research Network.

Tree improvement was chosen as a theme also because the Network's activities in this area represent varied but complementary approaches. The Network's support for seed collection, provenance trials, and production of annotated bibliographies for *Acacia auriculiformis* and *Dalbergia sissoo* illustrates the type of research required for many MPTS for which scientists lack basic information. The regional program for breeding psyllid-resistant *Leucaena* species represents fast response to a pest problem using a classical breeding strategy, and highlights the potentials of the process of regional coordination. The study of farmers' tree-breeding objectives is an innovation toward involving farmers with scientists in a collaborative process of species improvement. The range of publications from this period highlights the collaboration with international and national scientists that has taken place to address the unique challenges of improving trees for multiple products and uses.

This report highlights the network approach and developments in the reporting period. It does not cover ongoing tree improvement programs by network scientists at the national level, for example on *Azadirachta indica* and *Melia azedarach* in Thailand.

Summary

Between May 1990 and May 1991, F/FRED activities related to tree improvement yielded a number of results. The short history of improvement research for multipurpose tree species (MPTS) has called for a combination of approaches: assembling a baseline of available research information, surveying farmers to see in what respects classical breeding strategies correspond to their own objectives, identifying promising provenances for different environments and products, and breeding for resistance to important pests. In employing these approaches, F/FRED and the MPTS Research Network try to employ the network approach to best advantage.

Twelve- and 18-month results of an international series of *Acacia auriculiformis* provenance trials, begun with Australian collaboration in 1989, display the genetic diversity of this fuelwood and ornamental species. The experiments were designed to identify promising provenances for each site in the eight participating countries, and to provide a basis for selection and improvement for different uses. F/FRED has sponsored experiments in Malaysia, the Philippines, the Republic of China, and Thailand, and has provided software for recording data at all sites. An annotated bibliography of the literature on *A. auriculiformis* was prepared by Khongsak Pinyopusarerk and published jointly by CSIRO and Winrock-F/FRED in 1990.

Following a plan for developing *Dalbergia sissoo* outlined by network scientists in 1989, the Network Secretariat arranged for seed collections in Nepal and Pakistan for an international set of provenance trials. Five experiments were established in India, Nepal, and Pakistan in 1990. F/FRED commissioned Kevin White to prepare an annotated bibliography on the species. The bibliography, distributed early in 1991, is the first to summarize the diverse but often inaccessible literature on this important timber and handicraft species, which farmers also use for fodder.

Defining Tree-Breeding Objectives for Multipurpose Tree Species in Asia, by Lert Chunanaparb and Radha Ranganathan, provides a regional analysis of a survey conducted by 16 network scientists in 1989. The interdisciplinary study, which included 28 villages in 7 countries, was intended to help tree-breeders orient their work to small-farm production objectives. The researchers, most of them social scientists, used line drawings to elicit farmers' preferences for stem form, rooting habit, leaf shape and size, and canopy shape. The report describes 82 specific ideotypes, and draws three general composite types. Two case studies from Sri Lanka and the Philippines describe additional ways of analyzing farmers' preferences for application in tree improvement.

Pursuing the concept of farmer involvement in tree improvement, network scientists at a meeting in May 1991 in the Philippines planned a pilot project for improvement of *Artocarpus heterophyllus* (jackfruit). Jackfruit serves a wide range of uses in the Central Visayas region of the Philippines, where there are good markets for its fruit in commercial ice cream production and its wood for making guitars. An important result of the pilot project will be a methodology for scientific collaboration with farmers on tree improvement that can be adapted elsewhere.

Network scientists in five countries are participating in the *Leucaena* Seed Production (LSP) program. The program, started in 1988, has tested 10 sources of *Leucaena spp.* at sites in India, Indonesia, the Philippines, the Republic of China (Taiwan), and Thailand. These experiments provide a basis for seed orchards of the best-performing provenances at each location. In October-November 1990, Mr. Robert Wheeler, NFTA, visited scientists at all five sites, taking with him a draft manual for seed orchard

technicians. The outcome of their discussions was incorporated in a *Guide to Management of Leucaena Seed Orchards*, which was distributed early in 1991.

A number of institutions in the LSP program are also participating in the regional program of leucaena psyllid control. Tree-breeders in Taiwan have had success in improving growth and vigor of *L. diversifolia*, a species found to have relatively good resistance to psyllid damage, through selection and crosses.

Strategies for tree improvement of MPTS is the subject of a second volume in the project's Technical Series, published mid-1990. Edited by Nancy Glover, Nitrogren Fixing Tree Association (NFTA), and Norma Adams, F/FRED Publications Manager, *Tree Improvement of Multipurpose Species* covers the subject from seed collection to breeding strategies and seed orchard management.

F/FRED also co-published *Breeding Tropical Trees*, the proceedings of a conference organized by the International Union of Forestry Research Organizations.

Four successful proposals in the 1991 series of small research grants are on topics related to tree improvement.

MPTGro is a microcomputer-based growth prediction model developed by the project's Global Research Systems staff, located with the F/FRED Management Office in the United States. MPTGro simulates increases in wood and leaf biomass and tree diameter over the lifetime of a tree stand, based on species allometric equations. While intended primarily as an aid to scientists in selecting species and management practices for a particular site's conditions, the program will also interest those involved with tree improvement. Scientists desiring to establish a seed orchard for *A. auriculiformis*, for example, will be able to use MPTGro to help determine appropriate plant spacings, given the site's soil and weather information and improvement objectives.

Survey of Farmers' Tree-Breeding Objectives

In 1989, 16 scientists conducted a study intended to help tree-breeders orient their work to small-farm production objectives. In particular, it set out to study the extent to which traits desirable in commercial tree-breeding programs (for example, straight, single stem, minimum branching) are also desired by farmers for providing the products they need.

The interdisciplinary study was designed by a group of four scientists. Many of the participating scientists also collected data for the Farm and Village Forestry (FVF) study, and in most cases a subset of the FVF respondents were asked to participate in the tree-breeding objectives survey. In interviews with 10 villagers from each of 28 villages in 7 countries (see map and Table 1 of sites), researchers used line drawings of different tree characteristics to elicit farmers' preferences for stem form, rooting habit, leaf shape and size, and canopy shape. The series of single-sex and mixed-gender interviews in each village covered current products and planting niches of tree species used and ideas for possible improvements.

The scientists met in Bangkok, Thailand early in 1990 to assemble and discuss their findings. *Defining Tree-Breeding Objectives for Multipurpose Tree Species in Asia*, by Lert Chunanaparb and Radha Ranganathan, provides a regional analysis of a survey conducted by network scientists. The regional report describes 82 location- and species-specific ideotypes (see Table 2). From these, the scientists developed composite ideotypes for three general categories of trees: fruit and food species, fast-growing species on farms, and natural forest species.

The study found that farmers' ideotypes differed from commonly used tree improvement objectives: for fruit and food species, farmers stress stem form and branching for improved timber quality and value; in some planting niches, multiple stems are desirable for providing fodder and fuelwood (MacDicken and Mehl 1990).

In addition to the regional synthesis of these results, the survey also pointed up the nature of the variety of farmers' preferences. A case study by Ponce et al. (1991) compares the ideotypes identified by farmers in the Leyte uplands with those of lowland farmers. This case study presented ideotypes according to the type of primary product desired. Wickramasinghe (1991), in another case study arising from the survey, showed that ideotypes can vary according to planting niche (for example, homegarden, hedgerow, or woodlot). Therefore, while regional improvement programs can address broad needs, such as pest resistance and faster growth, national and local efforts are needed to complement them (see Tree Improvement by Farmers, p. 10).

A working meeting of the scientists who conducted the survey will take place later in 1991 to review methodological issues and problems, and to decide on follow-up activities.

Map and Table 1. Sites in the survey of farmers' tree-breeding objectives.

Countries	Village(s) (District, State or Province)
South Asia	
Bangladesh	Belpukur and Samsadipur (Rajshahi, NW Bangladesh)
India	Thennalur (Pudukottai, Tamil Nadu); Vadapalanji (Madurai, Tamil Nadu) Sukhomajri (Ambala, Hary a); Sahajpur, Yavat, Kadus, Shiradhon, and Shindwane (Pune, Maharashtra); Satara (Aurangabad, Maharashtra)
Nepal	Kankre and Tusal (Ugrachandi, Kavre); Rakhi (Rakhi Panehayat, Kaski); Lekhnath (Lekhnath, Kaski)
Sri Lanka	Madugalla and Bambarabedda (Udadumbara, Kandy)
Southeast Asia	
Indonesia	Payungagung and Karangsari (Panumbangan, Ciamis West Java)
Philippines	San Isidro (Baybay, Leyte); San Miguel (San Isidro, Leyte); Barangay Bila and Barangay Guizadon (Bauko); Barangay Paiton (Nanjan, Oriental Mindoro); Sitio (Banilad Barangay, Dulangan 3, Oriental Mindoro); Jose P. Laurel and Juan Santiago (Laguna)
Thailand	Ban Non Si Sawat and Ban Kam Kham (Nong Kung Sai, Kalasin); KM 7 and Nongyang (Sanamchaikhet, Chachoengsao)

Table 2. Tree species and uses for which farmers in the survey identified tree-breeding ideotypes.

Species	Countries	Uses
Fruit and Food Species		
Achras zapota	Indonesia	Fruit, minor timber
Artocarpus altilis	Sri Lanka	Fruit, timber, fuelwood
Artocarpus heterophyllus	Bangladesh, Indonesia, Philippines, Sri Lanka	Fruit, fuelwood, fodder, timber, medicine
Cocos nucifera	India, Philippines, Sri Lanka	Fruit, timber, other minor uses
Coffea arabica	Philippines	Fruit, fuelwood, medicine, mulch
Madhuca longifolia	Sri Lanka	Fruit, timber, fuelwood
Mangifera indica	Bangladesh, India, Philippines, Sri Lanka	Fruit, fuelwood, timber, fodder
Parkia speciosa	Indonesia	Food, fuelwood
Persea americana	Philippines	Fruit, fuelwood, timber, medicine
Persea gratissima	Sri lanka	Fruit, fuelwood
Pithecellobium dulce	India	Fruit, fodder, fuelwood
Psidium guajava	Philippines, Sri Lanka	Fruit, timber
Sesbania grandiflora	Thailand	Food, soil conservation, fuelwood
Syzygium cumini	India	Fruit, fuelwood, timber
Tamarindus indica	Sri Lanka, India	Fruit, fuelwood,timber, medicine, fodder
Zizyphus mauritiana	India	Fruit, fuelwood, timber, fodder
Fast-growing MPTS on Farms		
Acacia leucophloea	India	Fuelwood, timber, fodder
Acacia nilotica var. *cupressiformis*	India	Fuelwood, fodder, timber
Acacia nilotica var. *indica*	India	Timber, fodder, fuelwood, tannin
Ailanthus excelsa	India	Mulch, timber, fuelwood
Albizia lebbek	India	Fuelwood, timber, fodder
Albizia procera	Indonesia	Timber, fuelwood, fodder
Alnus maritima	Philippines	Fuelwood, shade, fencing, mulch
Alnus nepalensis	Nepal	Fuelwood, timber
Azadirachta indica	India, Thailand	Fuelwood, fodder,timber, medicine, mulch
Betula alnoides	Nepal	Fuelwood, timber, fodder
Borassus flabellifer	India	Timber, fruit leaves, construction material, other
Carissa spinarum	India	Fuelwood, fruit, medicinal value
Ceiba pentandra	Thailand	Fuelwood, silk-cotton
Dalbergia sissoo	India	Fuelwood, timber, soil conservation
Delonix elata	India	Mulch, timber, fuelwood
Eucalyptus camaldulensis	Philippines	Timber, medicinal purposes
Gliricidia sepium	Philippines, Sri Lanka	Fuelwood, mulch, fodder, timber, food
Leucaena leucocephala	India, Thailand, Philippines	Fuelwood, fodder, mulch, timber, windbreak, shade
Maesopsis eminii	Indonesia	Timber, fuelwood, fodder
Melia azaderach	India	Fodder, fuelwood, timber
Morus serrata	India	Fuelwood, fodder, fruit, handicrafts
Paraserianthes falcataria	Indonesia, Philippines	Timber, fuelwood, fodder, handicrafts
Prosopis juliflora	India	Fuelwood, fodder, timber
Prosopis spicigera	India	Fuelwood, fodder,timber, soil conservation
Prunus cerasoides	Nepal	Fuelwood, fodder, timber
Sesbania sesban	India	Fodder, fuelwood, timber
Thespesia populnea	India	Mulch, fodder, timber
Natural Forest Tree Species		
Albizia amara	India	Timber, fuelwood, fodder
Cotylelobium melanoxylon	Thailand	Timber, fuelwood
Dipterocarpus alatus	Thailand	Timber, fuelwood
Dipterocarpus grandiflora	Philippines	Fuelwood, timber
Dipterocarpus obtusifolia	Thailand	Fuelwood, timber
Dipterocarpus tuberculata	Thailand	Fuelwood, timber
Irvingia malayana	Thailand	Timber, fuelwood
Phoebe sterculodes	Philippines	Timber, handicrafts
Pinus kesiya	Philippines	Timber, fuelwood
Pterocarpus indica	Philippines	Timber, fuelwood
Pterocarpus macrocarpa	Thailand	Timber, fuelwood
Schima wallichii	Nepal	Timber, fuelwood
Shorea obtusea	Thailand	Fuelwood, timber
Shorea siamensis	Thailand	Fuelwood, timber
Vitex parviflora	Philippines	Timber, fuelwood

Note. Shade, windbreak and soil conservation uses are noted only where farmers specifically indicated these uses. Source: Lert and Ranganathan (1990).

Research on *Acacia auriculiformis*

An international series of *Acacia auriculiformis* provenance trials was begun in 1989 using seed from a joint collection activity with the Australian Centre for International Research (ACIAR). *A. auriculiformis*, native to Australia, is currently used to provide fuelwood, erosion control, shade, and ornament (Pinyopusarerk 1990). The trials were designed to identify the most promising of 25 provenances at each of 12 sites, and to provide a basis for selection and improvement. In addition, intersite analysis may yield information useful for growth simulation modelling, for assessment of which provenances are likely to perform best at other sites where trials have not been established.

F/FRED is supporting experiments in Malaysia, the Philippines, the Republic of China (Taiwan), and Thailand (see table). IADSS is being used to record data on survival, height, and diameter at all sites.

As a reference to complement this research, F/FRED and CSIRO jointly commissioned Khongsak Pinyopursarerk to prepare an annotated bibliography on the species, which was published in 1990.

With the experiments approaching two years of age, 12- and 18-month results are being reported.

Results from three sites in Thailand and one site in the People's Republic of China were reported at the ACIAR-sponsored Second International Workshop on Tropical Acacias, held in Bangkok, Thailand, February 11-15, 1991. The sites in Thailand show clear differences among provenances in growth and form, with provenances from Queensland and the Northern Territory performing as well as those from Papua New Guinea on some sites (Luangviriyasaeng et al., in press).

The first two-year agreement for the trials ended in June 1991. ACIAR and F/FRED staff have agreed to work together on follow-up activities, including compilation of data for intersite analyses as originally planned. Further cooperation will focus on obtaining a standard assessment of tree form from trial cooperators. Another area for further work, identified by a team evaluating the wide range of ACIAR-supported research on Acacias, is exploration of other uses for the species. Biomass studies at each site would help to assess the potential of each provenance for pulp, paper, and plywood. These studies could also clarify management strategies needed for a given product.

Table 3. Institutions conducting *A. auriculiformis* provenance trials.

Institution	Number of sites	Country	Funding Source
South Kalimantan Trials Project	1	Indonesia	FINNIDA
Faculty of Forestry, Universiti Pertanian Malaysia	1	Malaysia	F/FRED
Ecosystems Research and Development Bureau	1	Philippines	F/FRED
Research Institute of Tropical Forestry	1	PRC (China)	ACIAR
Taiwan Forest Research Institute	1	ROC (Taiwan)	F/FRED
Forest Department/Upper Mahaweli Watershed Management Project	2	Sri Lanka	GTZ
Royal Forest Department	3	Thailand	ACIAR
Faculty of Forestry, Kasetsart University	1	Thailand	F/FRED
Forest Department	1	Zimbabwe	ACIAR

Research on *Dalbergia sissoo*

In India, Nepal, and Pakistan, *Dalbergia sissoo* (shisham or sissoo) provides timber, fodder, fuelwood, and medicinal products. The wood's fine color and grain make it prized in furniture and crafts, and the tree provides fodder when other forage is scarce (White 1990). Honey is often an important commercial product of *D. sissoo*. Yet seeds used for most plantings come from unimproved sources, and natural stands are fast disappearing (MacDicken and Lantican 1990).

Following the development plan for *Dalbergia sissoo* prepared in 1989, the Network Secretariat supported seed collections from the species' natural range in Nepal and Pakistan for an international provenance trial. Seeds from 13 provenances (10 from Pakistan, 3 from Nepal) were sent to participating scientists in India, Nepal, and Pakistan in May 1990. The provenances represent a latitudinal range of 26°30' - 34°09' N, and an altitudinal range of 100-492 m. Five experiments have been established (see Table 4). The design is a randomized complete block arrangement with 4 replications, with trees planted at 2 x 2 m spacing.

At the site in India, several of the seedlots from Pakistan did not germinate well at first; these were resown and outplanted in May 1991. In Nepal, both sites were outplanted in July 1990. The Pakistan sites were outplanted in February and March 1991.

The development plan for *D. sissoo* included preparation of an annotated bibliography summarizing literature on the species. Kevin White, commissioned by the Secretariat, prepared the bibliography. It compiles for the first time the wide range of research literature on this species, with 382 relevant records from 450 references consulted. The book was distributed to participating scientists and others early in 1991.

Table 4. Sites of *Dalbergia sissoo* provenance trials.

Site name	Location	No. of provenances in trial	Lead scientist and institution	Country
Labbiballi, Pune	c. 18°N c. 73°E	13	Mr. Narayan Hegde BAIF Research Foundation	India
Shankar Nagar, Rupahdehi	27°42' N 83°28' E	8	Mr. Rajendra Joshi Forest Research Division	Nepal
Tarahara, Sunsari	26°40' N 87°20' E	8	Mr. Rajendra Joshi Forest Research Division	Nepal
Mu[illegible], Peshawar (NWFP)	34°N 71°33' E	13	Mr. Shams-ur-Rehman Pakistan Forest Institute	Pakistan
Changa Manga (Punjab)	31°05' N 73°58' E	13	Mr. Shams-ur-Rehman Pakistan Forest Institute	Pakistan

Breeding *Leucaena* Species

The MPTS Research Network was a leading force in preparation of a regional plan for control of the leucaena psyllid (*Heteropsylla cubana*) in 1987. The pest first appeared in Asia in 1984, defoliating millions of *L. leucocephala* trees that farmers used for fodder and other products. Tree-breeders in the Network are growing seed orchards using seed from selected individual trees that showed greater resistance to the pest, and are breeding improved varieties with F/FRED support.

In addition to psyllid resistance, Fuh-Jiunn Pan and the staff at the Taiwan Forest Research Institute (TFRI) have explored the potential of hybrids for widening the scope and uses of fast-growing *Leucaena*. By combining relatively psyllid-resistant tetraploid *L. diversifolia* with vigorous *L. leucocephala*, they have developed a KX3 hybrid that can perform well on lowland acid soils (pH 4.2-4.5) as well as on soils with higher pH values, effectively widening the plant's environmental range. Research is also working toward forage varieties with lower mimosine content, as well as better performance at higher elevations and against wind. Furthermore, hybrid crosses of psyllid-resistant *L. pallida* with straight-boled *L. diversifolia* have been proceedings; F5 generations are expected to be available to farmers next year. Tetraploid parents (*L. diversifolia*) are being crossed with diploid parents to obtain sterile triploid progeny, which is useful for maintaining quality populations for seed orchards and distribution to farmers.

In psyllid resistance and other *Leucaena*-breeding objectives, F/FRED has collaborated closely with NFTA. NFTA managed the F/FRED-funded *Leucaena* Seed Production (LSP) Program, which distributed seed early in 1989 to five institutions for establishment of seed orchards in each participating country (see Table 5). Psyllid resistance was a key factor in determining varieties to be established at each site.

In October-November of 1990, Robert Wheeler visited the sites in the LSP program. He discussed seed orchard plans with the scientists, confirmed identification of promising varieties. During the visits, discussion also included a draft manual for

Table 5. Participants in the Leucaena Seed Production project.

Institution	Lead scientist	Country	Principal genotypes in seed orchard
BAIF Research Foundation	Mr. Narayan Hegde	India	KX2 Comp 1 *L. collinsii* Comp 1
Bogor Research Institute for Food Crops	Dr. I.N. Oka	Indonesia	KX1 (*L. diversifolia* x *L. pallida*) *L. pallida* Comp 1
Visayas State College of Agriculture	Dr. Rudolfo Escalada	Philippines	*L. diversifolia* 4n Comp KX3 Maui Comp
Taiwan Forest Research Institute	Dr. Fuh-Jiunn Pen	R.O.C.	KX3c and KX3 Maui Comp
Thailand Institute for Scientific and Technological Research	Mr. Panas Buranasilpin	Thailand	*L. leucocephala* PR Comp 1 *L. salvadorensis* Comp 1

seed orchard management. The outcome of their discussions was incorporated in a *Guide to Management of Leucaena Seed Orchards*, which was distributed early in 1991. One point that came up in discussions at the sites is the need to base selection of trees on performance under the management regime for which the trees are likely to be used. For example, where *Leucaena* is used primarily for fodder production, as in Thailand, the trees should be coppiced and regrowth should be observed before identifying superior individuals. In that case, selection should be based on quantity of leafy biomass and relative psyllid resistance (Wheeler 1991).

In Thailand, Panas Buranasilpin with the Thailand Institute for Science and Technological Research (TISTR) is conducting LSP trials at an experimental site along with other psyllid-resistance research supported through the regional psyllid control program. Thus the efforts of one experiment can be immediately understood with respect to another experiment: at Chan Thuk, studies of 12 Thai *Leucaena* provenances for psyllid resistance and vigor can be compared to the performance of seedlots obtained through the LSP program. Improved seeds are expected to be available to Thai farmers there early in 1992. Other scientists and national institutions are also benefitting from participation in both programs.

Siriphong Pattanavibul, TISTR, examines a tree for psyllid damage at the Chan Thuk experiment site near Nakhon Rachasima, Thailand.

Tree Improvement by Farmers

A group of scientists met in May 1991 in Manila, Philippines to plan development of a methodology by which farmers and scientists can collaborate to improve a species in which they are interested. The scientists outlined a four-phase pilot activity focussed on *Artocarpus heterophyllus* (jackfruit) in the Central Visayas region of the Philippines.

The activity is based on the concept of farmer-led tree improvement, or "barefoot tree-breeders," described by MacDicken and Bhumibhamon (1990). The plan also serves as follow-up to the regional survey of farmers' tree-breeding objectives (see pp. 3-5).

On the island of Cebu in the Philippines is a vigorous and diverse commercial trade in *A. heterophyllus* that includes a range of production, processing and marketing. The tree's fruit is marketed fresh and processed for ice cream on a large scale, and the wood is used in making guitars. By addressing *Artocarpus heterophyllus*, the pilot project will provide not only a methodological model for other efforts in collaboration with farmers, but also more information on the varied uses of this popular species that has been neglected by research. The regional study of farm and village forestry practices found *A. heterophyllus* -- and food-producing MPTS in general -- to be highly-valued by farmers throughout Asia.

The pilot project in the Philippines is planned for four years. The first phase will include an initial literature review, field survey of producers and user groups, and a marketing survey to define the baseline situation of germplasm production, utilization, and marketing potential. Workplans for the following three phases will be developed in light of this baseline, expected to be ready by the end of 1991.

The project will include both genetic improvement and non-genetic improvement through management techniques such as grafting and budding.

Much of the research will be conducted by scientists at the Visayas State College of Agriculture (ViSCA), with technical support from the Network Secretariat.

The pilot project forms part of a potentially larger network of jackfruit research. The development of the methodology for this form of participatory, community-based research and development is another component of F/FRED's activities in Extension Research and Development (see Figure 1).

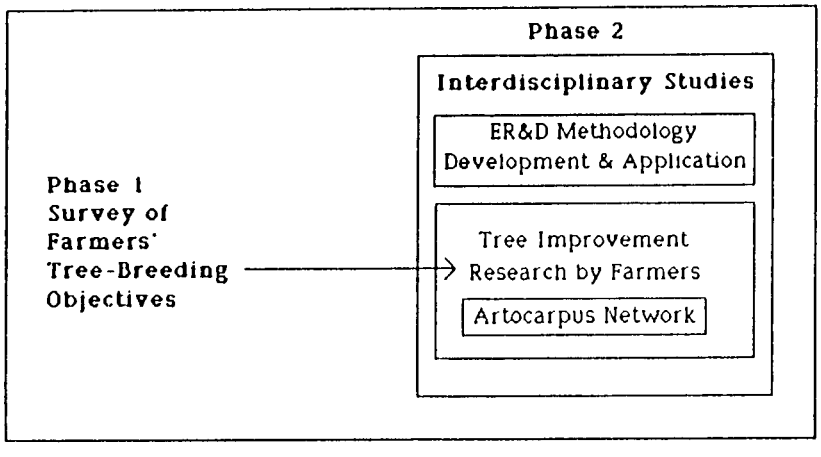

Figure 1. Tree improvement by farmers in the context of other network research.

Volume on State-of-the-Art Tree Improvement Strategies

Tree Improvement of Multipurpose Species, the second volume in the project's Technical Series, was published in mid-1990. Edited by Nancy Glover, Nitrogren Fixing Tree Association (NFTA), and Norma Adams, F/FRED Publications Manager, the book contains six papers covering: seed collection, definition of improvement goals, experiment designs and breeding strategies, and seed orchard management. The volume includes a glossary of terms.

The papers highlight the wise use of genetic diversity in improvement programs and considered selection of improvement goals. Recognizing the variety of conditions under which MPTS improvement is conducted, the volume presents optional improvement targets; for example, the choice between relieving environmental constraints and addressing preferred uses and products. More than five design options are presented for experiments on genotype evaluation. To illustrate alternate breeding strategies, Matheson employs eight case studies from Asia, the Pacific, Africa, and Latin America of existing improvement programs on *Leucaena*, *Erythrina, Paulownia, Calliandra, Gliricidia, Prosopis, Acacia mearnsii,* and other *Acacia* species.

Authors of the papers included in the volume were selected for their expertise in the respective subject areas. Previous working relationships with the MPTS Research Network and the F/FRED Project helped facilitate the cooperation. The Danish International Development Agency (DANIDA), Oxford Forestry Institute (OFI), the Australian Commonwealth Scientific and Industrial Research Organization, NFTA, and the USDA Southeastern Forest Experiment Station, each received free copies of the book for participating in the project.

Other Activities Supporting Tree Improvement

Co-sponsorship of *Breeding Tropical Trees*

With OFI, Winrock-F/FRED published *Breeding Tropical Trees: Population Structure and Genetic Improvement Strategies in Clonal and Seedling Forestry*, edited by G.L. Gibson, A.R. Griffin, and A.C. Matheson. The book is the proceedings of a conference organized by the International Union of Forestry Research Organizations (IUFRO) in late 1988. Included in the 98 papers are papers on genetic improvement of nitrogen-fixing trees for agroforestry, results of provenance trials on a number of MPTS, and descriptions of strategies for genetic conservation. The proceedings represents experience from Africa and Latin America as well as Asia. The book was distributed mid-1990.

Small Research Grants

In the 1991 series of F/FRED small research grants, which were screened by the Network Secretariat and expert reviewers in the first months of the year, 4 out of 27 winning proposals are directly related to tree improvement (see Table 6). The grants were announced at the meeting of the Network's

Research Committee in June. With the length of small grants studies increased from the previous one-year maximum, long-term proposals on tree improvement are better supported.

Table 6. Small grants awarded in 1991 related to tree improvement.

Title	Scientist(s)	Country
Vegetative propagation, genetic improvement, and agroforestry techniques for selected MPTS	Dr. Shyamal K. Roy	Bangladesh
Increasing the biomass of *Dalbergia sissoo* and soil improvement for small-farm use on degraded sites	Mr. I.C. Dutta, Mr. S. Haque and Ms. S.P. Sah	Nepal
Breadfruit seedling production through vegetative propagation and tissue culture and its importance to farmers	Ms. Celsa A. Quimio	Philippines
Resistance of different Leucaena lines and species to the psyllid (*Heteropsylla cubana*)	Mr. Frederick Corey, Jr.	Philippines

Growth and Yield Prediction Using MPTGro

MPTGro is a microcomputer-based growth prediction model developed by the project's Global Research Systems staff, located with the F/FRED Management Office in Arlington, Virginia, U.S.A. The program is one component of MPTSys, the database and decision support package to be released around the end of 1991 as an improved version of the IADSS 2.0 software package distributed in 1989. MPTGro incorporates site information with species allometric equations to predict biomass production in a given environment.

MPTGro simulates increases in diameter, wood, and leaf biomass over the lifetime of a tree stand based on species allometric equations. While intended primarily as an aid to scientists in species selection and spacing for particular site conditions, it will also interest those involved with tree improvement.

Scientists desiring to establish a seed orchard of *A. auriculiformis*, for example, could use MPTGro to help determine appropriate plant spacings, using data on the site's soil and weather conditions and improvement objectives. Intersite analyses of the international *A. auriculiformis* trials (see p. 6), may refine the equations to show the potential of different varieties and the variation in their ability to provide a particular product or combination of products at a point within the range of sites studied. For *Leucaena pallida* and KX1 and KX2 *Leucaena* hybrids, Wheeler and Brewbaker (1990) reported that the ratio of stem wood to leafy biomass can reverse over a range of warm to warm-dry sites. This has clear consequences for whether these varieties are to be recommended to address priority needs for fodder or for pulp.

If it is known that farmers in the area surrounding the proposed seed orchard desire primarily a fodder species (as in the case of the *Leucaena* seed orchard at Chan Thuk in Thailand), MPTGro can help show that at the site, the wood:foliage biomass ratio for *A. auriculiformis* wood not be most efficient for a fodder species (see Figure 2). As allometric equations for other species and varieties are refined, MPTGro will be able to present more alternatives for species and variety selection.

By using the program's drought-stress simulation feature, a scientist can also predict the effect of an unusually dry season on wood and foliage biomass production and diameter growth.

MPTGro's developers caution that the program should not yet be used to interpolate beyond three-year growth. A small working meeting is planned for December 1991 to review MPTGro with physiology and modelling experts in the region.

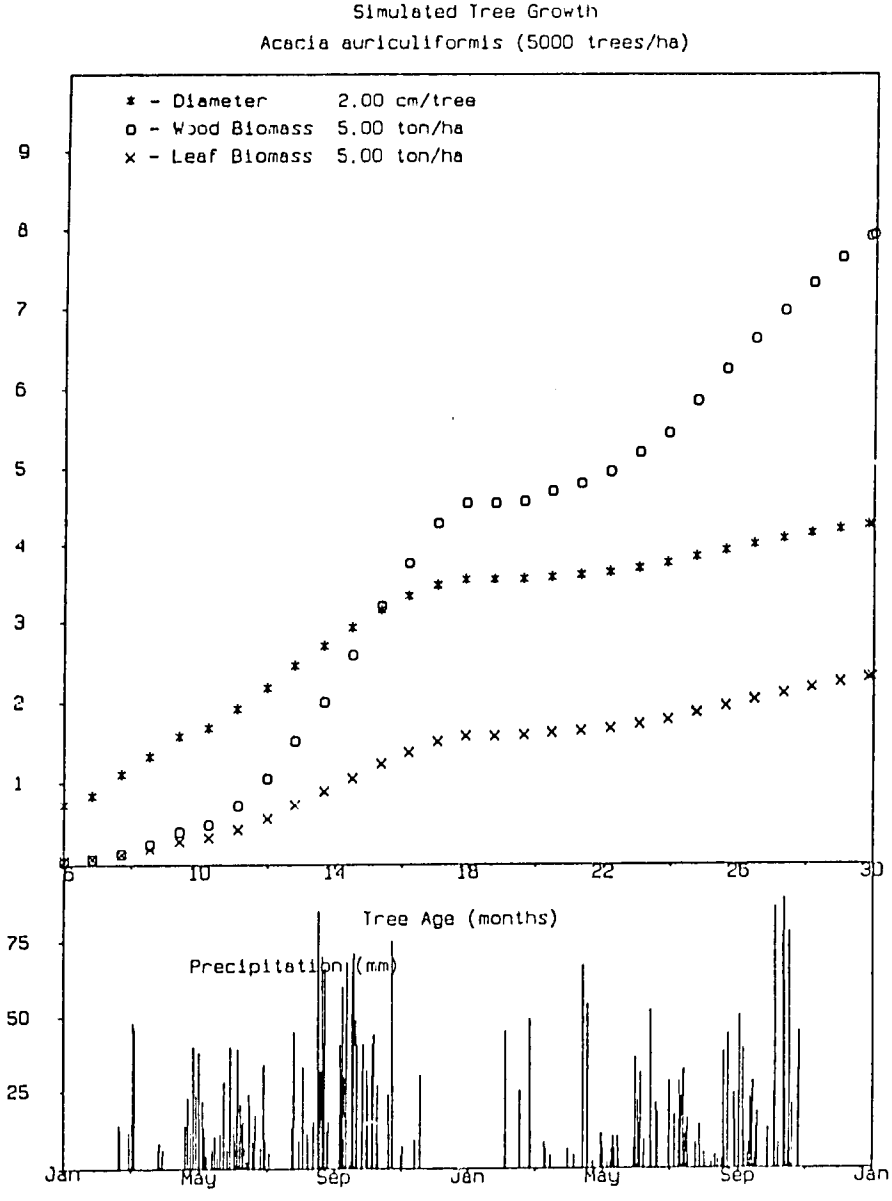

Figure 2. Sample MPTGro output showing predicted foliage and wood biomass and diameter growth for *A. auriculiformis* over a two-year period. The output is based on soil and weather conditions recorded at the network field trials site TS02 in Thailand. Precipitation data for the site appears at the bottom.

References

Chuntanaparb, Lert and Radha Ranganathan. 1990. Defining tree-breeding objectives for multipurpose tree species in Asia. MPTS Research Series Report Number 10. Bangkok: Winrock International-F/FRED.

Gibson, G.L., A.R. Griffin, and A.C. Matheson. 1989. *Breeding Tropical Trees: Population structure and genetic improvement strategies in clonal and seedling forestry.* Proceedings of an international IUFRO conference held in Pattaya, Thailand, November 28 - December 3, 1988. Oxford: Oxford Forestry Institute and Winrock International.

Glover, Nancy and Norma Adams, eds. 1990. *Tree Improvement of Multipurpose Species.* Technical Series Volume 2. Arlington, Virginia: Winrock International.

Luangviriyasaeng, V., K. Pinyopusarerk, and E.R. Williams. In press. International provenance trials of *Acacia auriculiformis* in Thailand. In: Proceedings of the Second International Workshop on Tropical Acacias, held in Bangkok, Thailand, February 11-15, 1991. Canberra: CSIRO.

MacDicken, Kenneth G. and Celso B. Lantican. 1990. *MPTS Research Supported by the Forestry/Fuelwood Research and Development Project (1987-1990).* Special Report Number 11. Bangkok: Winrock International.

MacDicken, Kenneth G. and Suree Bhumibhamon. 1990. Barefoot tree breeders: The use of farm resources for multipurpose tree species improvement. In: *Multipurpose Tree Species Research for Small farms: Strategies and Methods.* Proc. of an international conference held November 20-23, 1989 in Jakarta, Indonesia. Bangkok: Winrock International and IDRC.

Pinyopusarerk, K. 1990. Acacia auriculiformis: *an annotated bibliography.* Bangkok: Winrock International and ACIAR.

Ponce, Eliseo, Lucylen Ponce, and Leonarda Maurillo. 1991. Preferred characteristics of multipurpose trees: A case study with lowland and upland farmers in Leyte, Philippines. MPTS Research Series Report Number 17. Bangkok: Winrock International-F/FRED.

Wheeler, Robert A. 1991. *Guide to management of Leucaena seed orchards.* Bangkok: Winrock International-F/FRED.

Wheeler, R.A. and J.L. Brewbaker. 1990. An evaluation of results from the Leucaena psyllid trial network. *Leuc. Res. Rpts.* 11 (November 1990):23-31.

White, Kevin J. 1990. Dalbergia sissoo: *an annotated bibliography.* Bangkok: Winrock International-F/FRED.

Wickramasinghe, Anoja. 1991. Defining tree-breeding objectives for multipurpose tree species: A case study in Sri Lanka. MPTS Research Series Report Number 16. Bangkok: Winrock International-F/FRED.