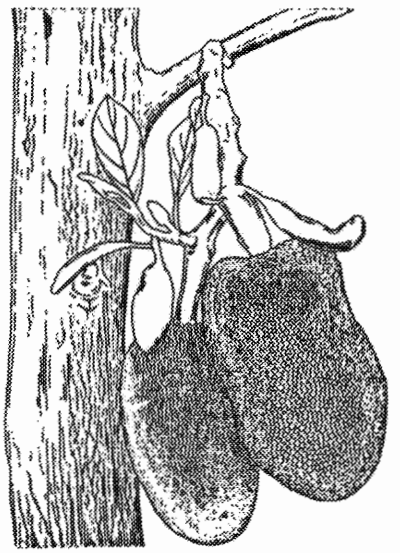
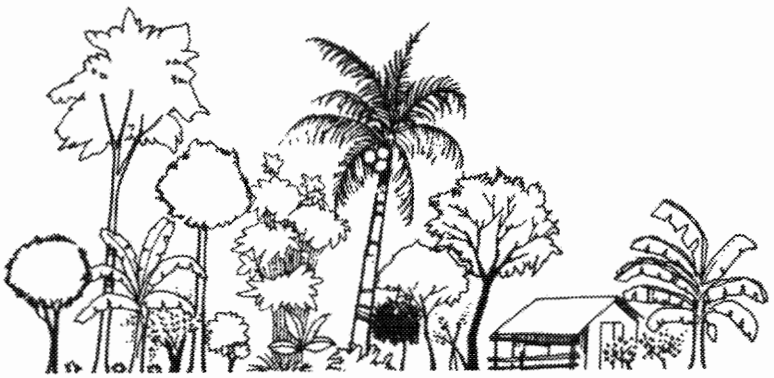
Forestry/Fuelwood Research and Development Project





Final Report 1994

Multipurpose Tree Species Research Network

USAID

Forestry/Fuelwood Research and Development Project

Final Report

1994

Winrock International Institute for Agricultural Development

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Forestry/Fuelwood Research and Development Project

Winrock International Institute for Agricultural Development

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Contents

Acronyms

ACIAR	=	Australian Centre for International Agricultural Research
ADB	=	Asian Development Bank
A/D/C	=	Agricultural Development Council
APAN	=	Asia-Pacific Agroforestry Network
ASEAN	=	Association of Southeast Asian Nations
ATSC	=	Australian Tree Seed Center
BAIF	=	Bharatiya Agro-Industries Foundation (Pune, India)
CAB	=	CAB International Information Services (U.K.)
CATIE	=	International Center for Agronomic Research and Training (Costa Rica)
CGIAR	=	Consultative Group on International Agricultural Research
CIBC	=	CAB Institute of Biological Control (U.K.)
CIDA	=	Canadian Institute for Development Assistance
CIFOR	=	Center for International Forestry Research
CIRAD-Forêt	=	Centre de coopération internationale en recherche agronomique pour le développement (France)
COGREDA	=	Consultative Group for Research and Development of Acacias
CSIRO	=	Commonwealth Scientific and Industrial Research Organization (Australia)
CUSRI	=	Chulalongkorn University Social Research Institute (Bangkok, Thailand)
DANIDA	=	Danish International Development Agency
DTEC	=	Department of Technical and Economic Cooperation
ER&D	=	Extension Research and Development
ERDB	=	Ecosystems Research and Development Bureau of the Philippines
FAO	=	Food and Agriculture Organization of the United Nations
FF	=	Ford Foundation
F/FRED	=	Forestry/Fuelwood Research and Development Project
FINNIDA	=	Finnish International Development Agency
FORSPA	=	Forestry Research Support Program for the Asia-Pacific (Bangkok, Thailand)
FORTIP	=	Forest Tree Improvement Project
FPRDI	=	Forest Products Research and Development Institute (Los Banos, Philippines)
FRDC	=	Forestry Research Development Centre (Bogor, Indonesia)
FRIM	=	Forestry Research Institute Malaysia (Kuala Lumpur, Malaysia)
FTPP	=	Forest, Trees, and People Programme (FAO)
FVF	=	Farm and Village Forestry

GTZ	=	Deutsche Gesellschaft fuer Technische Zusammenarbeit
GRS	=	F/FRED Global Research Systems
IBRD	=	World Bank
IBSRAM	=	International Board for Soil Research and Management
ICFRE	=	Indian Council of Forestry Research and Education
ICIMOD	=	International Centre for Integrated Mountain Development
ICRAF	=	International Centre for Research on Agroforestry (Nairobi, Kenya)
IDRC	=	International Development Research Centre of Canada
IIED	=	International Institute for Environment and Development
INBAR	=	International Network on Bamboo and Rattan
IOF	=	Institute of Forestry (Pokhara, Nepal)
ITTO	=	International Tropical Timber Organization
IRRI	=	International Rice Research Institute
IUFRO	=	International Union of Forest Research Organizations
KUFF	=	Kasetsart University, Faculty of Forestry (Bangkok, Thailand)
LDC	=	Lesser developed country
LOA	=	Letter of Agreement
LSP	=	Leucaena Seed Production
MOU	=	Memorandum of Understanding
MPTS	=	Multipurpose Tree Species
MUSFAD	=	MPTS Utilization for Small Farm Development
NFTA	=	Nitrogen Fixing Tree Association (Waimanolo, Hawaii, U.S.A.)
NGO	=	Non-Governmental Organization
ODA	=	Overseas Development Administration of the United Kingdom
OFI	=	Oxford Forestry Institute
PFI	=	Pakistan Forestry Institute (Peshawar, Pakistan)
RECOFTC	=	Regional Community Forestry Training Center (Bangkok, Thailand)
RWEDP	=	Regional Wood Energy Development Programme in Asia (FAO)
SDC	=	Swiss Development Corporation
SIDA	=	Swedish International Development Agency
TFRI	=	Taiwan Forestry Research Institute (Taipei, Taiwan)
TISTR	=	Thailand Institute for Scientific and Technological Research (Bangkok)
TROPIS	=	Tree Growth Potential Information System
UNDP	=	The United Nations Development Programme
UP	=	University of Peradeniya (Peradeniya, Sri Lanka)
UPLB	=	University of the Philippines at Los Banos
UPM	=	Universiti Pertanian Malaysia (Serdang, Malaysia)
USAID	=	United States Agency for International Development (Washington, U.S.A.)
ViSCA	=	Visayas State College of Agriculture (Leyte, Philippines)
WRI	=	World Resource Institute

Foreword

This document reports on 9 years of research to improve the quality and uses of short rotation multipurpose trees. It describes a project, widely known by its acronym F/FRED, which was administered by Winrock International, and funded by $18 million provided by the U.S. Agency for International Development. The aim of the research was to meet the basic needs of developing countries for fuelwood and other tree products, and thereby improve incomes and quality of life for their people.

Given the steady depletion of forested lands because of population growth and land clearing, the future of forestry in all but a few countries will depend upon tree plantings in farming systems, tree lots, and plantations.

The F/FRED Project has made an important contribution toward establishing farm forestry on privately owned farmland as a necessary adjunct, even a successor in many cases, to traditional forestry programs. For, despite efforts at preservation, the world's remaining tropical forests are continuing to shrink and alternative sources of wood products must be established. Multipurpose, fast-growing trees provide an important alternative. Unfortunately, most such species have been viewed by traditional foresters as trees of limited commercial value and development of their potential has been neglected.

The F/FRED Project integrated the social with the biological sciences to adapt research on tree improvement, management practices, and marketing to the preferences and needs of small scale tree farmers. In the process, dozens of leading scientists became involved. More than 100 books, conference proceedings and research documents were produced, greatly expanding and spreading knowledge. This knowledge is readily available to researchers throughout the world in a computer software package developed by the Project.

Direction and leadership for activities in the 11 participating countries was provided by a Steering Committee comprised of distinguished Asian biological and social scientists who established the research agenda and provided continuing advice on project research activities. A Research Committee of leading Asian forestry specialists developed the research program and undertook extensive annual review and analysis of the research undertaken through the network. National committees were established, these providing for widespread extension of results from F/FRED activities throughout Asia and in other regions of the world.

Because of funding constraints within USAID, the F/FRED Project has had to be terminated 10 months earlier than planned, and completed the final years with reduced resources. Nevertheless, significant progress was made towards meeting all of the targets set forth for the Project. Many activities launched under the Project are being continued by others. At the same time, it should be noted that forestry research by its nature requires a longer time for results than does research on field crops; and that the study and improvement of little known multipurpose trees is still in its infancy.

Special thanks are due to Rick J. Van Den Beldt and James H. French for the preparation of this final report; along with the dedicated Project staff listed in Annex 1.

As a practitioner in the field of international development for 40 years, I can say with confidence that the F/FRED Project has been a good investment of American taxpayer's money. It has been a privilege to have been Project Manager throughout the life of this worthy endeavor.

Thomas C. Niblock
Project Manager

Executive Summary

Introduction

This final report covers both Phase 1 and Phase 2 of the Forestry/Fuelwood Research and Development (F/FRED) Project. Cooperative Agreement DHR-5547-A-00-0018-00 between USAID and Winrock International called for inputs of $12.5 million for a 5-year Phase 2, which was to end on April 11, 1995. However, because of severe cuts in USAID budget and changing priorities in US foreign assistance policy, the F/FRED Project received only about $8.5 million in Phase 2. This abrupt cutback not only forced premature closure of ongoing research projects; it placed severe constraints on the Project's efforts to synthesize and publish the vast amount of data collected.

Despite budget and time cuts, the F/FRED Project produced solid institutional and research accomplishments in Asian multi-purpose tree species (MPTS) research.

Outputs and Accomplishments

1. Development of an MPTS research network in Asia. The F/FRED Research Network, later renamed the MPTS Research Network, was initiated in late 1986 with a meeting in Bangkok. Interest in the network grew rapidly. Its structure provided a unique sense of ownership among its members. Numerous research and funding partners were identified and incorporated into the Network in Phase 1. An innovative operating structure was introduced that served through the end of the project. Creation of the MPTS Research Network and the procedures embodied in it were the primary accomplishments of the F/FRED Project.

Largely because of project initiatives, the network approach is now standard methodology in Asian forestry research. INBAR, APAN, FORTIP, FORSPA—these are all acronyms for networks recently established in the region following models and mandates resembling F/FRED's. The reason for this goes far beyond mere donor interest. It reflects positively on the ability of Asian forestry research institutions—NGOs, national institutes, universities, industries—to conduct quality research.

2. Sustainability of the Network. Two years before the end of the project, F/FRED prepared a successor "Farm Forestry" proposal (Annex 3). Although this was not funded, it stimulated thought and action on the issue of sustainability. Funding for the annual Research Committee meeting and country meetings ended in mid-1993. Despite this, the Research Committee Chair convened the sixth annual meeting in June 1994 in Taipei, Taiwan. It was planned, funded, and organized without input from the Network Secretariat, and was attended by representatives from all 11 member countries. At the meeting, the MPTS Research Network was renamed the MPTS Research Network for Asia. It will be based on national MPTS committees that will continue to operate into the foreseeable future.

This reorganized Network will continue to use the mailing address of the F/FRED Project in Bangkok. It is likely that some office space will be retained in the Kasetsart University Faculty of Forestry for the Network. During the preparation of this report, the SE Asian office of ICRAF, located in Bogor, submitted a proposal to the Government of Japan for continuation of the MPTS Network Secretariat with ICRAF staffing. Negotiations on operating modalities of the new MPTS Network are ongoing.

3. Genetically improved and accepted MPTS in Asia. The tree improvement program of the F/FRED Project has made significant progress. In close collaboration with other donors and numerous national programs, provenance trials were established, monographs published, seed orchards and provenance seed stands established, and improved seed made available to field workers for a number of important species. There is much left to do. Breeding is always an ongoing effort, and there are still many species that have not found their way into formal improvement programs.

Equally important are the tree improvement activities initiated by F/FRED. The collaborative process described in this report—short-listing of tree species for improvement, development of collection procedures, design and implementation of network trials, sharing of data, transfer of improved seeds. Itis a major innovation of the F/FRED Project and has attracted the interest of groups that will continue tree improvement efforts in the region.

4. Development of an MPTS information and decision support system in Asia. The MPTSys software developed by the Project was distributed to over 300 collaborators since its development. Training was provided in its use, and it was incorporated in the programs of several regional institutions. As stated in Section 3.3, MPTSys will need updating and refinement to stay relevant; this will depend on the users of the system in the Network.

5. Publication of MPTS field data and general newsletters. As with other internationally-operating institutions, the publications of F/FRED were its most appreciated output. The project produced over 100 publications. Several of the later ones were so popular second printings were required to meet demand. *Farm Forestry News* emerged as one of the most respected MPTS newsletters in the region. Synthesis of data generated by the Project in the areas of species improvement and management, farm and village forestry, and marketing have been of high quality, and have been well received around the world. Scientific articles based on Project data submitted by Project staff for publication in refereed, international journals have all been accepted. This 100% acceptance rate speaks well of the soundness of the approach and the standards set by the Research Committee and F/FRED's Global Research Unit. There is still much to be published, however, and all departing Network Secretariat staff took with them materials for future synthesis, analysis, and publication.

6. Trained professionals in MPTS development. The training program of the Project emphasized skill development in the scientific process, including proposal preparation, research design, field implementation, data analysis, and write-up. Correspondence courses on proposal writing and experimental design were especially popular (and cost effective). Roving courses using traveling teams of regional experts were developed for training in statistical methodology. These innovations ensured that training was directed at the persons needing it most—field level researchers without access to funding for centralized training courses.

Six PhD candidates were funded to attend Michigan State University in 1988. Of these, three received their PhD degrees; two are expected to finish by September, 1994; and one received a Master's Degree.

Conclusion

It is unfortunate that a formal post-ante evaluation of the F/FRED Project will not be done. I am confident its conclusions would have mirrored my own and those of others who have worked with the MPTS Network. As with any collaborative effort, full credit goes collectively to all members of the Network and my predecessors and colleagues in the F/FRED Project.

A final word on the content of the report is in order. Throughout the text, readers will find citations of various F/FRED Manuals, Reports, Proceedings, etc. Full titles and authorship of these may be found in Annex 4. Readers interested in procuring copies of reports listed in Annex 4 may contact Winrock International or the Agribookstore for information on where individual titles may be purchased or borrowed.

Dr. Rick J. Van Den Beldt
Field Team Leader
MPTS Research Network

1. Organization of the Report

The conceptual framework used to prepare this report draws upon experience of the Center for Development Information and Evaluation in USAID, as well as experience of the Winrock team. **Figure 1** illustrates the key components in this framework.

The framework identifies two major areas reflecting Project strategy. These are process areas, which aim primarily at strengthening institutional capabilities and action areas, which aim at overcoming specific technical and socioeconomic constraints through research. These thrusts are addressed by describing the pre-Project situation, what the Project did to bring about change, and what activities are suggested for the future.

Chapter 2 presents background information on evolution of MPTS research networks in Asia, Project strategy and the scope of work that was undertaken by the Forestry/Fuelwood Research and Development Project. The purpose here is to lay the groundwork for more detailed discussion. Chapter 3 describes the process areas that F/FRED addressed in the course of Project implementation. These include development of the MPTS Research Network in Asia, standardization of research methods, creation and promotion of the MPTS Information and Decision Support System, and provision of training and communication support services. Chapter 4 sets forth the action areas F/FRED addressed in the course of Project implementation. These include tree improvement activities, farm and village forestry initiatives, multilocational management trials, and marketing and economics studies. Chapter 5 presents a set of future options which may be considered by institutions and projects which remain active in the field. Finally, the annexes summarize Project inputs, publications, and other useful reference material.

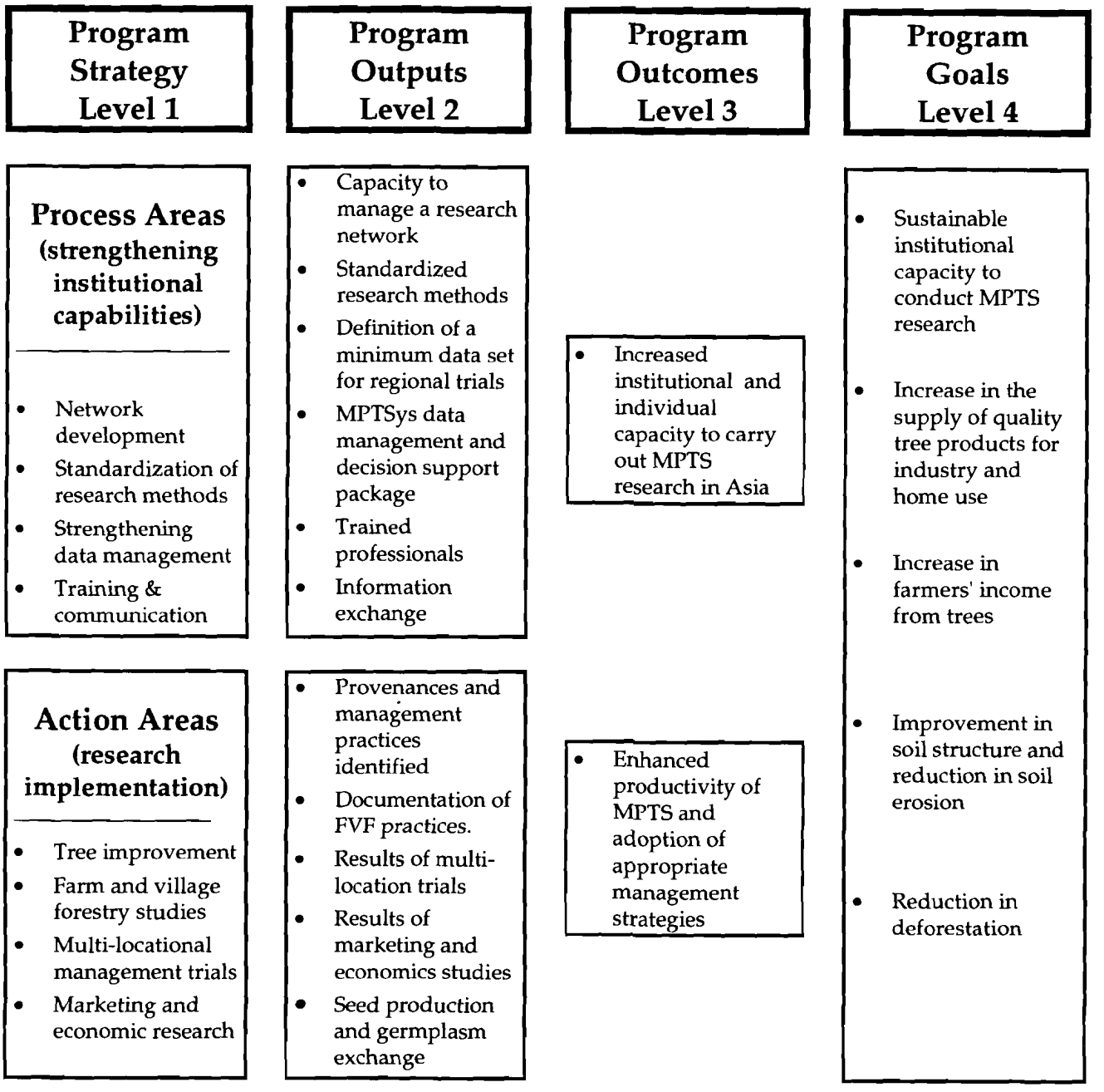


Figure 1. Conceptual framework for reporting on the F/FRED Project

2. Background

2.1. Evolution of MPTS research networks in Asia

Forestry leaders from developing countries and international agencies expressed concern in the early 1980s about the relatively low priority being given to forestry research; the lack of emphasis on social forestry; and the urgent need for enhancement of forestry research capabilities in developing countries.

The World Bank and UNDP provided funding for a Special Program Coordinator for Developing Countries in 1982. The main tasks of this coordinator were to organize forestry research planning workshops in Asia, Africa and Latin America on research themes of common interest to these regions and to generate funding from other donors for this special program.

An outcome of the above initiatives was the Asian Region Research Planning Workshop held in July 1984 in Kandy, Sri Lanka. The theme was "Increasing Productivity of Multipurpose Tree Species" and resulted in a well-articulated plan called *Blueprint for Action*[1]. This plan aimed to increase, within 10 years, the productivity and usefulness of MPTS in sustainable land-use systems to improve the quality of life of the rural poor. The activities of the F/FRED Project were guided by the recommendations of this workshop.

The Multipurpose Tree Species Research Network was established in 1986 under the F/FRED Project. F/FRED was envisioned as a ten-year effort under the United States Agency for International Development (USAID) and implemented by the Winrock International Institute for Agricultural Development. Priority MPTS for three climatic zones were identified for research at the Kandy workshop. Following consultations with Asian forestry

[1] Shea, Keith and Les W. Carlson. 1984. *Increasing Productivity of Multipurpose Trees: A Blueprint for Action.* IUFRO Planning Workshop for Asia, 16-28 July 1984, Kandy, Sri Lanka.

researchers and administrators, the F/FRED team recommended that the Project focus initially on priority species in two of these zones. Detailed Project objectives and strategies as they evolved over Phases 1 and 2 are found in Section 2.2.

During the intervening period, the Forest Tree Improvement Project (FORTIP), the Regional Wood Energy Development Programme (RWEDP), the Asia-Pacific Agroforestry Network (APAN) and the Forestry Research Support Programme for Asia and the Pacific (FORSPA) were set up under the FAO umbrella. These projects have responded to different aspects of MPTS related research and development.

In response to a continuing felt need in the larger global context, the International Centre for Research in Agroforestry (ICRAF) set up a regional office in Bogor to address special challenges in Asia. Soon after this, in late 1993, the CGIAR's long-awaited Center for International Forestry Research (CIFOR) was established.

All of these events indicate a recognition of the need to take concerted action on development of trees and tree products. The role that F/FRED has played in this development is significant particularly in terms of the process used for networking and fine tuning of methodologies for conducting network trials. The specific nature of interventions will be discussed in subsequent sections.

2.1.1. Energy and environmental concerns

Aside from the Kandy workshop, there was a global concern in the early 1980's with fuel/energy shortages and related ecological issues. These concerns helped shape the F/FRED Project strategy.

2.1.1.1. Energy

In 1984 IUFRO reported that most rural populations and low-income groups in developing Asian countries depended heavily on fuelwood, charcoal and other traditional fuels such as agricultural residues and dung to cook their food and heat their dwellings. More than 80 percent of the tropics' roundwood production was used for fuelwood. The volume of fuelwood removed exceeded the

regenerating capacity of existing woodlands in several developing countries and regions within countries.[1]

In 1985, FAO estimated that acute scarcity situations prevailed in mountainous areas of northern India, Nepal, and Afghanistan, affecting some 30 million rural people. Deficit situations prevailed in the Indo-Gangetic Plain, the Nepal Terai, Bangladesh, Southern India, Sri Lanka, Central Thailand, and Java (Indonesia), with some 550 million people affected. It was projected that an additional 270 million rural people in the region would face a fuelwood deficit by the year 2000. During the last two decades, widespread loss of forest cover has occurred as a consequence of logging, agricultural squatting, shifting cultivation, and fuelwood cutting. This has severely affected the quality of land and water resources, as well as crops.

2.1.1.2. Ecology

In upland watersheds, deforestation led to massive increases in soil erosion, sedimentation of dams and reservoirs, and increased flooding causing loss of crops and, in extreme cases, human lives. Another issue of major concern was the pressure of expanding agricultural settlements in tropical rainforests. A fundamental problem was how to cope with low fertility of rainforest soils and the attendant difficulties in devising sustainable cropping systems. Other key research topics concerned development of species to increase productivity of fruit, perennial agriculture crops, and forest trees (particularly the legumes) that augment sustainable farming systems.

Land distribution was also uneven in most countries of Asia. While some element of success in agrarian reform was achieved in a number of countries, a trend towards concentration of land in the hands of larger-scale farmers and landowners continues today. This, combined with rapid population growth, has resulted in smaller size farm holdings which may ultimately force small farmers to become sharecroppers and landless workers. Rural poverty, therefore, was seen as a major problem in most developing Asian countries.

A final issue related to demographic and socioeconomic trends in the Asia region. In 1984 the annual per capita income ranged from U.S. $80 to $300. In

[1] Madamba, C. Joseph. 1985. A Proposal for Establishment of MPTS Research Networks in Asia. Los Banos, Philippines: International Union of Forest Research Organizations.

the smaller ASEAN group of countries, per capita income was substantially higher — $420 to $1,670, excluding Singapore. Large income disparities between rural and urban populations continue. Rural-to-urban migration reduced agricultural production on marginal lands which were left abandoned. The opportunity for low-input perennials, therefore, was high and increasing for marketable MPTS products.

2.1.2. Research management concerns

One conclusion of the Kandy workshop was that high priority should be given to strengthening research capabilities within the region. Support of networks by donor organizations was seen as crucial. Most of the countries that could benefit from increased productivity from MPTS lacked the human, financial, and physical resources necessary to carry out the required research. Some concerns that were raised in formulating the F/FRED Project are described below.

2.1.2.1. Traditional focus on site-specific trials

In the tropics, one frequently finds researchers working in relative isolation from colleagues conducting similar work elsewhere. This means that results of many field trials are of only local concern or use. It also limits the opportunity for researchers to participate in multilocational studies which are important in assessing species x environment interactions and applying experimental results over a wide area. In agricultural research, multilocational trials are routine, and robust networks exist in many places to test management and varieties. However, this is rare in tropical forestry research.

Borrowing from experiences of IRRI and others, the F/FRED Project, from the start, stressed a multilocational approach to field research. As described in project publications, first efforts were not always successful. However, with experience, Network participants were able to successfully design and implement multilocational trials with species, provenance, and management factors.

2.1.2.2. Traditional segregation of scientific disciplines

Separation of biophysical and social scientists is a perennial problem in forestry research. Because of the differences in methodology, terminology, and scope, one rarely finds a true multidisciplinary team working comfortably together on a

sustained basis. Special effort must be made to keep the disciplines in close contact. The F/FRED Project facilitated a dialogue between physical and social scientists by providing seats for each on the Research Committee, short term training in each other's fields of research, and interdisciplinary workshops.

2.1.2.3. Duplication of effort

The process of systematic inquiry is greatly enhanced when people look at the same problem from slightly different perspectives. There comes a point, however, when returns on the research investment start to diminish due to overlap. The MPTS Research Network has, therefore, encouraged synchronization of effort among scientists in different countries and agroecological zones. This does not eliminate duplication. Rather, it orchestrates activities that standardize methodologies and optimize efficiency.

Given the broad similarities and local diversities in Asia, network trials have a strong comparative advantage over trials undertaken in only one country or a single region in one country. Examples can be found in the action areas of tree improvement, multilocational management trials, farm and village forestry, and marketing/economic studies described in Chapter 4.

Another dimension to duplication of effort is the need for synthesis of what is known from related studies. Such synthesis raises the process of inquiry to a higher conceptual level and generates conclusions that may be used in planning future experimentation. Species monographs and proceedings of international consultations are examples of synthesis efforts in which the Network has been involved.

2.1.3. Technical issues

The technical priorities articulated at the 1984 Kandy workshop are highlighted below:

- select, genetically improve, and conserve MPTS;
- develop nursery establishment and tending techniques for MPTS;
- develop management systems for MPTS;
- develop protection systems for MPTS;
- develop techniques and systems for maintaining soil productivity;
- determine social, economic, and environmental aspects; and

- provide for institutional support and common services.

A number of these priorities are reflected in the F/FRED Project strategy. Other issues that emerged during the course of Project implementation involved such problems as the leucaena psyllid outbreak and integration of jackfruit as an MPTS.

2.2. Project strategy

2.2.1. Goals and objectives

Cooperative Agreement No. DHR-55547-A-00-0018-00 between Winrock and USAID laid out the following targets, which span phases 1 and 2:

The broad **goals of this Project** were to meet the basic needs of developing countries for fuelwood and other tree products through the genetic improvement of multipurpose trees; for improved land and water resource management; and for increased employment and income.

The **objectives of the Project** were:

- research on the selection, management, and improvement of multipurpose tree species (MPTS);
- network development and support to address common problems related to forestry/fuelwood research across the Asia region;
- better information management to enhance research analysis and publication of results, as well as decision-making about MPTS;
- integration and collaboration of the biophysical and social sciences in MPTS research;
- balance and due consideration of interdisciplinary approaches as appropriate to specific research activities; and,
- a species approach by ecological zones as one major means of addressing regional forestry/fuelwoood problems.

The **Project purposes** for which the cooperator has responsibility were to:

- improve formulation, planning, and management of international forestry/fuelwood and agroforestry research;
- support development of a network of scientists and institutions focused on the selection, improvement, and management of fuelwood/ multipurpose tree species; and

- enable countries to address their own critical forestry/fuelwood needs through better use of forestry and agricultural-related research information.

Project outputs. Project activities included:

- Development of an MPTS research network in Asia;
- Sustainability of the network;
- Genetically improved and accepted MPTS in Asia;
- Development of an MPTS data base and decision support system for MPTS in Asia;
- Publication of MPTS field data and general newsletters; and,
- Trained professionals in MPTS development.

The above hierarchy of objectives is also reflected in Figure 1, which was used as the conceptual framework for this report.

2.2.2. Overview of philosophy and mode of operations

The Project was designed with the belief that networks are an important way to build on the strengths of individual researchers and institutions in member countries. Furthermore, these strengths can, when combined, produce results that are far greater than those arising from efforts of individual members working alone.

Phase 1 of the F/FRED Project provided for a subcontract with the University of Hawaii under which the University developed global components of the project. By agreement between Winrock and the University, a respected biometrician, Dr. Foster Cady, was appointed the University's Principal Investigator for the subcontract operating under the guidance of Winrock's overall Project Director in Arlington. The subcontract operated from a base on Maui throughout Phase 1. For Phase 2 the Maui team was moved to Arlington, Virginia and integrated into the Winrock Project team where it completed the design and establishment of the MPTSys information and decision support system in July of 1992.

Major activities included (i) development of a software system including regional and global databases integrated with decision support packages, (ii) training focussed on data management, data analysis and interpretation, and modeling, (iv) global coordination with counterparts in other regions, and (v)

cooperation with emphasis on experimental design, minimum data set, and site characterizations.

A particular concerns of USAID in planning the F/FRED Project was that the results of its large investment be well documented and disseminated. The position of Publications Manager was established in the Arlington office and tasked to develop a quarterly newsletter, and to provide professional support and oversight for a number of project publications (annual reports, research documents, conference proceedings, theme workshops, etc.). Annex 4 contains a list of the more than 100 books, principal papers and reports, manuals and handbooks produced under the auspices of the project. The newsletter, *Farm Forestry News*, was developed into a professional and widely appreciated periodical distributed globally to some 5,000 readers.

The mode of operations was based on the principle that participants would guide Network activities through democratic representation on the Steering and Research Committees. The Network Secretariat in Bangkok was designed to play a lead role as a catalyst and facilitator, a role to be gradually assumed by spin-off networks.

In April 1988, the network's name was changed from the F/FRED Research Network to the MPTS Research Network. Institutional membership in this Network was established through a Memorandum of Understanding (MOU), which provided the basis for cooperation between member organizations and the F/FRED Project. Specifically, MOUs provided guidelines for information database development, germplasm management, research improvement through workshops, training, and coordination of programs with other organizations involved in MPTS research. A total of 30 institutions in Bangladesh, India, Indonesia, Malaysia, Nepal, Pakistan, Papua New Guinea, Philippines, Singapore, Sri Lanka, Taiwan, and Thailand signed MOUs as members of the MPTS Research Network (**Annex 6** for a complete listing of these institutions).

Another basis for involvement in the network was a Letter of Agreement, which recognized the mutual interest of an institution and the F/FRED Project in research and management of MPTS without the formal obligations of the MOU. Seven institutions signed Letters of Agreement with Winrock.

2.2.3. Mid-stream adjustments

In late 1988, a six-member team evaluated the F/FRED Project. The mission was carried out by Tropical Research and Development Inc. under contract 1.Q.C. No. PDC-5517-1-00-7137-00. This evaluation provided feedback for fine-tuning Phase 1 activities and planning Phase 2.

The following comments are extracted from the executive summary of the evaluation.[1]

> *An important feature of F/FRED-supported forestry research is linking of biophysical and social scientists in a common network. Joint meetings have occurred; scientists from many fields are involved in F/FRED-supported work; and the Asian MPTS Committee has members from both broad disciplines.*
>
> *F/FRED is developing a long-desired generalized data management system for MPTS. When perfected, this computer software system could have global utility.*
>
> *The evaluation team was impressed by the degree of collaboration with other donors in MPTS activities supported by F/FRED. Also, most USAID mission officers interviewed by the evaluation team ranked F/FRED high among AID's centrally-funded Projects. It is encouraging that these missions' portfolios include such projects as upland agriculture development, which will enhance LDC capacity to use MPTS research output.*
>
> *The evaluation team found the contractor's performance to be generally adequate and, in some aspects, excellent. Progress to date indicates that the contract's requirements will be met. The evaluation team's overall conclusion is that AID can correctly consider F/FRED one of its important, innovative projects. Adequate long-term financial support for this research-focused, 10-year project should be seen by AID as a desirable development investment.*

Recommendations made to improve the program were arranged in priority order by the mission as follows:

- preparation of a long-term strategic plan;
- additional Phase 1 and 2 funding;
- additional staff for Bangkok Coordinating Unit;
- dialogue on network sustainability;
- increase in socioeconomic emphases;
- fine-tuning of MPTS data management functions;
- identifying valid indicators of progress;
- location of contractor personnel in Phase 2; and
- continued flexible response in Phase 2.

[1] Butterfield, S. H. 1988. *Evaluation Report of the Forestry/Fuelwood Research and Development Project.* Washington D.C.: US Agency for International Development.

These recommendations were acted upon in the Phase 2 Cooperative Agreement, which was signed June 4, 1990.

2.3. Scope of work

2.3.1. Responding to national needs

A main function of the MPTS Research Network was to link researchers from various national institutions so they could research priority issues and share information on common concerns. The nature of interactions supported by the Project through collaborative activities is classified in Table 1.

2.3.2. Responding to regional needs

The MPTS Research Network also has forged linkages with other networks and regional/global institutions involved in research and development on MPTS. Table 2 gives an overview of the types of collaboration undertaken.

2.3.3. Interaction with donors

An important characteristic of the operating mode of the MPTS Research Network was cultivation of donor collaboration critical for the stability and continuity of long-term research efforts. Interaction with donors was extensive in terms of both regional and national efforts. Table 2 indicates of the scope of these interactions.

2.3.4. Responding to global needs

Winrock undertook a major effort at formulating a global Farm Forestry Project in 1993. The intent was to build upon the experience of F/FRED in response to global shortages in wood, food, fodder and other tree products. Refer to **Annex 3** for an overview of the proposal.

Table 1. Nature of collaboration among national level MPTS Research Network institutions.

National Institutions	Categories of Network Activities					
	International Meetings	Seed Exchange	Provenance and Management Trials	Publications and Information Services	Marketing and FVF Studies	Training
Bangladesh						
Bangladesh Agri. Research Council	X	X				
India						
Dept. of Botany, Univ. of Delhi	X					
Bharatiya Agro-Indust. Foundation	X	X	X	X	X	X
Maduari Kamaraj University	X		X			
National Inst. of Wastelands and Rural Development	X					
University of Madras	X					
Indonesia						
Agency for Forestry Res. & Development	X	X	X	X	X	X
Faculty of Forestry, Gadjah Mada Univ.	X					
Malaysia						
Forestry Res. Inst. of Malaysia	X		X	X		X
Universiti Pertanian Malaysia	X	X	X	X	X	X
Nepal						
Institute of Forestry	X	X	X	X	X	X
Department of Forestry	X	X	X			
Inst. of Agri. & Animal Science	X		X			
Tribhuvan University	X			X	X	
Pakistan						
Government of Pakistan	X	X	X	X		X
Pakistan Atomic Energy Commission	X		X			

(continued from Table 1)

National Institutions	International Meetings	Seed Exchange	Provenance and Management Trials	Publications and Information Services	Marketing and FVF Studies	Training
Papua New Guinea						
Department of Forests	X	X	X			
Philippines						
Ministry of Natural Resources	X		X			
U. of the Philippines at Los Banos	X	X	X	X	X	X
Visayas State College of Agriculture	X		X	X	X	
Central Mindanao Univ.	X		X			
Don Mariano Marcos Memorial State Univ.	X		X	X	X	
Forest Products Res. Dev. Institute.	X					
Ifugao State College of Agri. & Forestry	X		X			
College of Forestry, Isabela State Univ.	X		X			
Univ. of Eastern Philippines	X		X			
Republic of China (Taiwan)						
Taiwan Forestry Research Institute	X	X	X	X		X
Sri Lanka						
Forest Dept. of Sri Lanka	X					
University of Peradeniya	X	X	X	X	X	X
Singapore						
Plantek International, Ltd.		X	X		X	
Thailand						
Faculty of Forestry, Kasetsart Univ.	X	X	X	X		X
Thai Inst. of Scien. & Tech. Res.	X	X	X	X		
Center for Applied Econ. Res, KU	X				X	
Chulalongkorn Univ. Social Res. Institute	X				X	X

Table 2. Nature of collaboration between the MPTS Research Network, various donor institutions, and other research networks.

	Categories of Network Activities					
Institutions	**International Meetings**	**Seed Exchange**	**Provenance and Management Trials**	**Publications and Information Services**	**Marketing and FVF Studies**	**Training**
Donors						
ACIAR	X	X	X	X		X
ADB	X					
CIDA	X	X		X		
CSIRO	X	X	X	X		
CTFT	X	X				
DANIDA	X	X	X			
DTEC						X
FAO/Rome	X	X	X		X	
FINNIDA			X			
Ford Found.	X			X	X	X
GTZ	X		X			
IDRC	X			X		
ITTO	X					
IUFRO	X			X		
NFTA	X	X		X		
ODA	X			X		
SIDA	X					
TFRI	X	X	X			
TISTR	X	X	X	X		
USAID	X			X		X
Networks						
APAN	X			X	X	X
CATIE		X	X			
CIFOR	X			X		
COGREDA	X	X	X	X		
FORSPA	X			X		X
FORTIP	X	X		X		
ICRAF	X			X	X	X
INBAR				X		
NFTA	X	X		X		
OFI	X			X		
RECOFTC	X			X	X	X
RWEDP	X			X		

3. Process Areas

3.1. Development of the MPTS research Network in Asia

3.1.1. Overview

Networking is a term that has grown popular in international development for describing any mechanism that links individuals or institutions that share common problems. Winrock has accumulated a rare range and depth of experience in developing network activities. The Multipurpose Tree Species Research Network is one example in a long series of efforts.

Usually, networks have been categorized according to their degree of organization (informal collegial associations or formalized groups), and the hierarchical level of activity (local, national, regional, international). While this type of breakdown is useful, several other ways of looking at network taxonomy are more helpful in understanding how networks function and evolve.[1]

- *Process vs. product oriented* - Process networking activities link institutions or individuals, usually with the goal of capacity-building or awareness raising through training, study tours, newsletters, and the like. Product oriented networks focus on concrete output — exchange of seed, preparation of publications, establishment of field trials, and the like.
- *Felt needs vs. donor initiated* - A network based on felt needs arises from participants gathering among themselves, often out of frustration, to solve a common problem that requires collective resources. Donor initiatives can also address common problems, but often require a longer lead period to build initiative.
- *Complementarity vs. similarity* - Networks based on complementarity aim to delegate tasks according to each participant's comparative advantage.

[1] Winrock. 1992. Lessons from Winrock's experience with networking in Asia. Based on discussions at a Winrock gathering in Songkhla, Thailand, Nov. 1-5, 1992. Winrock International, Morrilton, Arkansas, USA.

> Specific network tasks, like field trials, require similarity in approach and rigid enforcement of standard research designs. Network activities are similar or complementary based on the skills and needs in each country.

The MPTS Research Network a) addressed both process and product objectives, b) responded to felt needs while understanding the bias of particular donors, and c) built on the comparative advantage of network participants through complementary activities while, at the same time, insisting on rigor in standardized regional trials.

3.1.2. Operational modalities

3.1.2.1. National committees

As the project evolved in early years the need for national committees was recognized. Over time most participating countries established National MPTS research networks. This unplanned development came to constitute a vital linkage to the regional network. The Network Secretariat encouraged membership in national committees to be inclusionary, incorporating members from all sectors performing or interested in MPTS research -- NGOs, government institutions, the private sector, and mentor institutions. National Committees held annual conferences with partial F/FRED support around a theme of current national interest. At the meetings, delegates to the MPTS Research Committee, one biophysical scientist and one social scientist, were elected.

3.1.2.2. Advisory committees

The MPTS Network had two advisory committees -- the Research Committee and the Steering Committee. The Research Committee was comprised of delegates elected from the annual national committee meetings. The Research Committee met annually to review the progress of the Network, plan for future activities, discuss the outcome of the national committee meetings, and elect a Chair and two representatives for the Steering Committee. The annual meeting of the Research Committee was a major event of the MPTS Network. It proved to be crucial in maintaining standards and continuity in Network activities.

The Steering Committee was comprised of three senior Asian foresters, the Chair of the Research Committee, and the two Research Committee delegates. Its function was to guide the Network by establishing policies and strategies and promoting programs and activities. It met annually, with invitations being

extended to other regional networks, USAID mission representatives, and other individuals.

3.1.1.3. Professional Service Agreements (PSAs)

Most research and publication work of the Network was conducted through professional service agreements (PSAs) with network collaborators. These were basically of two types: contractual work for specific studies, tasks, and publications; and small research grants. Table 3 describes the scope and distribution of PSAs (contracts and small grants) to participating countries.

The contractual approach not only strengthened the network approach to research but also obviated the need for large project expenditures on equipment, staff, and other research infrastructure. Often, such contracts only partially covered actual costs of the research. There was substantial (but unquantified) support from the researchers and the institutions they represented.

3.1.2.4. Twinning

Scientists working on common research problems benefited from the Network's ability to pair, or twin, scientists from various institutions at national, regional, and global levels. Such linking strengthened the regional Network by encouraging dialogue and cooperative action to meet common needs. Areas of work included curriculum development in the social sciences, joint supervision of graduate-degree programs, and coordinated research on species and soil conditions common to participants' countries.

Institutionally, the Universiti Pertanian Malaysia (UPM), University of the Philippines at Los Banos (UPLB), and Kasetsart University Faculty of Forestry (KUFF), through an F/FRED twinning agreement, planned for joint research on common timber species, writing a field text on social forestry, and organizing a symposium centered on MPTS every two years.

Table 3. Distribution of small grants issued in support of F/FRED activities, by type of Network activity and country.

Network Activity	PAK	NEP	IND	BDS	SRL	THL	INO	MAL	PHL	TWN	PNG	Others	Total
Conferences			1		1	5		1	2			1	**11**
National Committee meeting	1	4	5		7	7	5	5	11	5	6		**56**
Study Tours						1							**1**
Institutional twinning						1		1	1				**3**
Tree Improvement	4	5	6	2	6	13	2	1	13	3	1	9	**65**
Network Research		7	2	2	2	8	6	5	17	1			**50**
Humid/ Sub Humid Network trials					2	16	9	7	6	8			**48**
Arid/Semi-Arid Network trials	7	4	4		1								**16**
Social science research	1	3			1	4			8			1	**18**
Regional comparative studies	3	3	2		2	11	2	1	18				**42**
Marketing	1	1			2	1	1	1	7				**14**
Extension research		1	1										**2**
Training support					1	4			2			1	**8**
Long term training	1	1				1			3				**6**
Short term training			3		2	1	2	3	10	3	1		**25**
Publications	1		1		2	18	3	2	3	2		5	**37**
Total	**19**	**29**	**25**	**4**	**29**	**91**	**30**	**27**	**102**	**22**	**8**	**17**	**402**

PAK = Pakistan NEP = Nepal IND = India
BDS = Bangladesh SRL = Sri Lanka THL = Thailand
INO = Indonesia MAL = Malaysia PHL = Philippines
TWN = Taiwan PNG = Papua New Guinea

3.1.2.5. Co-funding of research and scientific meetings

A large part of F/FRED's role has been as a broker in arranging donor support for joint meetings. Table 2 (Chapter 2) indicates the extent of this activity.

3.1.3. Analysis of accomplishments and constraints

3.1.3.1. During life of the Project

Management of the MPTS Research Network has necessarily evolved in response to changes in the level of active participation and funding. Network development can be classified into three stages, each requiring different management strategies i.e.: organization, establishment and sustainable operations.

Organizational stage. The MPTS Research Network began as the F/FRED Research Network in late 1986 with a meeting in Bangkok (F/FRED Proceedings No. 1). The first management challenge was establishing staff and facilities at the Project Management Office in Arlington, Virginia. Work plans were developed and potential Network participants were identified in line with the terms of the F/FRED management contract.

The process of design of the USAID-funded Project reflected diversity of opinion about Project objectives, structure, research focus and network approach. The final Project design incorporated parts of several proposals, including portions of the 1984 Kandy meeting and a proposal from the Agricultural Development Council (A/D/C) for a natural resources management network.

Establishment stage. During the establishment stage, linkages between institutions were fostered through such activities as *Farm Forestry News*, the project's flagship publication, regular Network meetings, cooperative research projects, and study tours. It was gratifying to note the extent of willingness of participants to commit resources and share research methods and results. Participation in such Network programs as field experiments, training courses and meetings was active. Much of the management role during the establishment phase was the organization and implementation of Project activities designed to set the stage for sustained Network operations at the end of USAID funding.

During this stage of the Project, significant progress was made to improve the probability of long-term success. Key factors were establishment of functional committee structures, leadership of Project-funded activities by Network participants, and diversification of donor support and counterpart funding, which included national funding sources. To consolidate operations, the Maui office moved to Arlington.

The management role of the Bangkok-based Network Secretariat evolved in accordance with changing needs. As cooperative relationships developed, the tasks of the Secretariat shifted to emphasize Network coordination and broadening the base of Network support. Symbolic of this effort was the change in the name of the Network from the F/FRED Research Network to the MPTS Research Network for Asia. With this shift also came additional co-sponsorship of Network activities with major donors of Europe, U.S., and Australia. In addition, the two MPTS Research Network committees have played an increasing role in directing Network activities.

Sustainable operations stage. The future of the MPTS Research Network depends on the success of the third stage of development, in which the Network is operated and sustained by a combination of donors and participating governments. The minimum level of effort for this stage is likely to be a secretariat or coordinating unit that can be supported with modest, but sustained financing from multiple sources. In this stage, major initiatives should come from participants with the secretariat serving as a facilitator for meetings, research grants, and publications distribution.

3.1.3.2. Sustainability

During the process of Network establishment, several lessons have been learned that influence sustainability. Ken MacDicken identified thirteen critical management factors.[1]

1. Active group of core participants. A nucleus of cooperators who are keenly interested in the network approach is essential to successful Network development. While this core may be less than 10 percent of the total number of

[1] MacDicken, K. G. (undated). Manging MPTS Research Networks in Aisa. Unpublished paper, Forestry/Fuelwood Research and Development Project, Bangkok, Thailand: Winrock International.

members, it provides critical leadership, both formal and informal, and technical expertise that strongly influences Network programs.

2. Managing conflicts of interest. The MPTS Research Network involves diverse participants including researchers, research administrators, donor agency administrators and end-users of research. In principle, each of these groups is working toward common goals yet, in practice, differences in perspective and strategy often lead to disagreement. A critical role of Network management is balancing these conflicting viewpoints, assuming the role of an honest broker when necessary.

3. Flexibility. Networks can thrive only when provided with enough institutional and managerial flexibility to allow some redirection in research focus and allocation of funds. For example, flexibility in Project design and execution was critical to responding rapidly to the outbreak of the psyllid pest which seriously damaged *Leucaena leucocephala* production in much of Asia and the Pacific in the late 1980s.

4. Neutral host institution. A neutral host institution is needed to provide an impartial venue. The MPTS Research Network has been most fortunate to be headquartered at the Kasetsart University Faculty of Forestry. The Faculty has provided good facilities and has contributed to the regional mission of the MPTS Research Network.

5. Sustained long-term support. A ten-year funding commitment was a reasonable minimum period for the network to grow from the organizational to the sustainable operations stage. Because of discontinuity in USAID support during the final years, the search for other mechanisms for continuation had to be accelerated.

6. Strong scientific and professional interest. Finding important problem areas of broad regional interest is not difficult, but agreeing on methods of cooperation or coordination can be. Cooperation is easily encouraged on crisis topics that are current and mutually important. Organization and administration of research on non-crisis topics have required more initiative and staff work by the Network Secretariat.

7. Legitimacy through regional effort. The MPTS Research Network can provide significant incentives for national researchers to become involved in innovative research that may not attract the attention of national research

administrators. Research on MPTS or social aspects of farm forestry have generally received little attention from national funding sources and have often been considered out of the mainstream.

8. Standardization of methodology. Scientists at F/FRED planning meetings have exercised professional cooperation in developing plans for Network field trials, agreeing on both treatment designs and common methods. Standardized methods in cooperative research resulted in generation of valuable data from multilocational experiments on a wide range of sites. It is hoped that this cooperation will help provide the foundation for long-term professional relationships which are the core of a functioning network.

9. Spirit of compromise. Cooperative effort among researchers inevitably means compromise. There are often profound differences in preferred experimental designs, data collection methodology, statistical analysis, and reporting requirements among network participants. Compromise is needed to ensure the value of data collected through Network experiments.

10. Appropriate grant levels. MPTS research in Asia attracts a wide range of funding from a variety of sources. Small projects from national programs often provide individual researchers less than US$1,000 while large donor research projects can range up to US$200,000 or more. F/FRED has bridged this gap by providing modest funding levels that cover operational costs for small-scale individual research projects. This has allowed the Project to increase the number of scientists and scope of work with limited research funds available. It has also encouraged co-financing of research from national sources, adding to the likelihood that such investigations will receive future attention from national programs.

11. Effective coordinating staff. Adequately trained and well-motivated staff are critical to the success of any research effort. Network development and management requires staff who have recognizable skills in the subject area focus and can deal with a wide range of researchers and administrators with Network interests.

F/FRED Secretariat staff, coming from several disciplines and nationalities, provided a wide range of in-house expertise to Network members. They also presented an opportunity for multi-disciplinary cooperation in research design, implementation, and analysis.

Inclusion of two former deans of Asian forestry faculties added significantly to credibility of network staff. Continuity of Winrock Project leadership was likewise important. There were only two field team leaders over the year project a single project manager, publications manager, and database manager.

12. Donor cooperation. Donor coordination is also important. Each donor agency has strengths and weaknesses that determine the limits of its effectiveness. For example, one donor may have substantial research funds, yet be unable to support a coordination meeting on a given tropic. When coupled with F/FREDs travel and workshop funds to support research planning, the result can be impressive. In a collaborative effort, all participants must recognize their roles and work together to bridge as many gaps as possible.

13. Decentralized management. The MPTS Research Network evolved from centralized management of activities to decentralized management by Network participants. This process reflects the need to adjust funding and management strategies to help Network participants take on greater responsibility.

3.2 Standardization of research methods

3.2.1. Overview

Research on multipurpose tree species (MPTS) often uses methods, tools, and standards borrowed from traditional forestry research. Yet traditional forestry approaches that do not take into account other tree products are not always appropriate and need to be modified or replaced by more suitable techniques for MPTS research.

MPTS researchers often face the problem of trying to use inappropriate methods because standard ones have been unavailable for such common problems as how to measure multiple-stemmed trees or partition foliage. Understanding the relation between biomass production and production of food/fruits, fodder, resin, and other tree products is critical for small farmers. The need for revised methods was addressed by the Network workshop that resulted in *Field Trials Manual for Multipurpose Tree Species,* (F/FRED Manual No. 3) which was followed by *Standard Research Methods for Multipurpose Trees and Shrubs* (F/FRED Manual No. 5). The latter volume seeks to provide standards

based on years of experience with MPTS assessment in various internationally operating institutions.

3.2.2. Responding to regional and national needs

While the concept of networking and international collaboration appears straightforward, the path is full of hazards, especially when the linkage is between countries of different regions with people of different cultural and religious backgrounds, attitudes, and training. In addition, the institutions have widely contrasting backgrounds and varying resources. The problem is further heightened when institutions are inflexible with their own programs.

Six main groups of problems have been experienced in MPTS Research Networks. These are outlined below.[1]

1. Choosing species or topics. Deciding on appropriate species and subjects for research has to take into account the cost-effectiveness of limited resources and the widest potential socio-economic benefit. For a network that covers a wide geographical region with different ecological zones, this can pose a problem. The MPTS Research Network adopted the approach of continuous consultations with its cooperators and division of research activities according to ecological zones. New species have been added to the initial priority list. Similarly, priority research areas, and approaches, have been revised through the course of the Project to reflect changing needs.

2. Identifying the lead center. Successful networks need strong and effective leaders who can provide firm yet sympathetic guidance, relevant information, appropriate experimental designs, and, where necessary, data analyses. The MPTS Research Network has tackled this problem by establishing a Network Secretariat. The Secretariat enjoys strong support from the Research Committee which advises on research directions.

3. Identifying network participants. To be effective, membership should not be exclusive, except where there are legal or other constraints.

4. Encouraging active participation. Even when potential participants can be identified, they may not see the importance of joining a network, or they may not

[1] Awang, Kamis. 1993. Opportunities for Regional Research Networking: The F/FRED Experience. In: Proceedings of the International Consultation on Neem Improvement, Bangkok, Thailand: Winrock International.

have sufficient resources to follow the agreed-on research agenda. Collaboration among the participants and Secretariat staff was one of the key strategies adopted by the MPTS Research Network. Agreements were made regarding mutual commitment of resources. Training courses or workshops also enhanced the capability of staff in participating institutions.

5. Communications and feedback. There is a danger in not allowing adequate feedback from the field to the Secretariat. The F/FRED Project solicited feedback through its structure, its training program, site visits, and through its newsletter, the *Farm Forestry News*.

In some cases, feedback diverted substantial funding and staff effort to create new initiatives. Among these was COGREDA, the Consultative Group for Research and Development of the Acacias, which was created in 1992 as a result of a growing interest in the genus among network members. At the end of the Project, COGREDA remains one of the most viable creations of the MPTS Network.

6. Planting material. Most F/FRED network trials required exchange of plant material between countries. Plant quarantine requirements of the importing countries must be known in advance to avoid customs delay. Recalcitrant and non-orthodox seed demand special attention in their handling. The possibility of exchanging tissue cultured or micropropagated material should not be discounted in the future.

3.2.3. Research design

Research is an investment whose full potential is rarely realized. Lack of standard research methods for MPTS makes it difficult to understand and apply the methods of one researcher to the problems faced by others. Also field research on MPTS is frequently done in single-site experiments. The results of each experiment have a limited recommendation domain to which they can be appropriately applied. Standard methods and the use of standard minimum data sets help ensure availability of enough information to allow interpretation and, in some cases, application of results to sites outside the recommendation domain.

In response to the above constraints, the MPTS Research Network produced the manual *Standard Research Methods for Multipurpose Trees and Shrubs* (F/FRED

Manual No. 5), a reference for those who wish to plan and conduct MPTS field research. Recommended standards and alternative approaches are provided for critical MPTS research decisions.

A participatory approach to research design was employed since the Project's inception. A recent case illustration of collaboration in research design was the 1993 International Consultation on Neem Improvement. Scientists came together from Asia, Africa, the United States, and Europe to develop a long-term strategy for improvement of *Azadirachta indica* (neem). One of the primary outputs of group discussion was the set of *Guidelines for Managing Neem Provenance Trials* (F/FRED Proceedings No. 11).

While each Network experiment had a unique set of design considerations, our experience showed there is considerable transferability in terms of the *process* of scientific inquiry. For example, the protocols for the neem trials were taken largely from experience gained in earlier trials (F/FRED Manuals No. 4 and 7). We found also that direct participation of research collaborators in preparing detailed design considerations helped increase the feeling of ownership and commitment to the trials.

The F/FRED technical publications entitled *Tree Improvement of Multipurpose Species* (F/FRED Technical Series No. 2) and *Modeling Growth and Yield of Multipurpose Tree Species* (F/FRED Technical Series No. 1) have also contributed significantly to raising the scientific standards of MPTS research work being undertaken in the region.

3.2.4. Managing multilocational research

When performance differences among genotypes vary from site to site, it is often due to the interaction with different environmental conditions. Usually, the interaction is sufficiently large to obviate application of trial averages to other, non-trial sites. Multilocational research can measure the magnitude of this G x E interaction. F/FRED has supported a series of multilocational Network trials in South and Southeast Asia. The approach adopted in carrying out these trials consists of the following stages, coordinated by the Network Secretariat:

1. **Planning meeting.** During the planning meeting, agreements are sought among potential cooperators on experiment objectives and design, standard methodology, minimum data set to be collected, germplasm to be used, sources

of supplies, site selection, the commencement time, data exchange and analysis, and authorship of publications. The protocols for the establishment, management, assessment, and data exchange are documented and distributed to all cooperators.

2. Site selection. Experimental sites can be selected to reflect a range of combinations for important pairs of environmental variables. It is important to have a clear idea of the number of sites and participating institutions or individuals to be involved in the trial. This will help determine the amount of seed required, so that seed ordering or collection can be done efficiently. Local climatic information influencing nursery and outplanting schedules is helpful so that seed can be dispatched in time.

3. Site description. For Network management trials, a full site description was conducted before planting. This was usually done by contracting roving teams of soil scientists and other experts to ensure standardization of methodology and to provide training to local trial participants. Key environmental data on weather, soil, and socioeconomic factors were collected before and during experimentation.

4. Trial monitoring and data collection. It is inevitable in a multilocation trial that some sites will drop out of the program. In the MPTS Network trials, reasons for this included fire, transfer of personnel, and changing host institution priorities. Loss of some sites makes it imperative that the remaining sites are maintained to standards and that data are collected in a timely and accurate manner.

Continuous communication between Network Specialists and cooperators is important to handle methodological and logistical problems as they arise. Visits by the Network Specialists to trial sites at the time of data collection can also assist participants in complex measurement decisions such as tree form classification. When feasible, inter-site visits by the participants themselves fosters scientific rigor and maintains a high sense of propriety in the program.

5. Data analysis and publication. Three types of publications were identified, and authorship rules established. Local data were published by individual cooperators, utilizing Network expertise and co-authorship as needed. Intersite analysis was primarily the task of the Network Secretariat, with the understanding that all parties contributing data were listed as co-authors.

Special papers derived from inter-site analysis, for example those based on modeling or statistical procedure, could be prepared by any network member, acknowledging the data source.

3.2.5. Nature of cooperation and support

All Network experiments were conducted on the basis of cooperation between the F/FRED Project and participants. The Network Secretariat provided partial support in terms of finance, germplasm, and expert advice. The cooperating institutions committed land, staff time, and sufficient financial resources to ensure success. F/FRED also collaborated with other donor agencies such as FINNIDA, ACIAR, CSIRO, and FAO who supplemented funding.

Sample checklist for managing network trials. A good example of the types of considerations that must be taken into account when managing multilocation research can be found in *Guidelines for Managing Neem Trials* (F/FRED Proceedings No. 11), which grew out of the International Consultation on Neem Improvement. An outline of the protocols for managing neem trials is as follows:

- **Defining and sampling provenances**
  - — Provenance delineation and description
  - — Selection of seed trees within a provenance
- **Seed collection**
  - — Time to collect
  - — Amount to collect
  - — Collection methodology
- **Seed processing and storage**
  - — Grading and depulping of fruits
  - — Stone drying
  - — Moisture testing
  - — Germination testing
  - — Seed lot documentation
- **Packing and shipping**
  - — Preparing to ship the seed
  - — Packing and shipping
  - — Notifying the recipient
- **Requesting and receiving a seed shipment**
  - — Preparing to receive the seed
  - — Planting seed in the nursery
  - — Care of seedling
- **Field trial establishment**
  - — Objective of the trial

- — Experimental design
- — Site selection
- — Site description
- — Trial layout
- — Planting
- — Post-planting maintenance

- **Data collection and exchange**
  - — Field data measurement
  - — Data exchange, analysis, and interpretation
  - — Reporting

3.2.6. Analysis of accomplishments and constraints

3.2.6.1. During life of the Project

One of most significant accomplishments of the F/FRED program was demonstrating that rigorous multilocational species, provenance, and management trials could be established with a wide range of collaborators. Data generated from these trials have been featured in journal and conference papers, synthesis documents, and production manuals. (Annex 4). Knowledge gained from them has fed into improved seed production programs for several species.

Equally important are the processes that have been developed by the MPTS Research Network in conducting field research. The collaborative approach of defining topics, outlining methods of studying them, and implementing research programs, has worked well. Although budget cuts and early termination of the project affected product output, the standard methodology and collaborative approach to research remains a viable example in the region.

3.2.6.2. Sustainability

At present, and in considerable part because of the F/FRED Project, the collaborative network approach to forest research is well entrenched in Asia. The Project has built upon earlier models of multilocational forestry studies in the region by incorporating two innovations--priority identification through formal networking, and standardization of research methodology, including a minimum data set structure. The process behind the research will continue to be a part of Asian forestry research.

3.3. MPTS information and decision support system

3.3.1. Overview

The Multipurpose Tree Species Information and Decision Support System, Version 3.0 (MPTSys 3.0), is an integrated microcomputer program designed to support the MPTS Research Network, as well as the global research component of F/FRED. Developed by the F/FRED Project's Global Research Systems staff, MPTSys 3.0 (F/FRED Manual No. 8) grew out of the earlier Information and Decision Support System (IADSS) developed during the first five-year phase of F/FRED.

The information and decision support system was developed through 1) joint planning with collaborating Asian scientists in the MPTS Research Network, 2) coordination with global efforts of MPTS data management specialists, and 3) study of existing databases from key forestry and agricultural organizations. The system addresses one of F/FRED's core objectives — providing better information management to enhance analysis, publication of research results, and decision making related to multipurpose tree species.

MPTSys is designed to help scientists, administrators, and extension workers organize, manage, and share research information on multipurpose tree species. This system is based on a modular approach to system design. The components include regional and global databases and application programs. Stand-alone components allow the users flexibility of installing selected ones to meet their individual needs and resources. The system does not require users to have had previous training in computers or database management. Standardized screens, options and menus along with help windows, reduce learning time.

The database management program has standard options to add, search, modify, delete, browse, and output records. MPTSys can provide improved information management to enhance research analysis, publication of results, and decision making.

3.3.2. Research databases

3.3.2.1. Experiment Database

The Experiment Database, the flagship of the system, has supported the multilocational trials carried out by the Network since 1987. This database not

only allows easy data exchange of Network experiments among researchers but also can be utilized for non-Network trials to meet independent research needs. Researchers can enter stem, plot, or tree information directly into the system. Data can be selectively retrieved, viewed, and printed to disk, file, or printer.

The Experiment Database is the prime residence for experiment data sets generated by the MPTS Research Network. It is ideally suited for comparative analysis from a series of trials with common treatments, experimental designs, and methodologies. The Experiment Database is, furthermore, linked with a data analysis and graphics package. Database files on experimental design, treatment to plot assignments, and user-selected plot measurement data are joined within MPTSys and automatically inputted into MPTStat for an intra-site analysis of the data.

3.3.2.2. Summary Database

After performing appropriate statistical, economic and other analyses, the summarized information from experiments can be downloaded into another database that contains highly condensed, key information on MPTS which is suited for practical management decisions. This is called the Summary Database.

3.3.2.3. Soil Database

The Soil Database stores chemical and physical characteristics of tropical soils at the horizon level. It is comprised of two major data files. One contains information associated with a single soil profile and does not vary according to soil layer. The other contains information associated with a single layer of a soil profile. Data from F/FRED site characterizations are stored in this database along with tropical soil data from the World soil resources of the US Conservation Service and the US National Soil Survey Laboratory.

3.3.2.4. Climate Database

This database contains long-term climate data obtained from the Plant Protection and Production Division of FAO. Primary files contain station information and climate data. Climate variables include mean rainfall, minimum and maximum temperatures, vapor pressure, wind speed, sunshine, radiation, and daytime and night time temperatures.

3.3.2.5. Farm and Village Forestry Database

The FVF database stores and manages socioeconomic information at household, village, district, and national levels. It can be used to improve regional and global understanding of the biophysical and socioeconomic conditions under which small farmers grow multipurpose trees.

3.3.3. Reference databases

MPTSys contains three reference databases, with standard options to add, search, modify, delete, browse, and output records.

3.3.3.1. MPTS Specialist Database

This database provides quick access to the names, addresses, phone/fax numbers and expertise of researchers active in MPTS research worldwide. About 450 specialists are currently listed.

3.3.3.2. Abstract Database

Literature citations and abstracts relevant to MPTS are contained in this reference database.

3.3.3.3. Species Digest

This database stores species characteristics and environmental requirements. About 175 species are included from Oxford Forestry Institute.

3.3.4. Decision support packages

Decision support packages are principal subsystems. Their role is to assist in transforming data to information for decision-making. There are three such subsystems in MPTSys.

3.3.4.1. Data Analysis and Modeling

This general purpose statistical analysis, modeling, and graphics package, known as MPTStat, has been integrated into MPTSys. Its primary objective is to offer researchers an easy-to-learn yet flexible data analysis package to handle a range of research design situations. A detailed user's manual (F/FRED Manual No. 1) supplemented with annotated case studies complements the package.

3.3.4.2. Species x Environment Modeling

MPTModel, an interactive decision support package, assists the user to examine environment by genotype interactions and provide performance prediction analyses. Tailored to support Network multilocational trails, MPTModel allows a series of experiments with standardized treatment designs to be combined and analysed to evaluate the consistency of species and management performance across environments. The estimated prediction model may or may not include site descriptions.

Both MPTStat and MPTModel help Network cooperators eliminate the time-consuming steps of organizing and entering a data set into a decision support package. They also provide easy-to-use yet sufficiently flexible tools to handle a wide range of research design situations.

3.3.4.3. Growth Simulation

MPTGro (MPT Growth Simulation Model) is a computer model designed to predict yield and biomass of tropical MPTS under various management conditions, soil types, and climate conditions. For example, users can quantify trade-offs between species and planting density in terms of wood and foliage biomass production. As an integrated sub-system within MPTSys, MPTGro accepts data inputs from the system's soil, climate, and weather databases to help decision makers match MPTS requirements with environmental characteristics. A revised user's manual (F/FRED Manual No. 8) describes the model's development in addition to user assistance.

Allometry, the relationship between the growth rates of different parts of an organism, and light interception are the main conceptual components used to simulate growth in MPTGro. The interaction of allometry and light interception determines growth over time. Using MPTGro, researchers and teachers can compare field observations to a formally defined representation of concepts that may otherwise be vague.

Table 4 Comparison of MPTS Software and their Capabilities

Functions	MPTS Software									
	CABI	DATACHAIN	GROMAP	INSPIRE	MIRA	MPTS	MPTSys	PLANTGRO	SISTEM+	WORLD
Bibliography	●				●		●			
Field trial data		●			●		●		●	
Agro-ecological data							●			
Summary species description				●		●	●			
Summary treatments					●		●			
Site index models							●			
Tree performance models							●	●		
Spatial model			●							●
Integrated decision support							●			
Socio-economic analysis					●	●				
Utilities (data transfer and exchange)							●		●	

3.3.5. Analysis of accomplishments and constraints

3.3.5.1. During life of the Project

Early in phase one, the F/FRED Project assumed the leadership in global coordination with institutions interested in MPTS data management. The principal institutions were CATIE, CSIRO, ICRAF, NFTA and OFI. The project initiated joint planning meetings in order to maximize total efforts on agreed goals and minimize duplication. CSIRO and F/FRED jointly developed the Summary Database with attention to a minimum data set needed in applications supported by users. The Specialist Database was modified to meet NFTA's needs. Joint efforts with CATIE were guided by working agreements. The F/FRED Project supported two scientists at Turrialba to assist in developing of

the CATIE information system with emphasis on computer training, retrieving order data and developing a socioeconomic database. Progress was made among the institutions in standardizing a minimum data set and establishing joint codes. A session at the 1990 Montreal IUFRO meeting was jointly given by all five organizations.

MPTSys was distributed to over 300 Network cooperators and member institutions. On-site training courses were conducted on its use in participating countries.

Researchers capability to handle, exchange and utilize their data have been enhanced. The system as a whole encompasses enormous amounts of information. Therefore, a periodic monitoring/evaluation and updating of the system is required to ensure that it meets the specific requirements of institutions that adopt it and that archived data will be available for future use.

3.3.5.2. Sustainability

We have widely publicised the system through newsletters, journal articles, and other publications. Detailed manuals for the systems components (F/FRED Manual No. 8) have been prepared and mailed to key users and institutions. World Soils Resources of the US Soil Conservation Services has agreed to maintain and improve the soil database. In Australia, CSIRO will be adapting the Summary Database to meet the needs of its research centers throughout the country. The F/FRED Project has been helping CSIRO modify the database to suit its needs. MPTStat and MPTGro will continue to have support from codevelopes at Cornall University and the University of Kentucky. Table 4 gives an overall impression of how MPTSys compares to other forestry software. While there are some good alternative choices, each has its own strengths and limitations including cost and utility.

3.4. Training and communication support

3.4.1. Responding to regional and national training needs

As early as the conceptualization stage of the Project, training was seen as an important means to ensure sustainability of effort in Asian MPTS research. The F/FRED Project supported both long-and short-term training, as part of the MPTS Network and the global research component of the Arlington office.

As the MPTS Research Network came up to speed, it quickly moved from the standard training approach of sending trainees to western universities or conducting regional courses. Instead, alternative learning strategies were developed, including consultations through site visits and study tours, correspondence courses, and creation of roving teams of trainers. This approach had three advantages. First, it was cost effective. Over 600 persons benefited from F/FRED training with very modest expenditures. Second, training was directed at field-level researchers who most needed it. Third, decentralized F/FRED training programs were tailored to specific country or Network needs.

3.4.1.1. Advisory assistance

A major part of the interaction between the Secretariat and participants in the region was through site visits by Network Specialists and other senior Network participants. Such on-job interaction benefited the whole Network since visitors could act as the medium through which experience was exchanged among countries. At the national level, a similar role was played by Research Committee members and experienced collaborators positioned to support research in their own countries.

Regionally, study tours were conducted to provide interchange of ideas among participants in the 1987 Humid zone multilocational trials. These proved vital in maintaining interest in this first effort, and provided the basis for further development of the field trials program in succeeding years. A study tour was also conducted in 1993 with junior staff of KUFF, who traveled to northern India to study industry/farmer linkages in Punjab and Uttar Pradesh States.

3.4.1.2. Short-term training

Requests for short-term training usually emerged out of the annual meetings of National MPTS Committees. Responsibility for the development and implementation of the courses fell to the Network Secretariat Training Specialist, who matched regional training talent with specific training requirements. In the middle years of the Project, substantial training in statistical analysis, database management, and MPTSys was conducted by the F/FRED Global Research team located in Maui (later, Arlington, VA).

In-country short-term courses, central to the Network's training program, included the following:

Roving courses, where the trainers move from country to country, were designed to adapt to the same course to the special needs of participants throughout the region. Roving courses focused on design and analysis of MPTS experiments, microcomputer applications in forestry research, multivariate methods for MPTS research, research problem identification, proposal preparation, strategies for marketing tree products, and technical writing and presentation.

Correspondence courses, modeled on commercial self-study courses proved to be very popular with Network participants. The Network's first correspondence course, *Designing Effective Research Proposals*, took place over a four-month period using three training modules. Modules consisted of reading materials and exercises that were returned to the Training Specialist for grading. Of the 170 participants enrolled from 10 countries, 112 (65%) completed the course and received a certificate. An independent assessment of the course showed that 85% of the participants found the course very useful in their work and gave it high marks. In view of this response, a second correspondence course was conducted on *Design and Analysis of MPTS Field Experiments.* Reading materials and interactive computer software for training were developed for this course, and are available from Winrock International.

3.4.1.3. Long -term training

As of mid-1994, two individuals have received their PhDs and returned to their home country; one has defended his dissertation and returned to his home country and is making final changes while employed on a forestry project; one is in the final phase of her dissertation with completion expected by September, 1994; one delayed his return to his home country to be with his wife while she completes her PhD; and the last candidate completed his PhD course work, but did not dissertate and returned to his home country with a masters degree.

3.4.1.4 Curriculum development

Asian schools of forestry have provided an important focal point for networking activities. Design of quality forestry and agroforestry curricula of these schools is critical. The Tropical Resources Institute of Yale University was subcontracted in 1989 to organize and conduct a curriculum development workshop entitled Social Sciences in Asian Forestry Curricula (Khon Kaen, Thailand in November

1989). A follow-on workshop was held the next year in Pokhara, Nepal. Lessons learned and recommendations of participants were documented and widely disseminated through proceedings, bibliographies, working papers, and a handbook (F/FRED Special Reports 5, 7-9; Proceedings 4: and Winrock Handbook 3). During the later years of the project, several curriculum planning exercises were conducted by the Network Training specialist and selected contractual help.

3.4.1.5. Collaborative training

In recent years, F/FRED has collaborated in regional training courses run by the Regional Community Forestry Training Center (RECOFTC) and the Asia-Pacific Agroforestry Network (APAN). This has been particularly relevant to the social science aspects of Network activities.

3.4.2. Regional and national information needs

A combination of information channels were used to support achievement of Project objectives. These included direct person-to-person contact, group interaction in meetings, workshops, and seminars, use of interactive computer applications, distance learning through correspondence courses, and distribution of printed materials. Figure 2 gives an idea of the range of functions, actors, and communication methods involved.

Publications were, by far, the most important means of disseminating research findings in the Project. A complete list in included in **Annex 4**. These included.

Commissioned Papers	6	titles
Research Reports	21	titles
Bibliographies and Compendiums	3	titles
Monographs	3	titles
Manuals	8	titles
Field Handbooks	2	titles
Winrock Handbooks	3	titles
Technical Series	2	titles
Special Reports	21	titles
Proceedings	11	titles
Newsletters	8	volumes
Research Bulletins	9	issues
Progress Reports	8	titles
Other	13	titles

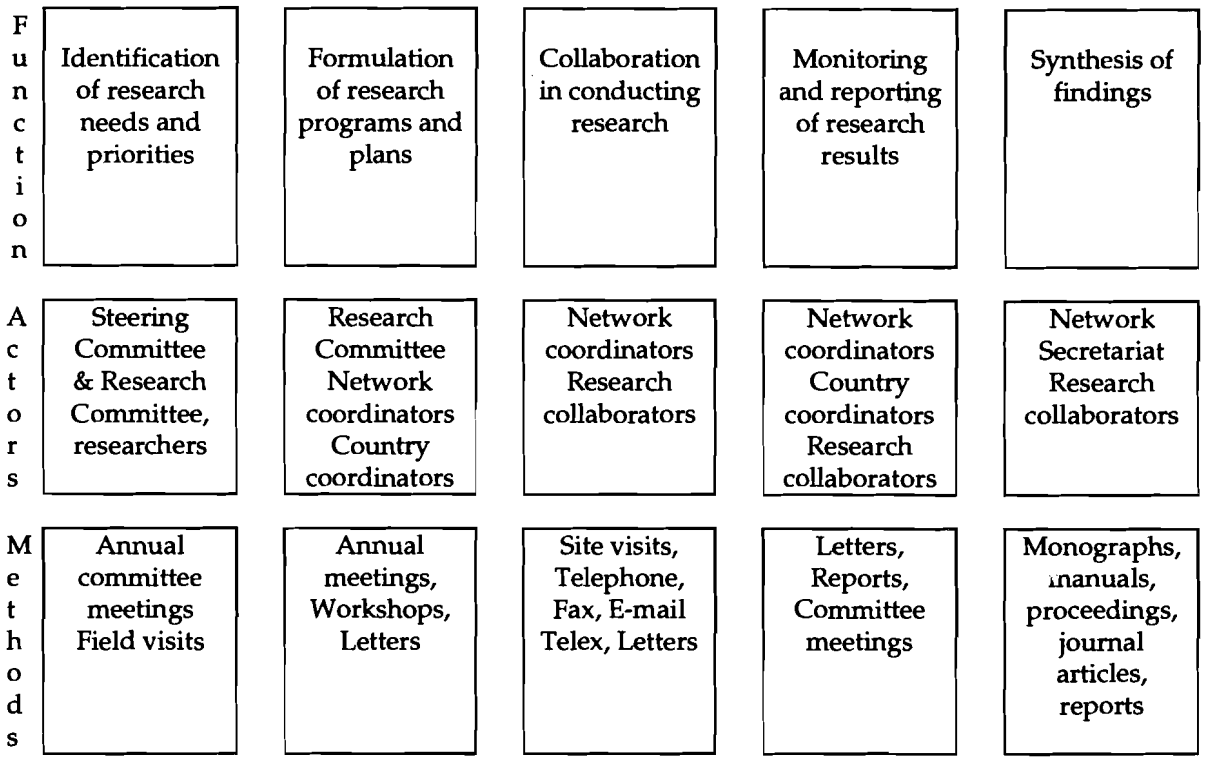


Figure 2. Components in the information support system of the MPTS Research Network

To give a better idea of how these publications contributed to key program areas of the Project, a rough content analysis can be found in **Table 5**. Note that the distribution of effort in the *action* and *process* areas were distributed fairly evenly.

3.4.2.1. Farm Forestry News

Farm Forestry News, F/FRED's quarterly newsletter, was distributed since 1986 to researchers, development workers, and policy makers in over 90 countries worldwide. It included summaries of Project research in the biological and social sciences, including data analysis of multilocational experiments, results of marketing studies, and case studies on the trees preferred by small farmers. The newsletter also provided a forum for scientists to express their views on problems related to MPTS research.

Publications intended for global audiences were prepared by the publications staff at the F/FRED Project Management Office in Arlington, Virginia.

Publications intended primarily for distribution in Asia are prepared and distributed by the publications staff in Bangkok. At the national level, F/FRED supported national MPTS meetings, proceedings, and publication of newsletters.

3.4.2.2. Research publications

Working papers, reports, monographs, manuals, handbooks, compendiums, species bibliographies, and research bulletins comprised the Network's MPTS research series. These publications were directed at a select group of biological and social scientists in the MPTS Research Network. A technical series, which focused on tree improvement and modeling, appealed to scientists with specialized interest in these areas. Theme workshop proceedings covered a wide range of topics, from problems associated with the leucaena psyllid to application of the social sciences in Asian forestry curricula. These books reached scientists throughout the world and are occasionally used as supplemental reading materials in university courses in both developing and developed countries.

3.4.2.3. Extension publications

During the last two years of the Project, an intensified effort was undertaken to repackage information into forms more easily used by extension personnel working directly with farmers.

A manual entitled *Growing Multipurpose Trees on Small Farms* (F/FRED Manual No. 6) was produced in 1992 and had an enthusiastic response in the Asia region. In Thailand, Peace Corps used it as a standard text for its volunteers in rural areas. In 1994, a revised edition was released to update and expand technical content and to improve the format of presentation for field workers. The revised version is being distributed to a diverse audience.

Other publications for outreach purposes included the *MPTS Research Notes Series* (Annex 4). A prototype of a production manual on *Acacia mangium*, which integrated investment decision-making issues with technical aspects, was prepared. Since the Project ended early, this effort is being carried out by others in the region.

Table 5. Content analysis of F/FRED publications

	Key Program Areas							
	Process Areas				Action Areas			
Categories of Publications	Network Development	Standardization of Research Methods	Strengthen Data Management	Training & Communication	Tree Improvement	Farm and Village Forestry	Multi-location Management Trials	Marketing and Economic Research
Papers	2	4	2		3	2	2	2
Reports	3	3	3	3	5	18	2	10
Bibliog. & Comp.	3	1	3	2	1		1	
Monographs		1	1	3	3	2	2	3
Manuals	3	5	4	2	3	1	3	
Handbooks	2	5	3	2	3	3	2	2
Technical Series		2	2		2	1	2	
Special Reports	13	4	5	9	4	7	3	3
Proceedings	8	8	8	3	8	6	9	5
FFN Articles	11	10	11	9	5	8	5	6
Bulletins	0	1	1		2	1	2	
Progress Reports	7			6	1			
Other	11	9	5	9	17	14	9	10
Total	64	53	48	48	57	63	42	41

* Individual publications may be entered more than once across *process* and *action* areas depending on content and scope of a publication.

3.4.2.4. MPTS Specialist Database for selective distribution

During the final 2 years of the Project, when funds were becoming scarce, a system for selective distribution of publications was initiated. Using the Specialist Database module of MPTSys and a revised mailing list, specialists in the region were identified based on, among other factors, their species interest, academic discipline, country, and position. This allowed the Network to target publications to specific people.

The Specialist Database has approximately 450 entries but needs continuous updating. This database, along with the remaining stock of publications, will continue to be managed by the MPTS Research Network for Asia based out of Kasetsart University.

Another innovation over the last year of the Project was to charge a nominal fee to recover the cost of publications requests after initial distribution to Network members. This has generated enough supplemental revenue for printing new publications. More importantly, this initiative will increase the chances that the MPTS Research Network will be able to sustain publication distribution after support from USAID and Winrock has stopped.

3.4.2.5. Public relations and administrative reporting

The Arlington office produced a publicity booklet describing the MPTS Research Network, which has been widely distributed in the region. Combined with the regular distribution of *Farm Forestry News*, this public information has helped convey a professional image of the Network.

Other public relations materials included videos, posters, brochures, annual reports, and project profiles. These were particularly useful during the start-up period and during international conferences.

It goes without saying that one of the most effective public relations tools has been the demonstrated dedication of Network members in participating countries. This is also reflected in the responsiveness of the Network Secretariat to regional problems.

3.4.3. Analysis of accomplishments and constraints

3.4.3.1. During life of the Project

Training and communication support was given high priority from the start of the Project. This effort was geared primarily to accomplishment of the research agenda, i.e., strengthening of research skills and reporting of scientific findings. The primary target groups were research managers and researchers themselves.

The training program of F/FRED successfully imparted skills in MPTS research from the proposal preparation stage through trial design, implementation, analysis, and reporting. The approach used by the training program, particularly roving courses and correspondence courses, was innovative and cost effective. The PhD program handled collaboratively with Michigan State University was also successful as five of the participants will have PhDs and one received a Master's Degree.

As the Project became more firmly established and a critical mass of research on both biological and social science aspects of tree production were achieved, interest moved increasingly toward synthesis and interpretation of research results. The result was a series of journal articles reporting results of the multilocation trials, and a monograph on *Acacia mangium* (F/FRED Monograph No. 3) with two others on *Acacia auriculiformis* and *Artocarpus heterophyllus* to follow. Also, in an attempt to reach extension personnel and foresters who have direct contact with farmers, the manual *Growing Multipurpose Trees on Small Farms* (F/FRED Manual No. 6) was prepared based on feedback from the field.

There is still a strong felt need for specific commodity or species production manuals that can be used to help make investment decisions based on local markets, availability of land and labor, site characteristics, availability of planting material, etc. An approach that looks at a species as a complete production system is needed so that potential investors (farmers and others) can analyze their risks and potential benefits. This approach also requires tight linkages with the private sector, which is very demanding in the types of technical information it needs for decision making.

3.4.3.2. Sustainability

Network-sponsored training will likely cease with the termination of the F/FRED project. Despite this, mechanisms initiated by the Project will continue

to provide training opportunities. Examples include COGREDA, subsumed by UPM, and the Neem Network, which will provide training funded by DANIDA on seed collection and handling and experimental design. Regional training on MPTS will probably be part of ICRAF's expanded program in SE Asia.

Mechanisms are now also in place to continue distribution of network publications from Kasetsart University in Asia and from USDA and Winrock's *Agribookstore* in the U.S. Publications will continue to be sold to recover costs and make reprints as necessary. ACIAR is funding production of a second edition of the *Acacia mangium Growing and Utilization* monograph (F/FRED Monograph No. 3) which will be distributed by COGREDA. Also RECOFTC has agreed to distribute the proceedings of the Workshop on Marketing of MPTS.

4. Action Areas

4.1. Tree improvement

4.1.1. Overview

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

Breeding efforts must address the marketing opportunities and/or home uses so that desirable products can be harvested by farmers from the seedlings they plant. Breeding efforts must also address the need of farmers to fit the commodity into their particular farming system. Traditionally, plant breeders emphasize the former task, and leave the latter to extension and systems researchers. This has not always proved successful.

4.1.2. Farmer-based tree breeding objectives

To guide the process of defining MPTS breeding objectives, an interdisciplinary study was conducted by 16 Network scientists in 1989 (F/FRED Special Report No. 18). The purpose of the study was to determine farmer perceptions of tree ideotypes for uses. Four categories emerged:

Timber. Timber was the most important end use identified by the study participants. The most important characteristics for timber species were:

- a long straight bole with no branches up to a minimum height of 3 m; and
- good wood quality (depending on the market demand).

Fruit and Food. Survey participants preferred the following traits:

- medium to large crown with many branches high on the stems;
- a single, straight, clear bole with no branches low on the stem;
- a deep taproot to withstand strong winds, bind the soil and improve the infiltration capacity of the soil; and
- good response to management (pruning/lopping) through quick and profuse regrowth of branches/leaves without reduction in fruit yield.

Fuelwood and Fodder. For fuelwood, participants generally preferred an ideotype with:

- a large crown with many branches;
- single or multiple straight, clear stem(s) up to a specified height;
- ability to regenerate quickly after lopping; and
- manageable canopy to avoid excessive competition with other crops.

The same criteria as above are also held for fodder, with the following additional characteristics:

- shorter periods of leaflessness; and
- improved production and quality of fodder.

Natural Forest Tree Species. Farmer participants also identified desirable traits in natural forest tree species for tree breeding objectives. These included:

- deep rooting to withstand storms and hold the soil;
- thornless or reduced thorniness;
- vigor in establishment and after lopping; and
- resistance to insects and diseases.

4.1.3. Systematic tree improvement

Generally, breeding MPTS follows the same process as other trees (refer to F/FRED Technical Series Vol. 2):

- screening for the correct species and/or seed origin of a species for a given area;
- studying and testing the variability within a species;
- incorporating desired trait(s) into improved planting stock;
- producing sufficient quantities of improved planting stock; and
- developing and maintaining a suitable genetic base for future generations of improved planting stock.

In the F/FRED Project, the greatest constraint to developing a tree improvement program was time. Given the long delay for many MPTS between planting and maturity, it is unrealistic to expect an eight-year project to develop and maintain a self-sustaining improvement program that would, by itself, cover all five stages of tree improvement. Therefore, from the beginning, F/FRED worked collaboratively with other institutions, leading the effort when it was advantageous to do so, and deferring leadership and/or participation when it was not. Above all, the issue of sustainability of effort after F/FRED was emphasized.

Table 6. List of MPTS species included in F/FRED-sponsored tree improvement activities.

	Activity*					
Species	TBO	SC	VC	PT	PSS	SO
Leucaena leucocephala			x			x
Dalbergia sissoo	x	x		x		
Acacia auriculiformis	x	x	x	x	x	
A. mangium	x		x			
Artocarpus heterophyllus	x	x	x			
Azadirachta indica	x	x		x		
Casuarina equisetifolia		x	x			
C. junghuhniana		x				
Gmelina arborea		x				

* **TBO:** tree breeding objectives, studies of farmer use, and marketing; **SC:** F/FRED-sponsored seed collections and exchange; **VC:** inclusion in multilocation variety x management trials; **PT:** multilocation provenance trials; **PSS:** provenance seed stands; **SO:** seed orchards of improved seed

During its life, F/FRED participated in improvement work with numerous species and collaborators. The species list (Table 6) represents a wide range of MPTS types, all of which are in varying stages of development. For some of the species, breeding work was well advanced elsewhere, and F/FRED assumed a

minor support role. For other species, coordinated breeding efforts were lacking, even in countries where the given tree was an important part of existing farming systems. In this case, F/FRED provided the leadership in initiating work.

It is impossible to fully report on every species represented in MPTS Network's tree improvement program. Relevant titles with detailed information may be selected in Annex 4. It is important, however, to present a few examples that illustrate the range of activities covered by the Network.

4.1.3.1. *Artocarpus heterophyllus (jackfruit).*

Analysis of the six-country study of Farm and Village Forestry (FVF), conducted in 1989, revealed commonalties and differences in how farm households in Asia currently obtain and use tree products. Growing out of this, a seven-country survey of farmers' tree-breeding objectives was published. The findings confirm that multipurpose food trees form a major category of MPTS, and among these, *Artocarpus heterophyllus* was selected for further study.

However, soon after selecting this species, it became apparent that defining breeding objectives was a major constraint for a Network approach. Use of jackfruit varies widely by country. Although it is used as a marketable fruit almost everywhere, the species has value for other uses that sometimes overshadow its importance as a fruit species. These include vegetable and seed production for local and export markets, wood for manufacture of guitars and furniture, fodder and medicine (from leaves), fuelwood, and green manure.

Before collection and breeding work could begin, information was needed on uses of tree products and the status of varietal descriptions already existing in the countries where jackfruit is important.

Pilot projects in the Philippines yielded the following publications.

- a review of literature on the biology, production, and utilization of jackfruit and ongoing research in the Philippines (F/FRED Monograph Series No. 1)
- a summary of jackfruit production, marketing, and user groups in the Central Visayas (F/FRED Special Report No. 18)

A documentary survey of jackfruit biology, production, and utilization in Sri Lanka was also conducted by H.P.M. Gunasena (F/FRED Monograph Series No. 2). This was followed by a field survey of distribution and local utilization

patterns of several *Artocarpus* species and by collection and analysis of jackfruit germplasm in Sri Lanka.

Other results of the jackfruit network include unpublished reports on wood yield in Bangladesh, literature reviews on biology and tree improvement in Bangladesh, a review of varietal improvement in the Philippines, and the uses of jackfruit in the Philippines. These reports and others will be synthesized in a refereed journal article under preparation as of the date of this report.

4.1.3.2. Azadirachta indica (neem).

As neem begins to receive international recognition, farmers and landowners the world over have begun to ask for improved seed and seedlings to plant on their land. Unfortunately, these are not available at the present time. In 1992, the research community had yet to begin the much needed task of selecting and breeding superior germplasm.

The importance of neem as an MPT and lack of progress on its improvement prompted establishment of the International Neem Improvement Network. This network was formed during an International Consultation on Neem Improvement sponsored by F/FRED, FAO, CIRAD-Forêt and DANIDA. The workshop brought individuals working on neem in Africa and Asia together to exchange seed and information. Before this, there had never been a successful international collection of neem from its naturalized range or a systematic exchange and evaluation of provenances (F/FRED Proceedings No. 11).

Participants made recommendations for neem seed collection, handling, and exchange. They also developed guidelines for establishing international provenance trials. Finally, there was a discussion of technical constraints in exchanging neem seed and establishing international provenance trials. Though provenance trials are a necessary first step, it was felt that complementary research was also needed to help researchers maximize their effectiveness.

The results of this first meeting were to 1) exchange results of research related to genetic improvement, 2) plan for seed exchange among Asian countries and with Africans, 3) plan a set of international provenance trials and 4) identify priority supplemental studies.

The work plan for seed exchange developed during the conference was implemented as a pilot case, and valuable experience was gained. Seed was

exchanged among five countries in Asia and shipments were sent to Africa and Central America from Thailand and India.

A follow-up consultation on neem was hosted by ICFRE in India. This took place in February 1994 and built upon the base set the year before.

4.1.3.3. *Acacia auriculiformis.*

Acacia auriculiformis, native to Australia, has been widely planted in Asia for wood products (fuelwood and pulpwood), soil conservation (N-fixing, soil erosion) and amenities (shade, ornamental). The Australian Tree Seed Centre (ATSC) has played a lead role in promoting and improving of this species. In September 1988, the ATSC undertook a collection of this species in Papua New Guinea and northern Queensland with financial support from F/FRED and other partners (F/FRED Report No. 4).

Using 25 provenances of this collection, 12 Network trials were set up in collaboration with eight Asian institutions and the Forest Department of Zimbabwe. Financial support for the trials was provided by F/FRED, ACIAR, FINNIDA, and GTZ. The objectives of the trial were to 1) determine superior provenances; 2) provide a genetic basis for selection and improvement, and 3) yield data for intersite analysis for growth simulation modeling.

Results of the trials through the third year have been published by F/FRED and others in conference proceedings and journal articles (Annex 4). A compendium of 15 published papers arising from this activity was assembled by the Network Secretariat and distributed to all participants involved in the *Acacia auriculiformis* network.

By the third year of the trials, it became clear that the Queensland provenances were superior. Further, independent studies in India demonstrated large differences between Queensland material and inbred local landraces that have arisen out of repeated seed harvest from inferior trees. As a result, F/FRED helped support further collection by ATSC from the Queensland provenances and, through *Farm Forestry News,* solicited interest for the establishment of provenance seed stands. So far, seed for 20 of such stands have been shipped by the ATSC.

Strong interest in continuing the trials has been demonstrated by CSIRO and its Asian partners who will continue to make selections for improvement.

Further, inter-site analysis for the third-year data is underway at CSIRO and should yield valuable information for extension of the Queensland provenances to other sites.

4.1.4. Vegetative propagation

In 1988 the F/FRED Project funded a subcontract with Plantek International of Singapore to assist in application of tissue culture technology to the growing of multipurpose trees. Early progress was rapid and satisfactory. Tissue culture protocols were developed, clonal stock was acquired, and tissue cultured plantlets were produced. The subcontractor experienced difficulty in acquiring sufficient quantities of uniform, viable stock for several of the selected species and in shipping plantlets across international borders.

Little progress was achieved in the field trial phase of the subcontract with the result that economic analysis of the experimental treatments did not occur. Further problems were encountered when Plantek changed ownership and reorganized. As a result, the subcontractor was unable to negotiate implementation arrangements with four of the five countries where outplantings were to be made.

In response to continued interest in vegetative propagation, the Project published a set of guidelines on propagation of tropical tree species by stem cuttings (F/FRED Report No. 21).

4.1.5. Application of research results

4.1.5.1. Provenance trials

The project achieved major success with its series of multilocational provenance trials. F/FRED-sponsored seed collections of *Dalbergia sissoo, Acacia auriculiformis, Casuarina equisitifolia, C. junghuhniana,* and *Azadirachta indica* were all planted in trials conducted in collaboration with several other donors and numerous regional collaborators. As these trials age, they will provide valuable genetic resources for future improvement work on these species in the region.

4.1.5.2. Seed production areas

The F/FRED-funded leucaena seed production program began in 1989 through a contract with NFTA and the University of Hawaii. In five countries, the program

established seed orchards of psyllid-resistant genotypes that also showed good growth and form. Orchards in Indonesia, Philippines, Taiwan, India, and Thailand are now producing seed for use in research and farmers' fields. The Network Secretariat provided sizable quantities of the *Leucaena leucocephala* K636 seed to farmers and farmer groups. Associated with this effort, the publication *Guide to Management of Leucaena Seed Orchards* (F/FRED Field Handbook No. 2) was produced. This has been in high demand for training courses in the region and for personal reference.

Seed of the best Queensland seed origins in the Acacia auriculiformis provenance trials have been shipped to 20 collaborating NGO, and government institutions for provenance seed stands. This project, which is being implemented jointly with FORTIP and CSIRO, is expected to vastly increase the growth and production of this important MPTS, especially in India.

4.1.5.3. Psyllid resistance

An international workshop reviewing state-of-the-art knowledge on control of the leucaena psyllid, a serious insect pest that caused massive damage to leucaena throughout the region, took place in Bogor, Indonesia in January 1989. The proceedings of this workshop (F/FRED Proceedings Series No. 5) has been widely distributed in the region. An F/FRED supported program of research on the leucaena psyllid commissioned 23 studies in four coordinated national programs in Malaysia, Philippines, Republic of China (Taiwan), and Thailand. Most studies were completed by the end of 1990.

4.1.6. Analysis of accomplishments and constraints

4.1.6.1. During the life of the Project

Tree improvement projects are difficult to implement in the best of circumstances. The F/FRED Project had its share of failures. Finding commonality with research priorities proved especially difficult in the early days of the semi-arid Network. Even when such issues were resolved, others arose when the plans moved to the implementation phase. Problems with timely seed harvest and shipment cropped up repeatedly. Despite agreements made at planning conferences, nursery practices and data collection methodology differed from site to site.

Through experience, F/FRED streamlined its procedures to the point where they became almost routine. For example, the 1993 neem collections were conducted by eight cooperating national institutions, supported financially by five donors. So successful was this collaborative approach that several bilateral institutions used Network services to facilitate tree collections and shipments.

Lessons learned. First, it is necessary to be inclusive when developing a multilocational trial. Some of the biggest failures were brought about by relying on large national research institutes to the exclusion of smaller, local ones. Some of the greatest successes were accomplished by under-funded staff of small universities. Another advantage of the inclusive approach was that it surmounted funding problems. A package of many donors, each with a small financial input, is easier to assemble that one with one or two donors.

Second, it is imperative to operate from a position of felt need and mutual ownership. If a network trial truly services its partners, it allows them ample opportunity to define their research objectives. The key is dialogue and opportunity for comparison of results and experiences.

4.1.6.2. Sustainability

F/FRED's tree improvement program will continue after the Project ends. A few examples of the successes include:

- *Azadirachta indica.* FORTIP, DANIDA, and FAO conducted the second neem meeting in Jodhpur, India with their partners in the national programs. Further collections are planned for 1994 and 1995, with no further F/FRED participation.
- *Casuarina equisetifolia.* This series of multi-locational provenance trials has been subsumed by CSIRO, who will make remaining payments.
- *Acacia auriculiformis.* Provenance trials are being continued by the respective national programs. The effort will be coordinated by COGREDA and FORTIP.
- *Dalbergia sissoo.* FORTIP's ongoing work will build on F/FRED's experiences. More collections and seed exchanges are likely. Meanwhile, NFTA is publishing a manual which should support improvement work.

The popularity of these trials indicates clearly that tree improvement is a strong research interest throughout the region. The F/FRED tree improvement

trials and the methodology used to implement them have been important contributions.

4.2. Multilocational management trials

4.2.1. Overview

The objective of the multilocational management trials was to carry out intersite analysis of how various management treatments influence different genotypes under different environmental conditions. The trials assessed leaf and wood biomass and, in some cases, tree form. Climate and soil characterizations provided the basis for selecting variables used in interpreting site x species interaction.

4.2.2. Arid and semi-arid zone trials

Species management trials in the arid and semi-arid zone, most begun in 1989, tested five priority species: *Acacia nilotica*, *Dalbergia sissoo*, *Eucalyptus camaldulensis*, *Prosopis cineraria*, and *P. pallida*. Each trial site also includes a locally-selected species.

However, from the time of establishment to the appointment of a Network Specialist for the Arid/Semi-arid Network in 1992, there was insufficient coordination or follow-up to the trials. An unpublished consultancy prepared by H.P.M. Gunasena in December, 1990, found major problems with the program. Poor establishment in many sites related to exchange of non-viable seed, poor nursery management and outplanting methods, and failure to adhere to agreed experimental protocols.

A meeting of the principal collaborators was held in Kandy in September, 1991 to review the situation (Table 7). At the meeting, it was decided that the program could be continued provided a Network Specialist could be appointed as per the staffing list in the Phase 2 Project outline.

Table 7. Sites in the arid and semi-arid Network trials.

Site	Cooperating Institution	Date Planted
Semi-arid trials		
Madurai, India	Madurai Kamaraj University	December 1989
Hyderabad, India	ICRISAT	August 1989
Dulapally, India	Indian Forest Service	August 1989
Delhi, India	Tata Energy Research Institute	August 1989
Butwal, Nepal	Forest Research Division, Nepal	July 1989
Dang, Nepal	Institute of Forestry, Nepal	August 1989
Rampur, Nepal (2 sites)	Institute for Ag. and Animal Sc.	September 1989
Sialkot, Pakistan	Pakistan Forest Institute	March 1990
Pubbli Hill, Pakistan	Punjab Forest Institute	March 1990
Badulla, Sri Lanka	Forest Department, Sri Lanka	
Arid trials		
Pune, India	BAIF Development Research Foundation	July 1990
Annanthapur, India	Indian Forest Service	July 1990
Tandojam, Pakistan	Atomic Energy Research Center	January 1991
D.I. Khan, Pakistan	Pakistan Forest Institute	January 1990
Faisalabad, Pakistan	Punjab Forest Institute	March 1990
Islamabad, Pakistan	National Agricultural Research Center, Pakistan	July 1989

It took nine months to fill this position. In late 1992 the newly-appointed Network Specialist visited all but one of the active trial sites and found 6 of the original 11 in the semi-arid zone worth continuing. In the arid zone, 3 of the 6 trials were performing satisfactorily. In early 1993, the Steering Committee decided to continue support. Funds were provided through a series of PSAs issued in late 1992 and early 1993.

Unfortunately, USAID budget cuts necessitated the early termination of the PSAs and the untimely departure of the Network Specialist in mid-1993. As a result, no suitable analyses and publication of this work could be completed.

4.2.3. 1987 Humid/subhumid zone trials

The first set of international Network field trials began in 1987 (F/FRED Manual No. 2) with cooperators in five Southeast Asian countries. These species x management trials aimed at improved knowledge of species' site requirements, growth rates and yields, and responses to three management regimes. They have also provided an impetus for developing standardized research methods

(F/FRED Manual No. 5), and a basis for creating seed production areas of known genetic quality in each participating country.

A summary of the 18-month data of eight of the sites was presented in *Farm Forestry News* (Vol. 4, No 3). In the combined analysis, there was strong species x site interaction that was not explained by soil moisture type (udic, or wet, vs. ustic, or drier) alone. It was expected that subsequent data collection and analysis would clarify this interaction.

An unpublished intersite analysis of data from the final 36-month measurements of these trials was distributed to trial participants in early 1994. The study compared the biomass responses to pollarding and pruning treatments for two genotypes each of *Leucaena* spp., *Acacia mangium*, and *A. auriculiformis*. At most of the wetter (udic) sites, the acacias outperformed the leucaena genotypes (Table 8). Among the relatively drier (ustic) sites, the acacias also showed better growth on generally less fertile (shallow, poorly or excessively drained, low base content) soils. On the ustic sites, where base content was sufficient, the leucaena genotypes generally did as well as the acacias.

Table 8. Total wood weight (kg) at 36 months in the 1987 Network trials, for the interaction between sites and genotype at udic sites.

Site	Aur_PNG	Aur_QLD	Man_PNG	Man_Qld	Hyb_KX3	Div_156
Serdang (Malaysia)	11.1 (1.7)	10.5 (1.7)	10.2 (1.7)	5.6 (1.7)	2.0 (1.8)	2.7 (1.8)
Dramaga (Indonesia)	10.6 (2.0)	10.2 (2.0)	16.1 (2.1)	14.0 (2.0)	2.2 (2.1)	1.7 (2.0)
Cikampek (Indonesia)	13.0 (2.0)	14.7 (2.0)	15.3 (2.5)	19.6 (2.1)	2.2 (2.0)	1.8 (2.9)
Hengehum (Taiwan)	17.5 (1.7)	17.5 (1.7)	12.7 (1.7)	10.9 (1.8)	7.2 (1.8)	9.7 (1.7)

Values indicate means; values in parentheses represent ± SE, using least squares means.
Aur = *A. auriculiformis*, Man = *A. mangium*, Hyb = leucaena hybrid, Div = *L. diversifolia*

In general, pruning did not reduce stem wood or foliage production, while pollarding resulted in smaller-diameter trees and lower final yields of wood and foliage. *A. mangium* did not tolerate pollarding, as expected. The results are being prepared for formal publication by staff of UPM and CIFOR.

Individual cooperators have also analyzed the results at their sites. Wood samples taken from selected sites are being subjected to chemical and physical analysis to check their suitability for pulp, paper, plywood, and other uses. In terms of the research process, these trials demonstrated the benefits of commonly collected soil characterizations, a common database for data storage and management, and identification of key variables affecting fuelwood and fodder yields. The trials also confirmed the need to determine the impact of species x site interaction and explain its sources through the use of minimum data sets.

4.2.4. 1991 Humid zone trials

A second set of humid zone trials, established on 33 sites in Indonesia, Malaysia, the Philippines, Taiwan (Republic of China), Sri Lanka, Thailand, and Costa Rica, tested two genotypes each of *Acacia auriculiformis* and *Leucaena* spp. Like the 1987 Network trials, the 1991 trials compared leaf and wood biomass produced by pruning and thinning treatments. In addition, the experiments assessed tree form and labor required for the cutting treatments at 12 and 24 months for use in cost-benefit analysis (F/FRED Manual No. 4).

For data exchange, all cooperators received the Experiment Database of MPTSys Version 3.0. Cooperators also received completed soil analyses for 27 sites conducted by the Department of Soil Science, Universiti Pertanian Malaysia, with assistance from staff of the Thai Department of Land Development and the Philippine Bureau of Soils. First-year data from 23 of the original 33 sites was received by the end of the project and is being analysed for publication by UPM.

4.2.5. Analysis of accomplishments and constraints

4.2.5.1. During life of the Project

Generally, the early multilocational management x species trials were not as productive as Network provenance trials. Possible reasons include underestimation of the amount of labor required to handle the management components of these trials, lack of general relevance of the management treatments, and the apparent difficulty in following management-related experimental protocols.

However, there was tremendous demand for participation in the 1992 humid zone trials; 33 sites were planted and characterized, and most of these produced

satisfactory first-year data sets. The 1987 humid zone trials demonstrated the need to consider sources of site x species experimental error in multilocational trials. The importance of fully site characterizing sites to explain this error was also confirmed.

The greatest constraint facing the trials, particularly the Arid/Semi-arid (ASA) Zone and the 1991 Humid Zone trials, was the uncertainty of USAID funding. A Network specialist was appointed too late in the day to influence the ASA trials; then the position was terminated even before the restructured project could bear fruit. Similarly, final payments on the 1991 Humid Zone trial could not be made because of budget cuts and early termination of the Humid Zone Network Specialist.

4.2.5.2. Sustainability

The issue of sustainability affects only the 1991 Humid Zone trials, since support for the other two was completed or ended during the life of the project. Unlike the provenance trials, a home has not been found for the 1991 trials. The loss of the 20+ sites, and the potential they represent for modeling site x environment interaction would be most unfortunate.

4.3. Farm and village forestry (FVF)

4.3.1. Overview

In 1988, a Workshop on *Standardized Methods for Farm and Village Forestry* was held in Kathmandu, co-sponsored by F/FRED, ICIMOD, IDRC and Tribhuvan University. Workshop participants identified priority topics for comparative research and listed the minimal social, economic, cultural and environmental information considered necessary for understanding local forest use and on-farm tree growing practices (F/FRED Special Report No. 2).

Based on a survey instrument that grew out of the Kathmandu workshop, a regional study was carried out in 1989 to survey farm and village forestry practices in 26 villages in 6 countries including Nepal, Bangladesh, Sri Lanka, Thailand, Indonesia, and the Philippines.

In 1991, the first analysis of the aggregate FVF data was published (F/FRED Report No. 16). Three broad patterns of FVF practices were identified: 1) the

pattern of usage and sourcing of tree products is largely influenced by the size of the farm; 2) homegardens are the most common on-farm locations for growing trees, followed by scattered trees in the crop fields; and 3) fruit and other food producing trees are an important category of multipurpose trees that has tended to be overlooked by researchers.

Subsequent analyses explored these patterns in more detail and looked at additional relationships between variables in the FVF dataset. Major findings are summarized below.

4.3.2. Examples of FVF findings

4.3.2.1. Roles of trees

The three main uses of trees were timber and construction materials followed closely by fuelwood and food. Fodder was a surprisingly distant fourth, followed by handicraft materials and charcoal and, at a much lower level, industrial materials and other residual-use categories (F/FRED Report No. 20). The top three species mango (*Mangifera indica*), coconut (*Cocos nucifera*), and jackfruit (*Artocarpus heterophyllus*), conventionally thought of as fruit trees, were, in the eyes of villagers, multipurpose trees in the truest sense of the word. Though one must be careful not to overgeneralize, these early findings showed that Asian farmers perceive not one but three major types of multipurpose trees: fast growing nitrogen fixing trees, multipurpose food trees, and local forest trees. Only the first of these has been given much attention by researchers.

4.3.2.2. Source of tree products

FVF studies found that the farm itself was by far the dominant source of tree products for household consumption, followed by off-farm forest and bush areas, and local markets (F/FRED Report No. 20). This finding suggests that farm forestry is very important in the actual procurement strategies of villagers in Asia. The level of support and attention it has received is less than deserved.

The source of tree products varied according to whether they were grown for home consumption or sale. Trees only plots appeared to be the production choice for commercially-oriented farmers, but scattered trees in crop fields also contributed substantially to commercial production. The homegarden was less

important as a source of tree products for sale than as the primary source of tree products for home consumption.

Another interesting finding of the FVF studies was that households with a higher percentage of their income from trees tended to come from lower wealth brackets. The reasons for this could be that trees tend to be a more important source of cash income for poorer households or that the amount of income derived from trees is small but constitutes a significant proportion of household income in poorer families.

4.3.2.3. Gender patterns

An analysis of the gender-disaggregated FVF data revealed that men were almost twice as heavily involved in tree products procurement as women in the FVF villages. Males accounted for 63% of all procurement activity as compared to 33% for women. This contrasts sharply with patterns in the division of labor in some parts of Africa, where women are responsible for most tree procurement activity (F/FRED Report No. 19).

There are country differences, however. South Asian women tended to have a bigger share in the collection of tree products than do women in Southeast Asia. Also, this pattern of greater male involvement did not apply equally to all tree products. Women tended to show greater equality with men in those areas of the household economy directly concerned with daily consumption needs (food, fuelwood, charcoal, and fodder). This is consistent with the priority women place on survival and domestic needs, a reflection of the roles conventionally assigned to them in traditional Asian villages as mothers, wives, and homemakers.

Men, on the other hand, showed clear predominance in the collection of timber, construction materials, and products for a wide range of other uses. However, gender specialization was far from absolute. Men were not excluded from collecting products for domestic consumption; in most countries, women were not excluded from involvement in the marketplace for tree products.

There was an interesting pattern of gender similarities and differences in terms of sources of supply of tree products frequented by men and women. On-farm sources were more important than off-farm sources for both men and women. But, as a rule, men were more likely than women to purchase tree

products from the market. As a result, government forests figure relatively higher as a sources of products for women than for men.

On the whole, the FVF data suggest that there is a great deal of complementarity between Asian men and women in supplying household needs. Any forestry extension program must recognize this while, at the same time, attempting to address the special needs of rural society as a whole.

4.3.3. Analysis of accomplishments and constraints

4.3.3.1 During life of the Project

Farm and village forestry has been the area of most sustained effort within the social science component of the F/FRED Project. Unfortunately, it has also been the area of activity most affected by discontinuity of donor funding. Disruption of funds during the middle of Phase 2 greatly handicapped an ambitious and fruitful program of research. As a result, programmed synthesis activities were truncated or dropped altogether. Nevertheless, the FVF program was a sustained effort in which a great deal of learning took place. In spite of the succession of setbacks, the FVF program has been judged, by Network participants, to be a very useful and productive activity.

4.3.3.2 Sustainability

Unlike some other activity areas, there is no network positioned to take up the FVF program. Nonetheless, the impact of the FVF model will surely influence the way future interdisciplinary research is conducted in the region. By bringing biophysical and socioeconomic researchers together from around the region, F/FRED has helped focus MPTS research on the practical issues of feeding the family and generating income. We are beginning now to better understand how Asian farmers actually produce and use trees in their everyday lives. Also, by integrating social, economic, and biological research, we are now in a position to develop trees as commercial agricultural commodities rather than dwelling too much on their service role in conservation programs.

4.4. Marketing and economics studies

4.4.1. Overview

Economic studies in Phase 1 focused on two areas: 1) economic evaluation of tissue culture as a method of propagation for MPTS, and 2) development of a methodology for analysis of fuelwood markets. In Phase 2, the Steering Committee emphasized marketing of MPTS products. In response to this mandate, the Network Secretariat in Bangkok commissioned a series of case studies and analyses of marketing research. This effort resulted in some small grants and culminated, at the end of 1993, in the marketing workshop described below.

Bioeconomics was another focus of activity in Phase 2, designed to help researchers use unconventional economic analysis to interpret the results of their own experiments. Due to staffing, financial, and conceptual constraints, little was accomplished in this sector.

4.4.2. Marketing studies

Surveys of market linkages and user groups involved with jackfruit in the Central Visayas region of the Philippines is an example of applied market research to improve MPTS production. Together with other F/FRED-funded marketing studies, there was a basis for fostering research in the region on marketing MPTS products.

The *International Workshop on Marketing of MPTS Products* was held in Baguio City, Philippines December 6-9, 1993. The F/FRED Project was joined by the Ford Foundation, IDRC, APAN, FTPP, RWEDP, and others to host this event. Workshop sessions on industrial markets reflected the natural division between markets for medium and large-scale industry and small-scale industry. This was followed by a session on how farm forestry markets have affected the course of rural development in India, agroforestry in the Philippines, and non-timber forest products in Nepal. The final paper session went beyond the analysis of existing market situations to highlight innovative approaches to market development.

A common theme throughout the workshop was the counterproductive role of government regulatory actions, which, in an attempt to conserve forest

resources, often serve to intensify illegal exploitation of forests by making legal harvest, transport, and marketing of their own wood difficult for private producers.

One of the most important recommendations was to gear smallholder production to the needs of the marketplace from the start, rather than attempt to market ill-matched products after they have been harvested. The methodology exists for conducting market surveys to identify the right types of products before tree planting begins. No amount of marketing studies, however, will relieve anyone of the responsibility to actually market products when the time comes.

Many workshop participants felt that the traditional taboo against mixing public sector projects and/or research with private sector business has created a distorted approach to economic development. Perhaps this workshop will be best remembered for the examples it provided of the marketing activities of non-government individuals and other public-spirited entrepreneurs who are able and willing to operate in both sectors simultaneously to the greater benefit of all.

4.4.3. Analysis of accomplishments and constraints

4.4.3.1. During life of the Project

Due to shifting responsibilities within the Network Secretariat, only one of the two focus areas was brought to a systematic conclusion, i.e. marketing. The study of MPTS marketing was the main, clearly mandated task given to F/FRED in the economics area and accomplishments have been substantial. Perhaps the main shortcoming of the overall F/FRED effort in economics was that concerted action on marketing research did not start earlier than Phase 2.

4.4.3.2. Sustainability

The past decade saw considerable progress in new approaches to tree growing and forest management by rural people. However, no systematic understanding of the process of marketing multipurpose tree products had been achieved until F/FRED became active in this area.

Little of the existing experience with marketing farm and village forestry systems in Asia has been documented. The studies that F/FRED commissioned and organization of the first ever International Workshop on the Marketing of

Multipurpose Tree Products were instrumental in sharing the Asian experience with others.

There is a general international consensus that a major focus on marketing of trees and tree products is long overdue. Through its initiatives, F/FRED has been able to give impetus to efforts aimed at developing a more complete and systematic treatment of marketing issues in forestry and tree farming. For example, RECOFTC held a marketing training course in April, 1994 utilizing many of the materials presented at the F/FRED marketing workshop. Also the regional office of FAO is planning a forestry marketing conference in 1995. The coming decade should see substantial progress, building upon the foundation that F/FRED has laid.

5. Evolving Partnerships—Future Options

The examples presented in this final report validate the original hypothesis of the F/FRED Project—that networking is an efficient way to conduct multidisclipinary forestry research in South and Southeast Asia. Among the related bilateral and multilateral projects in the region, F/FRED stands alone in achievement in fostering international cooperation in coordinated forestry research. This has been due to several truths that have guided the Project from the beginning:

- Scientists tend to work together most effectively when there is a professional vested interest to do so. Funding incentives alone do not guarantee success;
- Inclusion rather than exclusion of many partners desiring to participate is a more effective and productive approach; and
- Research must be multidisciplinary; there must be a dynamic balance between the social and technical sciences.

As the F/FRED Project neared its termination date, there was a growing concern that the efforts started would not be sustained. Although parts of the Project (e.g., provenance trials, publications) were subsumed by various institutions, the deeper issue was that the process of networking and the established structure of the F/FRED Project would fade. Discussion focussed on ways to incorporate F/FRED's methodology to enhance linkages between national, regional, and inter-regional forestry institutions, which all have their strengths and weaknesses.

5.1. National institutions

Traditionally, forestry research in South and Southeast Asia has been perceived as the responsibility of the formal research sector—ministries and bureaus,

universities, forest research institutions, and the like. However, as natural forests steadily decrease in area or are removed from production for other purposes (e.g., biodiversity conservation, watershed management), other sectors are emerging as research leaders or advocates of specialized research.

Foremost among these is the industrial sector, which is arguably the best and most productive group working in the area of tree improvement. Traditionally secretive and apart from the general research process, the industrial sector, particularly in South Asia, is rapidly forming production alliances with farmers and the marketplace to ensure adequate supply of woody raw materials.

As forestry moves from the closed natural forests and becomes commercially and production oriented, NGOs, farmer groups, and, most importantly, individual farmers and landowners are responding. Non-wood forest products and other products from perennial vegetation are increasingly valuable in local markets. New opportunities exist to link the private production sector with the industrial and government research sectors. Leadership will vary by country, but the most effective institutions for doing so will be those with active membership from all three sectors—producers, industry, and government. Although few of these now exist, the concept embodied in the MPTS Network's country committees comes close to the ideal in that a wide range of researchers are represented who meet regularly to discuss issues and plan research topics.

5.2. Regional institutions

One of the strongest regional forestry institution operating in South and Southeast Asia is FAO. Its two notable forestry research network projects—FORSPA and FORTIP—will continue well past the close of F/FRED. Despite their successes, their effectiveness has been limited by several factors. The first relates to the mandate of FAO itself. FAO is, in essence, an arm of its member governments. Advisory committee members of FAO forestry research network projects are invariably deputed from national research institutes, ministries, or universities. Other sectors (NGOs, industry) may be allowed to participate, but not as advisors. Secondly, these projects, like F/FRED, are limited in duration by their very nature. Lack of continuity in funding, which plagued F/FRED in its final years, is also felt by FAO projects.

CGIAR institutions have traditionally played a strong role in networking agricultural research, and the same could apply to forestry and agroforestry research. The SE Asian office of ICRAF is currently formulating networking activities in MPTS research that could well subsume portions of the F/FRED project.

Other regional players include various bilateral institutions from developed countries. Notable among these are the two Australian research agencies, CSIRO and ACIAR, the DANIDA Forest Tree Seed Center, and OFI. These groups have distinguished records of accomplishment, particularly in the area of species introduction and tree improvement. There is much to be gained from careful study of their operating methods. However, these agencies generally operate directly with national agencies. Except for theme conferences, there is little opportunity for their partners to come together to plan research programs among themselves.

Other institutions have a potential role to play. Among these are the various ASEAN-Canada forestry institutes funded by CIDA that are gathering strength and credibility. F/FRED's COGREDA is emerging as an independent association that could provide a good base from which to expand. INBAR, the IDRC-sponsored bamboo network, is just entering its Phase II activities.

In summary, many institutions that operate on a regional basis could be tapped to coordinate research programs. However, none by itself can claim outright ownership and management by the clients it serves—Asian forestry researchers. For a regional program to be truly effective, it must develop a framework in which all research sectors can participate as owners of the process.

5.3. Inter-regional institutions

Regional research coordinating capacity also exists in Africa and Latin America. Historically, FAO has been the most effective link between tropical regions. Its strength lies in its ability to gather and synthesize vast quantities of information from member countries. It also hosts consultations and meetings that are appreciated worldwide. Although a major restructuring process is forthcoming, the support role of FAO will continue to be paramount.

IUFRO is another international body whose main function is research coordination and networking among its members. It is an extremely viable

institution in the temperate regions yet, in the tropics, membership is declining as more and more institutions opt not to pay their dues. Reasons for this are not clear, but are of major concern to the leadership of that institution.

The CGIAR has recently branched into forestry, and the opportunity for further expansion from its traditional agricultural role provides a good prospect to network tropical forest scientists. Similarly, various sectoral institutions (e.g., ITTO) and NGOs (e.g., CARE and Save the Children) operate internationally and are well-respected among their clientele.

Thus, adequate institutional structure exists to coordinate and foster effective linkages between regional tropical forestry research institutions. Although such linkages are presently lacking, or are underdeveloped, the demand for them is great. It is inevitable they will emerge in the future.

5.4. Towards a pan-tropical network

The real challenge for the future is to link national research sectors in the tropics with regional research institutions in a manner that fosters inter-regional collaboration. This approach has yielded large dividends in the temperate countries, where formal and informal linkages between and among forestry researchers and their institutions abound. These have fostered rapid progress in tree improvement, modeling, silviculture, information processing, and countless other areas. Yet such inter-regional coordination and synergism has been less pronounced in the tropics.

In South and Southeast Asia, the F/FRED Project has provided a workable operational model that has been folded into the methodology used by other related networks. However, the participatory and inclusive nature of F/FRED's country and advisory committees is unique. Other projects would benefit by adopting such an approach—to the extent that their governing and funding bodies will allow. This change will foster an increased sense of ownership among participating research institutions. Such collaborative spirit can be formalized by creating a self-sustaining network of Asian research partners — governed by Asian forestry researchers from the private, industrial, and government sectors.

This partnership, and others like it in other regions of the tropics, could provide the pieces necessary for truly effective inter-regional coordination of

research efforts. If run correctly, these could emerge as the first stop for bilateral, multi-lateral, and mentor organizations searching for research partners. FAO and the CGIAR could play leadership roles in establishing and linking these regional networks. But the ideal home for this is IUFRO, provided it can reverse the growing perception that it primarily serves the interests of temperate foresters. Certainly, there will be resistance to change in IUFRO's governing structure. However, to incorporate the growing capability of tropical institutions to conduct quality research, some structural change will be required. If that does not happen, the only other option will be to create a separate, formal or informal tropical version of IUFRO.

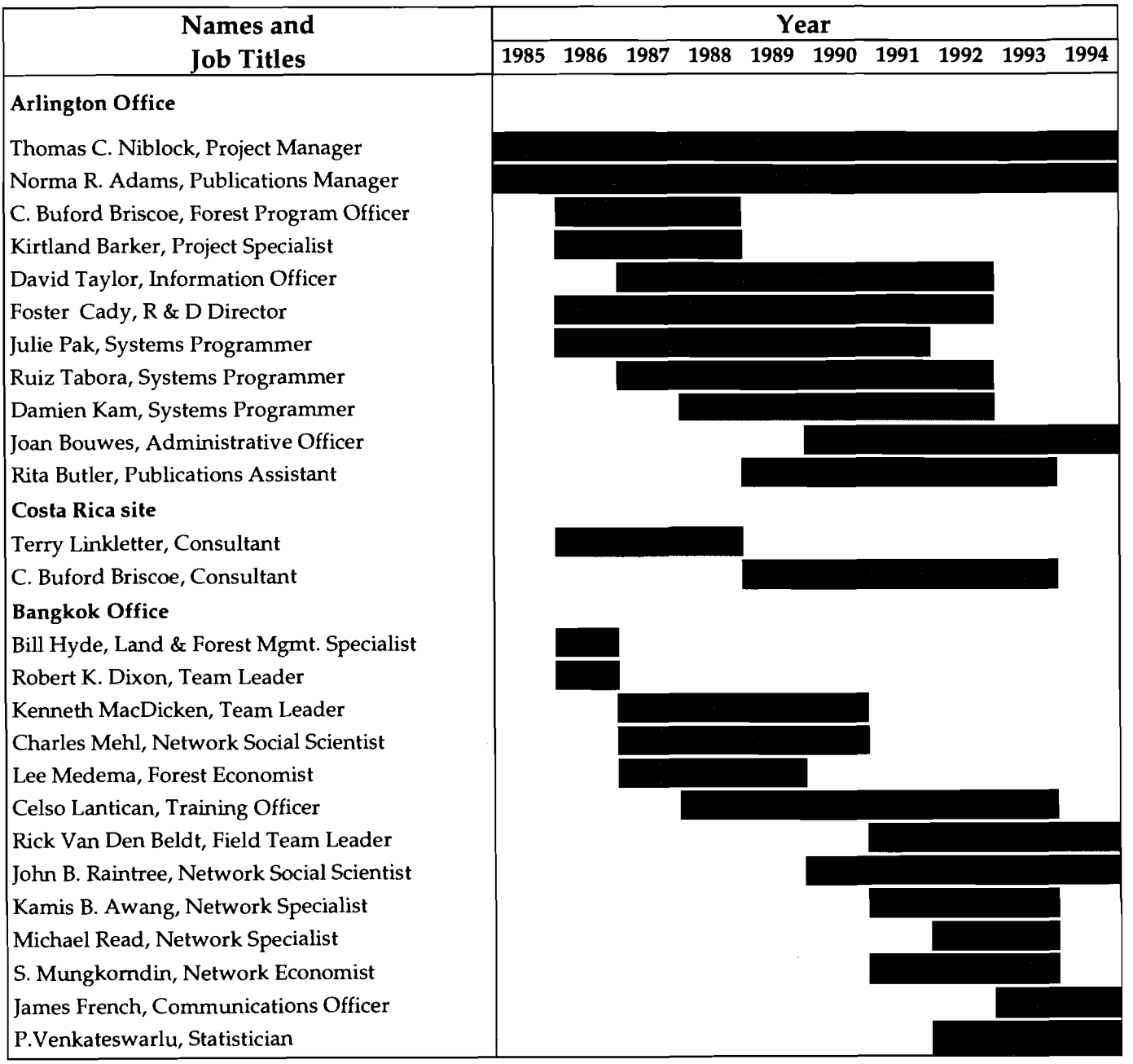
Annexes

1. Project personnel
2. Administrative framework of the MPTS Research Network
3. Farm Forestry Project overview
4. Publications of the MPTS Research Network
5. Representation of MPTS Research Network participants in F/FRED sponsored meetings
6. Network institutions

1. Project Personnel

The listing of Project personnel here is designed to give an idea of the scope of expertise that was involved in the program activities. Not all the short term consultants and recipients of Personal Service Agreements (PSAs) are included since this level of detail is beyond the scope of this report.

Long term specialists



Project Consultants

Consultant	Task
Martha Avery	Handbook preparation
William R. Bentley	Handbook preparation
James Bethel	Study of related networks
Douglas Boland	Network trials preparation
Franklin Bonner	Seed processing and storage, Pakistan
James Brewbaker	Workshops, conferences work
William Burch	Handbook preparation, curriculum activity
Robert Callaham	Course of forestry research management
M. G. R. Cannell	Handbook preparation
Brian Carson	Land use survey seminar, Nepal
Dean Current	Agroforestry seminar, Burma, Socioeconomic data mgmt..
Alan Ek	Biomass program
Dean Djerstad	Biomass program
Stanley Gessel	Study of related networks
Nancy Glover	MPTS tree improvement
John C. Gordon	Handbook preparation
James Hanover	Study of gums and exudates
Robin Harrington	Growth and yield modeling
Christine Haugen	Editing workshop proceedings
David Hughell	Forestry data management
William Hyde	Handbook preparation
Terry Linkletter	Forestry data management
Kenneth MacDicken	MPTS species study, workshops
Max McFadden	Psyllid research
Colin Matheson	Biotechnology studies
Lek Moncharoen	Soil characterization
Chin K. Ong	Handbook preparation
J. Kathy Parker	Handbook preparation, curriculum activity
Dietmar Rose	Information management systems development
Susan Riha	Growth and yield modeling
Uthaiwan Sangwanit	Mycorrhizae studies
Alice Spitzer	Library studies
Dale Withington	Editing workshop proceedings
Ronald Yeck	Soil characterization

Administrative Support Staff in Network Secretariat

Name	Position	Dates
Achara Maisuwannakul	Accounting Assistant	8/91 - Present
Apinya Chaivatanasirikul	Administrative Secretary	9/87 - 2/94
Atchara Jantrasaengaram	Computer Specialist	3/92 - 2/94
Chaloamporn Rangaratna	Administrative Secretary	4/88 - 6/92
Chedsada Thanakan	Clerk/Office Assistant	10/90 - 3/94
Damrong Intamara	Driver	3/87 - 3/94
Komson Kiangpradoo	Driver	6/86 - 1/93
Leela Wuttikraibundit	Publication Assistant	8/86 - Present
Nutchanat O-Charoen	Office Manager	9/91 - Present
Phatcharin Eiumnoh	Administrative Secretary	4/86 - 11/90
Sopapan Varasarin	Secretary	6/92 - 11/93
Suchada Meteekunaporn	Secretary/Receptionist	5/88 - 10/90
Supreecha Karnchanashas	Driver	1/87 - Present
Thongdee Thepmunee	Driver	2/93 - 2/94
Vilai Suansutjarit	Accountant/Office Manager	7/89 - 5/93
Wichan Preecha	Computer Specialist	5/91 - 1/92

2. Framework of the MPTS Research Network

Membership

Membership in the MPTS Research Network (hereafter referred to as the Network) shall be open to Asian Research organizations that have signed, or have expressed the intention of signing, a Memorandum of Understanding (MOU) or a Letter of Agreement (LOA) with Winrock International Institute for Agricultural Development.

Participation in the Network is open to any and all Asian institutions that are invited to attend meetings of the Network or exchange information with Network members.

Organization. The governing body of the Network is the Steering Committee. The Steering Committee shall oversee the activities of the Network through the Research Committee. The Network was formally established in early 1987 when six (6) institutions had signed an MOU or LOA.

Steering Committee

No.	Member	Term
1	Asian scientist with senior ranking in the International Union of Forestry Research Organizations	indefinite
1	Regional Forest Officer for Asia of the U.N. Food and Agriculture Organization	indefinite
1	Dean of the Faculty of Forestry, Kasetsart University	indefinite
2	F/FRED Network Specialists	one yéar, without vote
1	USAID-designated F/FRED Monitor for the country in which the Steering Committee meeting is being held.	one year, without vote
4	Representatives from the Research Committee, to include a biological and a social scientist from both the humid and Sub-humid Zone and the Arid and Semi-Arid Zone (one of these will be the Chairman of the Research Committee).	one year

Rules and Terms of Reference for the Steering Committee

The Steering Committee shall meet annually or as needed. The Steering Committee shall be called by its Chairman or by the Network Specialist at the F/FRED Coordinating Unit in Bangkok, Thailand.

The Steering Committee shall select its Chairman from among its members. The Chairman shall serve a one-year term.

Decisions of the Steering Committee shall be made by a majority of at least two-thirds of the voting members present at any meeting.

The Steering Committee may invite specialists to advise them as and when considered necessary.

The Steering Committee shall provide guidance and advice to the MPTS Research Network by:

- establishing policies and strategies
- planning Network activities
- guiding and assisting the Network Specialists
- promoting Network programs and activities
- approving annual Network progress reports
- encouraging the global sharing of information
- carrying out other functions as deemed necessary to implement the MPTS research program

Research Committee

The Research Committee is composed of Asian scientists from participating institutions. Each Asian country with participating institutions will be allowed representation on the Research Committee.

On alternate years, half of the countries with participating institutions will select two representatives to the Research Committee. In order to integrate the biological and social science disciplines on the Committee, one of these representatives must be a biological scientist and one must be a social scientist.

The selection process should be done in conjunction with National MPTS Organizing Meetings held in each country with participating institutions. Where this is not possible, selection will be done by the Chairman of the Research

Committee with consideration of the policies and procedures adopted by the participating institutions.

Non-voting members of the Research Committee include two Network Specialists from the Coordinating Unit and the USAID-designated F/FRED Monitor in the country where the Research Committee is meeting.

Rules and Terms of Reference of the Research Committee

The Research Committee shall report and be responsible to the Steering Committee. The Research Committee shall select a Chairman from among its Asian members. The Chairman shall serve a one-year term. The Chairman of the Research Committee shall serve a one-year term on the Steering Committee.

The Research Committee shall meet regularly as and when needed. Meetings of the Research Committee may be called by the Chairman of the Steering Committee or by the Network Specialists at the F/FRED Coordinating Unit.

Decisions of the Research Committee shall be made by a majority of at least two-thirds of the voting members present at any meeting. The Research Committee shall:

- plan research activities
- review and approve research activities
- coordinate research and other related activities
- ensure that standard methodologies are used in research and other related activities
- carry out any other functions as deemed necessary to ensure the success of Network activities

National Policies

The implementation of the MPTS Research Network shall take cognizance of national policies.

Changes to the Network

The Steering Committee may make changes in the Network as and when considered necessary.

3. Farm Forestry Project Overview

Goal

Increased worldwide supply of farm-grown and farm-managed trees, and, in turn, increased rural incomes, improved environment, reduced destruction of tropical forests, and added carbon storage

Purpose

To facilitate the widespread practice of farm forestry as a profitable enterprise for farmers in developing countries, primarily on private lands--farm woodlots, along borders, in homesteads, and in intercropping systems

Objectives

The principal objectives of the Project are threefold:

- Network development
- Transfer of skills and techniques
- Support services

Activities/Services

Types of Project activities and services include the following:

- Developing and operating international networks to facilitate an expanded practice of farm forestry; networks will include farmers, commercial and industrial users of tree products, NGOs, educational and research institutions, and forestry scientists
- Facilitating tree farmers' access to markets through linking with producer and market associations
- Supporting applied research across environmental zones to select and test tree cultivars suited for particular climates, soils, and pest conditions and to stimulate their adoption
- Producing and distributing improved seed material of farm-preferred tree species
- Facilitating establishment and care of fast-growing trees on farms and degraded lands through networks, extension programs, NGOs, and farmers' groups

- Providing educational, extension, and public information materials and training in farm forestry from cultural and business perspectives
- Developing and distributing relevant databases
- Providing links between international forestry centers, national forestry institutions, NGOs, and the private sector
- Supporting NGOs working with farmers
- Supporting USAID mission and other donor farm forestry activities, as requested, and other programs involving interface with U.S. forest, paper, and electrical power industries
- Developing multi-donor funding to complement Project activities
- Facilitating marketing and credit linkages
- Sponsoring entrepreneurship training courses to stimulate interest in farm-forest investment

Strategies

These strategies will guide Project activities:

- Flexible implementation responsive to local needs and conditions
- Establishment of links among farm forestry groups and industrial wood users
- Integration of biological and social disciplines
- Multi-purpose tree selection
- Seed production and distribution to small farmers
- Women's role as farm foresters
- Shaping farm forestry policy
- Stimulation of entrepreneurship among small farmers
- Markets, commercial utilization of MPTS, small enterprise development, income generation

4. Publications of the Multipurpose Tree Species Research Network

Papers

No. 1. *Feasibility Study on Tissue Culture for Multipurpose Tree Species.* Paiboolya Gavinlertvatana, A. Colin Matheson, and Eng Peng Sim. 1987.

No. 2. *A Regional Research Plan for Leucaena Psyllid Control.* Banpot Napompeth, Kenneth G. MacDicken, Max McFadden, and I.N. Oka. 1987.

No. 3. *Potential Impact of Biotechnology Research for Multipurpose Tree Species.* Wilfrido Cruz. 1988.

No. 4. *Feasibility Study on Small-Farm Production of Gums, Resins, Exudates, and Other Non-Wood Products.* James W. Hanover. 1988.

No. 5. *Socioeconomic Impacts of MPTS Biotechnologies on Small Farmers in Philippines, Nepal, and Thailand.* Charit Tingsabadh. 1989.

No. 6. *Using Social-Science Tools for Agroforestry Research.* John L. Marcucci. 1990.

Reports

No. 1. *Multipurpose Tree Species Networks for the Forestry/Fuelwood Research and Development Project: Recommendations.* Kenneth G. MacDicken, Michael R. Dove, James L. Brewbaker, and William F. Hyde. 1986.

No. 2. *The Status of Multipurpose Trees in Thailand.* Suree Bhumibhamon. 1987.

No. 3. *Multipurpose Tree Species Trials Data Compilation, Republic of the Philippines.* C. Buford Briscoe, Jocelyn M. Alcazar, and Paciencia A. Votacion. 1988.

No. 4. *1987 Seed Collection of Acacia auriculiformis from Natural Populations in Papua New Guinea and Northern Australia.* Brian Gunn, Maurice McDonald, and James Moriarty, compilers. 1988.

No. 5. *Agroforestry Practices in Selected Areas of Burma: Preliminary Recommendations.* Dean Current. 1988.

No. 6. *Survey of Farmers' Current Use of Multipurpose Tree Species on Small Upland Farms in Eastern Visayas, Philippines.* Lucylen B. Ponce and Audimar P. Bangi. 1989.

No. 7. *Access to, Use, and Production of Trees by Thai Farmers.* Yongyuth Chalamwong. 1990.

No. 8. *Use of Multipurpose Tree Species by Malaysian Farmers.* Bahari bin Yatim. 1990.

No. 9. *Farm and Village Forest and Land Use Practices: A Case Study in Sri Lanka.* Anoja Wickramasinghe. 1990.

No. 10 *Defining Tree-Breeding Objectives for Multipurpose Tree Species in Asia.* Lert Chuntanaparb and Radha Ranganathan. 1990.

No. 11 *Tree Use Practices in Selected Villages of India.* Radha Ranganathan. 1990.

No. 12 *Household Fuel Availability and Homegardens in Some Selected Locations of Bangladesh.* Md. Zainul Abedin and Md. Abdul Quddus. 1990.

No. 13. *Local Institutions in Small Farmers' Adoption of MPTS: A Case Study of An Agricultural Land Reform Area In Eastern Thailand.* Charit Tingsabadh. 1990.

No. 14 *Defining Tree-Breeding Objectives for Multipurpose Tree Species: A Case Study in Sri Lanka.* Anoja Wickramasinghe. 1991.

No. 15. *Preferred Characteristics of Multipurpose Tree Species: A Case Study with Lowland and Upland Farmers in Leyte, Philippines.* Eliseo R. Ponce, Lucylen B. Ponce, and Leonarda A. Maurillo. 1991.

No. 16. *Trees and Farms in Asia: An Analysis of Farm and Village Forest Use Practices in South and Southeast Asia.* Charles B. Mehl. 1991.

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No. 17. *Village Agroforestry Systems and Tree-Use Practices: A Case Study in Sri Lanka.* Anoja Wickramasinghe. 1992.

No. 18. *Imperata Grasslands in Southeast Asia: Summary Reports from The Philippines, Malaysia, and Indonesia.* Rick J. Van Den Beldt. (Ed.) 1993.

No. 19. *Gender-Specific Features in Forest and Tree Uses in South and Southeast Asia.* Anoja Wickramasinghe. 1993.

No. 20 *Toward an Extension Strategy for Multipurpose Trees.* John B. Raintree. 1993.

No. 21 *Vegetative Propagation of Tropical Tree Species by Stem Cuttings.* Darus Haji Ahmad and Aminah Hamzah. 1993.

Bibliographies and Compendiums

No. 1. Acacia auriculiformis: *An Annotated Bibliography.* Compiled by K. Pinyopusarerk. 1990.

No. 2. *Dalbergia sissoo: An Annotated Bibliography.* Compiled by Kevin J. White. 1990.

No. 3. *Compendium of National Research on Multipurpose Tree Species, 1976-1990.* Edited by Celso B. Lantican and David A Taylor. 1991.

Monographs

No. 1. *Jackfruit Biology, Production, Use, and Philippine Research.* A. L. Acedo, Jr. May 1992.

No. 2 *Documentary Survey on* Artocarpus heterophyllus *(Jackfruit) in Sri Lanka.* Prof. H.P.M. Gunasena. May 1993.

No. 3. Acacia mangium *Growing and Utilization.* Kamis Awang & David Taylor, eds. 1993.

Manuals

No. 1. *IADSS User's Manual (Version 2.0).* Global Research Unit. 1990.

No. 2. *Manual for Multipurpose Tree Species Research Cooperators for the F/FRED 1987 Humid and Sub-humid Network Trials.* Kirtland M. Barker, ed. 1988.

No. 3. *Field Trials Manual for Multipurpose Tree Species.* Second Edition. C. Buford Briscoe. 1990. (English and Spanish)

No. 4. *A Guide for Research Cooperators in the 1991 Humid and Subhumid Zone Network Trials.* Kamis Awang. 1991.

No. 5. *Standard Research Methods for Multipurpose Trees and Shrubs.* K.G. MacDicken, G.V. Wolf, and C.B. Briscoe, eds. 1992. (Supersedes Manual No. 3)

No. 6. *Growing Multipurpose Trees on Small Farms: A Manual 1994.* K. Awang, S. Bhumibhamon, F. Byrnes, H.H. Chung, R. Lasco, F.J. Pan, D.A. Taylor and C. Tingsabadh.

No. 7. *A Guide for Research Cooperators in the International Provenance Trials of* Casuarina equisetifolia. Kamis Awang. 1992.

No. 8. *MPTSys 3.0 Multipurpose Trees Species Information and Decision Support System, User's Manual.* 1993.

Field Handbooks

No. 1. *Farm- and Village-Forestry Practices: Methods for a Regional Study.* Charles B. Mehl. 1990.

No. 2. *Guide to Management of Leucaena Seed Orchards.* Robert A. Wheeler. 1991.

Winrock Handbooks

No. 1. *A Handbook on the Management of Agroforestry Research.* John C. Gordon and William R. Bentley, eds. 1990

No. 2. *Biophysical Research for Asian Agroforestry.* M.E. Avery, M.G.R. Cannell and C. Ong, eds. 1991.

No. 3. *Social Science Applications in Asian Agroforestry.* William R. Burch, Jr. and J.K. Parker, eds. 1992.

Technical Series

Vol. 1. *Modeling Growth and Yield of Multipurpose Tree Species,* Vol. 1. Norma R. Adams and Foster B. Cady, eds. 1988.

Vol. 2. *Tree Improvement of Multipurpose Species.* Nancy Glover and Norma Adams, eds. 1990.

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Special Reports

No. 1. *Report on the MPTS Research Network Steering and Research Committee Meetings.* Compiled by David A. Taylor and Woon W. Chuen. 1988.

No. 2. *Collaborative Research on Farm and Village Forestry.* Report of a workshop held April 23-25, 1988 in Kathmandu. Edited by David A. Taylor and Charles B. Mehl. 1988.

No. 3. *Planning the Future of the MPTS Research Network.* Report of a meeting of the Steering Committee, held March 20-22, 1989 in Bangkok, Thailand. Compiled by David A. Taylor. 1989.

No. 4. *Management of the Leucaena Psyllid.* Recommendations of an international workshop held in Bogor, Indonesia, January 16-21, 1989. Banpot Napompeth. 1989.

No. 5. *The Social Sciences in Asian Forestry Curricula.* Papers from the Workshop held Nov. 27 - Dec. 2, 1988 in Khon Kaen, Thailand. Edited by Robert E. Clausi. 1989.

No. 6. *MPTS Research Network: Achievements and Challenges.* Report of the Second Research Committee meeting held July 3-6, 1989 in Los Baños, Philippines. Compiled by Suree Bhumibhamon. 1989.

No. 7. *Tools and Approaches to Curriculum Development.* Working Paper. K. Parker, J. Bopp, and R.E. Clausi, editors. 1989.

No. 8. *Issues to Consider for Curriculum Development.* K. Parker and W.R. Burch. 1989.

No. 9. *The Social Sciences in Asian Forestry Curricula: Readings from the Literature of Social Sciences in Forestry.* Compiled by Carol Stoney and Cristen E. Gallup. 1989.

No. 10. *The MPTS Research Network: Strengthening Links.* Report of the Third Research Committee meeting held June 4-10, 1990 in Chiang Mai, Thailand. Compiled by Suree Bhumibhamon, Lim Hin Fui and David A. Taylor. 1990.

No. 11. *MPTS Research Supported by the Forestry/Fuelwood Research and Development Project (1987-1990).* K.G. MacDicken and C.B. Lantican. 1990.

No. 12. *Report of the Steering Committee of the MPTS Research Network.* from a meeting held July 31- August 2, 1990 in Arlington, Virginia, *USA.* Compiled by David Taylor. 1990.

No. 13. *Planning Forestry Extension Programmes.* (PSA No. 88013) Forest, Trees and People Programme, F/FRED Project, and FAO. 1988.

No. 14. *People and Forestry in Thailand: Status, Problems and Prospects.* Proceedings of a seminar held in Bangkok, September 8 - 9, 1988. Chulalongkorn University, Social Research Institute. (In Thai, with English abstracts)

No. 15. *Multipurpose Tree Species Research: Toward Practical Applications.* Report of the fourth MPTS Research Committee Meeting held June 17-26, 1991 in Kathmandu. Compiled by Suree Bhumibhamon, Ahmad Said Sajap and David A. Taylor. 1991.

No. 16. *1991 Report of the Steering Committee of the MPTS Research Network,* from a meeting held December 9-10, 1991 in Manila, Philippines. Compiled by David Taylor. 1992.

No. 17. *NGOs and Tree-Growing Programs: Working Between Farmers and Governments.* Report of an International workshop, September 24-27, 1991 in Pune, India. Edited by David A. Taylor. 1992.

No. 18. *Research on Farmers' Objectives for Tree Breeding.* Report of a workshop following a regional study in Asia. John B. Raintree and David A. Taylor, eds. 1992.

No. 19. *Native MPTS and Approaches for Sustaining MPTS Development.* Report of the fifth MPTS Research Committee meeting held June 21-30, 1992 in Taiwan, the Republic of China. Compiled by Suree Bhumibhamon, Ahmad Said Sajap, Zahid Emby, and David A. Taylor. 1992.

No. 20. *1992 Report of the Steering Committee of the MPTS Research Network,* from a meeting held December 1-2, 1992 in Peshawar, Pakistan. Compiled by David Taylor. 1993.

No. 21. *Indigenous MPTS and Approaches for Sustaining MPTS Development*. Report of the sixth MPTS Research Committee Meeting held May 24-28, 1993, Bangkok, Thailand. Compiled by Suree Bhumibhamon, Md. S. Othman, Aminuddin Mohamad, and James H. French. 1993.

Proceedings

No. 1. *Forestry Networks*. Proceedings of the First Network Workshop of the Forestry/Fuelwood Research and Development (F/FRED) Project held Sept. 24-27, 1986 in Bangkok, Thailand. Norma Adams and Robert K. Dixon, eds. 1986.

No. 2. *Trees on Small Farms: Multipurpose Tree Species Research for the Arid and Semi-Arid Tropics*. Proceedings of the Network Workshop of the Forestry/Fuelwood Research and Development (F/FRED) Project held Nov. 16-19, 1987 in Karachi, Pakistan, David A. Taylor and Lee Medema, eds. 1988.

No. 3. *Multipurpose Tree Species for Small-Farm Use*. Proceedings of an International Workshop held November 2-5, 1987 in Pattaya, Thailand. Dale Withington, Kenneth G. MacDicken, Cherla B. Sastry, and Norma R. Adams, eds. 1988.

No. 4. *The Social Sciences in Asian Forestry Curricular*. Report on the Workshop held Nov. 27-Dec. 2, 1988 in Khon Kaen, Thailand. J. Kathy Parker, Robert E. Clausi, and William R. Burch, Jr. eds. 1989.

No. 5. *Leucaena Psyllid: Problems and Management*. Proceedings of an International Workshop held Jan. 16-21, 1989 in Bogor, Indonesia. Banpot Napompeth and Kenneth G. MacDicken, eds. 1990.

No. 6. *Breeding Tropical Trees: Population Structure and Genetic Improvement Strategies in Clonal and Seeding Forestry*. Proceedings of a conference held in Pattaya, Thailand, Nov. 28 - Dec. 3, 1988 by IUFRO Working Parties S2.02-08 and S2.02-09. G.L. Gibson, A.R. Griffin, and A.C. Matheson, eds. 1990.

No. 7. *Multipurpose Tree Species Research for Small Farms: Strategies and Methods*. Proceedings of an International Conference held November 20-23, 1989 in Jakarta, Indonesia. Christine Haugen, Lee Medema, and Celso Lantican, eds. 1990.

No. 8. *Research on Multipurpose Tree Species in Asia*. Proceedings of an international workshop held November 19-23, 1990 in Los Banos, Philippines. David A. Taylor, Kenneth G. MacDicken, eds. 1991.

No. 9. *Tropical Acacias in East Asia and the Pacific*. Proceedings of a first meeting of the Consultative Group for Research and Development of Acacias (COGREDA) held on June 1-3, 1992, in Phuket, Thailand. Kamis Awang and David A. Taylor, eds. 1992.

No. 10. *Acacias for Rural, Industrial, and Environmental Development*. Proceedings of the second meeting of the Consultative Group for Research and Development (COGREDA) held in Udorn Thani, Thailand, February 15-18, 1993. Kamis Awang and David A. Taylor, eds. 1993.

No. 11. *Genetic Improvement of Neem: Strategies for the Future*. Proceedings of an international consultation held at Kasetsart University, Bangkok, Thailand, 18-22 January 1993. Michael D. Read and James H. French, eds. 1993.

Newsletters

Farm Forestry News. Norma Adams, ed. Vol. 1:1-4, Vol. 2:1-3, Vol. 3:1-4, vol.4:1-4, Vol. 5:1-4, Vol. 6:1-2 and special edition.

Research Bulletins

MPTS Research Notes. David Taylor, ed. Vol. 1, issues 1-5; Vol. 2, issues 1-4.

Progress Reports

Phase 1

F/FRED Progress Report May 1986 - March 1987.

F/FRED - Asia Progress Report, September. 1987.

F/FRED - Asia Interim Progress Report, May 1988.

F/FRED - Asia Progress Report, September 1988.

F/FRED Progress Report, September 1989.

F/FRED Phase 1 Summary: Achievements, Constraints, and Lessons Learned, July 1990.

Phase 2

Tree Improvement and the MPTS Research Network: A Progress Report, May 1990 - May 1991.

Multipurpose Tree Species Network: Annual Report 1991. F/FRED Project. 1992.

Multipurpose Tree Species Network: Annual Report 1992. F/FRED Project. 1993.

Booklets

Multipurpose Tree Species Research Network. F/FRED Project. 1992.

Brochures

Project Profile: Forestry/Fuelwood Research and Development (F/FRED). November 1989.

Thesis

An Economic Evaluation of Alleycropping Research in Sri Lanka and an Investigation of the Feasibility to Transfer this Technology to Farmers Who Practice Shifting Cultivation. Y. M.Wickramasinghe. Michigan State University. MSc thesis.

Community Woodlots: a Renewable Energy Source as a Means for Rural Development. Vitoon Viriyasakultorn. PhD Dissertation, Michigan State University. 1993.

Comparative Investigations of Productivity Variations among Important Fodder Trees in Research Trials and On Farm Agro-Forestry Systems in Nepal. Madhav Bahadur Karki. PhD Dissertation, Michigan State University. 1993.

Development of a Tissue Culture System for Micropropagation of Shorea stenoptere Burck. Lilian U. Gadrinab. PhD Dissertation, Michigan State University. 1994.

People, Forests and Tenure: Impact of Land and Tree Tenure Changes on the Garo Community and Madhupur Garh Forests of Bangladesh. T. M. Kibriaul Khaleque. PhD Dissertation, Michigan State University. 1993.

Refereed Journal Articles

Nor, Aini Ab Shukor, Kamis Awang, Mansor Mohd Rashid and Abd Latib Senin. 1994. Provenance Trial of *Acacia auriculiformis* A. Cunn. Ex Benth. in Peninsular Malaysia: 12 Month Performance. *Tropical Forest Science* (Accepted for publication).

Kamis, Awang, Nor Aini Abd. Shukor, G. Adjers, Suree Bhumibhamon, F. J. Pan and P. Venkateswarlu. 1994. Performance of Acacia auriculiformis Provenances at 18 Months on Four Sites. *Journal of Tropical Forest Science* (Accepted for publication)

Venkateswarlu, P. and Kamis Awang. 1994. A Note on the Effect of Outliers on the Variability in *Acacia auriculiformis* Trials. Journal *Tropical Forest Sceince* (Accepted for publication).

Kamis, Awang, P. Venkateswarlu, Nor Aini Adb. Shukor, G. Adjers, Suree Bhumibhamon, Bopit Kietvuttinon, Fuh-Juinn Pan, Kiatkong Pitpreecha and Apisit Simsiri. 1994. Three Year Performance of International Provenance Trials of *Acacia auriculiformis*. *Forest Ecology and Management* (Accepted for publication).

Nor, Aini Abd. Shukor, Kamis Awang, P. Venkateswarlu and Abd Latib Senin. 1994. Three Year Performance of *Acacia auriculiformis* Provenances at Serdang, Malaysia. *Pertanika Journal of Tropical Science* (Accepted for publication).

Venkateswarlu, P., Kamis Awang and Nor Aini Abd. Shukor. 1994. Grwoth and Genetic Variations of *Acacia auriculiformis* Provenances at Banjarbaru, Indonesia. *New Forests*.

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5. Representation of MPTS Research Network Participants in F/FRED Sponsored Meetings

Titles of F/FRED Sponsored Meetings, Seminars and Workshops	Participants											
	BGD	IND	INS	MAL	NEP	PAK	PHL	PNG	SRL	THL	TWN	Others
F/FRED Database Planning Meeting; Washington, DC. (February 1986)												CATIE, U.S. Universities USAID
Second F/FRED Planning Meeting for a Research Network Bangkok; Thailand (June 1986)		X		X			X			X		FAO
Third F/FRED Database Planning Meeting; Honolulu, USA(August 1986)												CATIE, ICRAF, NFTA OFI,
F/FRED Inaugural Workshop: Forestry Networks; Bangkok, Thailand (September 1986)	X	X	X	X	X				X	X	X	China (PRC), ICIMOD, IDRC, Plantek International
F/FRED Psyllid Control Workshop; Hawaii, USA (November 1986)			X	X		X			X		X	USAID , NFTA
Research Committee Meeting; Kuala Lumpur (December, 1986)	X	X	X	X	X	X	X	X	X	X	X	
Network Trials Design Meeting; Kuala Lumpur (December 1986)			X	X	X	X	X			X	X	
Leucaena Psyllid Regional Research Workshop; Manila, Philippines (June 1987)			X	X						X	X	CSIRO, NFTA
Planning Meeting for a Socioeconomic Database; Hawaii, USA (September 1987)					X					X		CATIE
Multipurpose Tree Species for Small Farm Use; Pattaya, Thailand (November 1987)	X	X	X	X	X		X	X	X	X		U.S.A.I.D, CSIRO, IDRC, IIED
MPTS Research for Small Farm use in the Arid and Semiarid Tropics; Karachi, Pakistan (November 1987)		X			X	X			X	X	X	USAID , CSIRO, IDRC
Combined Meeting of the Research and Steering Committees; Kuching, Malaysia (March 1988)		X	X	X	X	X	X			X	X	FAO
Applied Social Science and Economic Research on Farm and Village Forestry; Kathmandu, Nepal (April 1988)	X		X				X			X		AgaKhan Foundation, IDRC, ICIMOD, ICRAF, CATIE
Meeting of National Psyllid Plan Coordinators; Bangkok, Thailand (April 1988)			X	X						X	X	USAID , CIBC

(Continued)	Participants											
Titles of F/FRED Sponsored Meetings, Seminars and Workshops	**BGD**	**IND**	**INS**	**MAL**	**NEP**	**PAK**	**PHL**	**PNG**	**SRL**	**THL**	**TWN**	**Others**
Working Group Meeting for a Regional Study on Farm and Village Forestry; Bangkok, Thailand (July 1988)	X				X		X			X		
Tour of Humid/Subhumid Network Field Trials in Southeast Asia (October 1988)			X	X		X	X			X	X	
The Social Sciences in Asian Forestry Curricula; Khon Kaen, Thailand (November 1988)		X	X	X	X		X		X	X		USAID, FAO
Research Methods for a Regional Study on Farm and Village Forestry; Bangkok (January February 1989)	X	X	X		X		X		X	X		
Leucaena Psyllid: Management and Problems; Bogor, Indonesia (January 1989)	X	X	X	X			X		X	X	X	Canada, Singapore, USAID, CAB, NFTA
Meeting of the MPTS Steering Committee; Bangkok, Thailand (April 1989)					X	X	X			X		FAO, USAID, Ford Foundation, IBSRAM, IDRC, RECOFTC, SDC, Winrock, WRI
Meeting of the MPTS Research Committee; Los Banos, Philippines (July 1989)	X	X	X	X	X		X	X	X	X		
Working Group Meeting: Social Sciences in Asian Forestry Curricula; Pokhara, Nepal (July 1989)			X		X		X			X		FAO, U.S.A.I.D.
Planning Meeting for Research on *Dalbergia sissoo;* Bangkok, Thailand (September 1989)					X					X		NFTA
Orienting Multipurpose Tree Species Research to Small Farms; Jakarta, Indonesia (November 1989)	X	X	X	X	X		X	X	X	X		FAO, USAID, ICRAF, IDRC
Meeting of the MPTS Steering Committee; Jakarta, Indonesia (November 1989)				X	X					X	X	FAO, IUFRO
Network Trials Analyses Meeting, Hawaii (January 1990).												NFTA, Winrock
Review of the Regional Study of Farm and Village Forestry; Bangkok, Thailand (January/February 1990)	X	X	X		X		X		X	X		FAO, Ford Foundation
MPTS Research Committee Meeting; Chiang Mai, Thailand (June 1990)		X	X	X	X		X	X	X	X	X	
Meeting of MPTS Steering Committee, Arlington (Aug. 1990.)												
Research on MPTS in Asia; Los Banos (Nov. 1990).	X	X	X	X	X		X	X	X	X		IFS, INRA, Winrock, Yale, BSSFT, China, FAO

(Continued)	Participants											
Titles of F/FRED Sponsored Meetings, Seminars and Workshops	**BGD**	**IND**	**INS**	**MAL**	**NEP**	**PAK**	**PHL**	**PNG**	**SRL**	**THL**	**TWN**	**Others**
MPTS Advisory Committees Bangkok (December 1990).										X		Winrock, FAO, NFTA, CSIRO
Defining Tree-Breeding Objectives for MPTS; Bangkok (1990)	X	X	X		X		X		X	X		
Research on Farmers' Objectives for Tree Breeding; Kandy (1991)		X	X		X		X		X	X	X	
The Role of NGO's in On-Farm Tree Growing, BAIF, India (1991)		X	X				X		X	X		IDRC, FAO, NFTA
Multipurpose Tree Species research: Toward Practical Applications; Kathmandu (June 1991)												
Meeting of MPTS Network Steering Committee; Manila (December 1991)		X		X	X				X	X		FAO, USAID, Ford, IDRC, Winrock, IUFRO
Native MPTS and Approaches for Sustaining MPTS Development; Taiwan (June 1992)		X	X	X	X	X	X	X	X	X	X	
Meeting of the MPTS Research Network Steering Committee; Peshawar (Dec. 1992)				X			X			X	X	IUFRO, Winrock
Meeting of MPTS Research Committee Meeting, Bangkok (May 1993)		X	X	X	X	X	X	X	X	X	X	USAID, ICRAF
COGREDA-Tropical Acacias in East Asia and the Pacific; Phuket (June 1992)			X	X			X	X		X	X	CSIRO, FAO
COGREDA-Acacia for Rural, Industrial, and Environmental Development; Udorn Thani (Feb. 1993)		X	X	X	X	X	X	X		X	X	CSIRO, Laos, Myanmar, FAO, Vietnam
International Consultation on Neem Improvement: Strategies for the Future; Bangkok (Jan. 1993)	X	X	X	X	X	X			X	X		Burkina Faso, IBPGR, Mali, Myanmar, Niger, Nigeria, Senegal, Tchad, FAO, CIRAD-Forêt, Danida
International Consultation on Marketing of MPTS, Bagio, (Dec. 1993)		X	X	X	X	X	X		X	X	X	Ford, FAO, IDRC, APAN, FTPP

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6. Network Institutions

Network Participation involves institutions as well as individuals. Participation in research, training, and workshops does not require formal institutional membership but can make for smoother cooperation. Formal membership also enables access to all F/FRED publications and library support.

As implementing agency, Winrock International was flexible in developing formal Network agreements to accommodate differences in each country. In some countries, many institutions were interested to enter into formal agreements. In other countries, agreements with a few umbrella agencies permited participation by a wide range of institutions.

Bangladesh

Bangladesh Agricultural Research Council
Farmgate
Dhaka 1207

Institute of Forestry
University of Chittagong
Chittagong

India

BAIF Development Research Foundation
'Khamdenu' Senapati Bapat Marg
Pune 411 016

Department of Botany
University of Delhi
Delhi 110 007

National Institute of Wastelands and Rural Development
8, Pt. Pant Marg
New Delhi 110 001

Indonesia

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Jl. Gunung Batu
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Universiti Pertanian Malaysia
43400 Serdang

Forest Research Institute Malaysia
P.O. Box 201, Kepong, Selangor
52109 Kuala Lumpur

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Thapathali, Kathmandu

Department of Sociology and Anthropology
Tribhuvan University
Kathmandu

Institute of Agriculture and Animal Science
Central Campus
Rampur, Chitwan

Institute of Forestry
P.O. Box 43
Hariyokharka, Pokhara

Pakistan

Atomic Energy Agricultural Research Centre, Pakistan
Atomic Energy Commission
P.O. Box No. 1114
Islamabad

Food and Agriculture Division
Ministry of Food, Agriculture and Cooperatives
Government of Pakistan
Islamabad

Philippines

College of Agriculture and Forestry
Don Mariano Marcos Memorial State University
Rosario, La Union

College of Forestry
Central Mindanao University
Musuan, Bukindon

College of Forestry
Isabela State University
Cabagan, Isabela 1303

College of Forestry
University of the Philippines at Los Banos College,
Laguna 4031

Forest Products Research and Development Institute
College, Laguna 4031

Ifugao State College of Agriculture and Forestry
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Province of Ifugao

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Paper Industries Corporation of the Philippines
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University of Eastern Philippines
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Peradeniya

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