FORAGES for Smallholders Project

FSP

Technical Report No. 1

Feed Resources for Smallholder Livestock Production in Southeast Asia

Proceedings of the first regional meeting of the forages for smallholders project, FAO regional working group on feed and grazing resources in Southeast Asia, and FAO regional network on better use of locally available feed resources for sustainable livestock production in Southeast Asia

Vientiane, Lao PDR
16-20 January 1996

Edited by W.W. Stür

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Forages for Smallholders Project (FSP)

The Forages for Smallholders Project is a partnership of the governments of Indonesia, Lao PDR, Philippines, Vietnam, Malaysia, Thailand and P.R. China. It is funded by the Australian Agency for International Development (AusAID) and is coordinated by Centro Internacional de Agricultura Tropical (CIAT) and the Commonwealth Scientific and Industrial Research Organisation of Australia (CSIRO).

The objectives of the FSP are to increase the availability of adapted forages and the capacity to deliver them to different farming systems, in particular, upland farming systems in Indonesia, Lao PDR, Philippines and Vietnam, and to develop close linkages in forage development activities between these countries and Malaysia, Thailand and tropical areas of P.R. China.

The main implementing agencies are:

Indonesia:Directorate General of Livestock Services (DGLS);
Lao PDR:Department of Livestock and Fisheries (DLF), Ministry of Agriculture and Forestry;
Philippines:Philippine Council for Africulture, Forestry and Natural Resources Search and Development (PCARRD);
Vietnam:National Institute of Animal Hundbandry (NIAH), Ministry of Agriculture and Rural Development;
China P.R.:Chinese Academy of Tropical Agricultural Science (CATAS), Hainan;
Malaysia:Malaysian Agricultural Research and Development Institute (MARDI);
Thailand:Department of Livestock Development (DLD), Ministry of Agriculture and Cooperatives.

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Background photo: Upland agriculture in Quirino Province, Philippines. Taken 10 October 1995

Contents

Introduction

The roles of livestock in Southeast Asian agricultural systems are as diverse as the systems themselves. Buffalo provide draft power in intensive lowland cropping systems, as do cattle in many upland areas. Penned sheep and goats in Java provide a source of readily available cash for emergencies and meat for religious ceremonies. Cattle in central Vietnam provide valuable manure for maintaining fertility of limited cropping land. Cattle in coconut plantations of Indonesia and the Philippines control weeds, boosting plantation yields. Cattle and buffalo provide the only source of cash income for many shifting cultivators in the hills of northern Laos.

Across all these agricultural systems, feed resources are becoming markedly depleted, due to pressures from the expansion of agricultural land onto more-marginal soils and landscapes, and to increasing populations of people and livestock. In many cases, farmers are now recognising the need to manage their limited feed resources; a situation that was almost non-existent 20 years ago.

Between agricultural systems there are different opportunities and limitations controlling feeding strategies for livestock. Commonly, these strategies are based on more than one feed resource or more than one use for each resource. For example, in many areas of Indochina cattle are grazed in forests and grasslands during the wet season and on rice straw during the dry season, supplemented with tree leaves. In northern Vietnam, forages are used not only to feed cattle but also to supplement pigs fed grain and to feed fish.

The diversity of potential feed resources (including tree leaf, crop residues, forages and agro-industrial by-products) and the seasonality of their availability must be matched with the requirements of different livestock. Livestock development workers need to be aware of the full range of existing and potential future feed resources in their region.

For this reason, a meeting was held in Laos from 16-20 January 1996, to bring together three projects that are developing potential feed resource strategies for smallholder farmers in Southeast Asia. These were the Forages for Smallholders Project funded by AusAID, the FAO Regional Working Group on Feed and Grazing Resources for Southeast Asia and the FAO Regional Network (GCP/RAS/143/JPN) "Better Use of Locally Available Feed Resources for Sustainable Livestock Production in the South East Asian Region"). The meeting introduced the work of each project to the others and provided opportunities to share experiences on different feed resources. These proceedings contain papers relating to the Forages for Smallholders Project (FSP) and selected papers from the plenary sessions and from other projects.

Special thanks are due to Dr Singkham Phonvisay, Director-General, Lao Department of Livestock and Fisheries, for hosting the meeting, to Dr. Peter Horne and staff of the Department of Livestock and Fisheries for organising the meeting, and to AusAID and FAO for funding the meeting.

Forages for Smallholders Project—Overview and Methodology

The Forages for Smallholders Project—Aims, Activities, and Achievements

J.B. Hacker[1] and P.C. Kerridge[2]

The Forages for Smallholders Project (FSP), which operates in Indonesia, Lao PDR, Philippines, Malaysia, Thailand, Vietnam, and South China, is identifying and introducing new forage components for smallholder farming systems with the active participation of the farmers. Throughout the region, the demand for beef and milk and the need to develop more sustainable land use practices are increasing. Forage legumes and grasses can play a role in both areas. Livestock are a vital but secondary component of intensive production systems. Natural grazing lands with most native grasses are few and have a low forage potential. Many early development efforts identified useful forages which were not multiplied and adopted by farmers. The FSP project aims to improve this situation by developing new forage technology with farmers. It is a collaborative effort between the national organizations in the region, assisted by CIAT (Centro Internacional de Agricultura Tropical, a CGIAR center based in Colombia) and CSIRO Division of Tropical Crops and Pastures, based in Australia, and funded by AusAID, the Australian Development Agency.

The FSP followed the Forage Seeds Project that focused on introduction of new forages for acid infertile soils in Malaysia, Indonesia, Thailand, and Philippines. The Forage Seeds Project screened about 400 forage accessions and identified accessions of six species widely adapted through the region, particularly on acid soils (Table 1). Species for particular farming niches were also identified.

The objectives and scheduling of the Forages for Smallholders Project were planned after extensive discussions with national scientists and administrators of the region in early 1994. The proposal for the project was completed in September and accepted by AusAID in December 1994.

Table 1. Species selected from trials carried out through the Forage Seeds Project, 1991-94.

SPECIES	VARIETY	USES
Brachiaria decumbens	cv. Basilisk	grazing, cut-and-carry, erosion control
Brachiaria brizantha	CIAT 6780	cut-and-carry, grazing
Brachiaria humidicola	cv. Tully, CIAT 6133, 6369	heavy grazing, erosion control, revegetation
Andropogon gayanus	cv. Kent, CIAT 621	cut-and-carry, grazing
Stylosanthes guianensis	CIAT 184	cut-and-carry, grazing, feed meal, cover crop
Centrosema pubescens	CIAT 15160	cut-and-carry, grazing, cover crop, green manure

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The project is jointly managed by CIAT and CSIRO, which have extensive knowledge of tropical forages and large genetic resource collections available for evaluation. Overall leadership is provided by Dr. Peter Kerridge, CIAT. There are two FSP agronomists located in the region: Dr. Werner Stür, CIAT, in Los Baños, with responsibility for activities in Indonesia, Malaysia, the Philippines, and South China; and Dr. Peter Horne, CSIRO, in Vientiane, with responsibility for Lao PDR, Thailand, and Vietnam. Although there is a general separation of responsibilities, both scientists work as a team with country scientists in defining goals and meeting project objectives.

National country coordinators have been appointed by the implementing agency in each of the host countries (Table 2). The excellent collaboration between the coordinators and the FSP scientists has resulted in a very successful first year; activities were completed on schedule.

Aims of the Forages for Smallholders Project

The aims of the FSP are to identify and achieve adoption of improved forages within smallholder farming systems. Target ecosystems are shown in Table 3. There is strong focus on upland ecosystems, and lesser focus on lowland systems.

The extent of activities planned for different countries also differs according to need. Malaysia and Thailand have an active group of experienced forage agronomists; hence the project focused on other countries with a greater development need: Philippines, Indonesia, Lao PDR, and Vietnam. Pasture scientists in Malaysia, Thailand, and South China will contribute to and benefit from the FSP primarily through a strong commitment to communication and networking.

Table 2. Country coordinators working with the Forages for Smallholders Project.

COUNTRY	COORDINATOR	IMPLEMENTING AGENCY
Indonesia	Mrs. Maimunah Tuhulele	Bina Produksi, Directorate General of Livestock Services Kandor Pusat Departmen Pertanian Jalan Harsono Rm No. 3 Gedung B, Lantai II Rangunan Jakarta Selatan 12550 Indonesia
Lao PDR	(Mr. Vanthong Phengvichith) Mr. Viengsavanh Phimphachanhvongsod	LARED Department of Livestock and Fisheries P.O. Box 811, Vientiane Lao PDR
Malaysia	Mr. Chen Chin Peng	Livestock Research Division, MARDI GPO Box 12301 50774 Kuala Lumpur Malaysia
Philippines	(Mrs. Elaine Lanting) Mr. Eduedo Magboo	Livestock Research Division, PCARRD Paseo de Valmayor , Los Baños, Laguna Philippines
South China	Mr. Liu Guodao	CATAS Tropical Pasture Research Center Danzhou 571737, Hainan China
Thailand	Mrs. Chaisang Phaikaew	Division of Animal Nutrition Department of Livestock Development Phya Thai Road Bangkok 10400 Thailand
Vietnam	Mr. Le Hoa Binh	National Institute of Animal Husbandry, Ministry of Agriculture and Rural Development Thuy Phuong, Tu Liem, Hanoi Vietnam

The FSP has four main components: (1) Selection and delivery of improved forages to national systems; (2) Introduction of forages into farming systems; (3) Training; and (4) Communication. Planned activities in these areas are listed in Tables 4, 5, 6, and 7. Planned activities depend much on perceived needs in the countries. There is strong emphasis on selection of forages in Lao PDR and Vietnam, where there has been relatively little work in the past, and less emphasis on selection in the Philippines and Indonesia (Table 4).

In all four countries, there is strong emphasis on seed increase and development of multiplication systems. Rapid Rural Appraisal and participatory evaluation are strongly supported in all four countries (Table 5). Assessment of local forage systems is a minor objective in Lao PDR and Vietnam, where areas of native savannas or induced grasslands exist.

Training is given high priority in Lao PDR, Vietnam, Indonesia, and the Philippines (Table 6), where a high input into training in forage management by farmers, participatory research, forage agronomy, and forage seed production is planned. English language training is planned where the needs are greatest.

Communication is also given high priority (Table 7). With limited resources, and working over a very large area, it is important that we learn from each other's experiences. The FSP plan includes annual regional meetings and, following recommendations of the Forage Seeds Project in Samarinda, a regional SEAFRAD Newsletter and a Newssheet for the Project, to be translated into local languages.

Table 3. Target agroecosystems for introduction of forages.

AGROECOSYSTEMS	Indonesia	Lao	Malaysia	Philippines	S. China	Thailand	Vietnam
Agroforestry	•••	•••		•••	••	•	•••
Upland cropping systems							
Sedentary	•••		•	•••	••	•••	••
Shifting		•••					••
Plantation	••		•••	••			••
Natural/induced grasslands	•	••			••		••
Rainfed lowland rice systems	•	••	•	••		••	

Table 4. Planned FSP activities in the different countries: Selection and delivery of improved forages.

ACTIVITY	Indonesia	Lao	Malaysia	Philippines	S. China	Thailand	Vietnam
Introduction and initial increase	••	•••		••	•	•	•••
Evaluation in different environments	••	•••		•••	•	•	•••
Seed increase	•••	•••	•	•••	•	•	•••
Development of multiplication systems	•••	•••		•••		••	•••

Table 5. Planned FSP activities in different countries: Assessment of local systems and participatory evaluation of forages.

ACTIVITY	Indonesia	Lao	Malaysia	Philippines	S. China	Thailand	Vietnam
Assessment of local forage systems		••					•
RRA of farming systems	••	•••		•••			•••
Participatory evaluation of forages on-farm	•••	•••		•••		••	•••

Table 6. Planned FSP activities in the different countries: Training.

ACTIVITY	Indonesia	Lao	Malaysia	Philippines	S. China	Thailand	Vietnam
Farmer training in forage management	•••	•••		•••			•••
English language training	•	••		•			••
Training in participatory research	•••	•••		•••		•	•••
Training in forage agronomy	•••	•••		•••		•	•••

Achievements of the Forages for Smallholders Project, 1995.

Achievements of the Forages for Smallholders Project are summarized in Tables 8-12. We believe we can all be proud that much has been achieved in so short a time.

In Lao PDR and Vietnam, forage selection is at an early stage, but trials have been sown, both on research stations and farms. Development of adapted forage cultivars is further advanced in Indonesia and the Philippines where selected forages are being evaluated on farms and seed and planting material of selected accessions (Table 8) distributed to farmers. A new trial looking at a range of accessions addresses problems of seed production of *Brachiaria decumbens* in Thailand.

It is too early yet to get a measure of progress in forage adoption, but we have identified trial sites in the four target countries (Table 9). These districts will form the baseline for evaluating progress over the coming years. A separate activity investigating the grasses occurring naturally in dwarf bamboo (pek) savannas in southern Lao PDR was successfully completed.

A significant activity of the Project was the Training Course in Participatory Research in July, in the Philippines (Table 10). This training was followed by in-country courses in two countries. We plan to hold similar courses in other countries. A high level of communication has been established in the project, with its first issue of SEAFRAD News published by the PCARRD in the Philippines in 1995, and the FSP

Table 7. Planned FSP activities in the different countries: Communication.

ACTIVITY	Indonesia	Lao	Malaysia	Philippines	S. China	Thailand	Vietnam
Regional meetings	•••	•••	••	•••	••	••	•••
Facilitate internal communications	•••	•••	•	•••	•	••	•••
Regional R&D network	•••	•••	•••	•••	•••	•••	•••

Table 8. Achievements of the FSP, 1995: Selection and delivery of improved forages.

Indonesia	Distribution of forages to farmers in E Kalimantan On-farm evaluation of forages in C and E Kalimantan Seed production/propagation in E Kalimantan
Lao PDR	Sowing of trials at Nuam Suang and Huay Khot stations and Houay Pay farm
Philippines	Setting up of demonstration/seed multiplication areas set up in the Visayas and Mindanao Development of working relationship with key farmers in Southern Luzon, Leyte, and Mindanao Establishment of trials in upland rice systems in Leyte Seed production of elite accessions developed by FSP I Seed distribution to smallholders in Leyte
Thailand	Evaluation of seed production potential of *Brachiaria* accessions
Vietnam	Sowing of trials at M'Drac and Ba Vi, also on a farm at Ba Vi

Table 9. Achievements of the FSP in 1995: Assessment of local systems and progress in forage adoption.

Indonesia	Identification of target area in Aceh, N Sumatra, N Sulawesi, E Kalimantan
Lao PDR	Identification of trial sites; Survey of Pek savannas in southern Lao
Philippines	Identification of target areas in S Luzon Assessment of local systems around Isabela State University
Vietnam	Identification of trial sites in N and C Vietnam

Newsletter, which has been translated into local languages. (Table 11).

Collaboration and Linkages

To be effective, we must share our ideas with other projects in the region, and benefit from their experiences. Only through this networking can we expect to make real progress. Table 12 shows linkages already in place. In some cases linkages are developmental; in others, there are strong interaction and collaboration. The large number of other projects keen on interacting with the FSP is a strong indication of the value of our work.

Summary

The first year of the FSP has provided a sound foundation for the future. Most of our major aims have been achieved and we can look forward to a productive year ahead.

Table 10. Achievements of the FSP, 1995: Training.

	REGIONAL	IN-COUNTRY
Lao PDR		English Training Courses (June, September) Participatory Research Training Course (December; Luang Phabang)
Philippines	Participatory Research Training Course (July)	Participatory Research Training Course (October); Training in practical seed production–staff from Quirino and Isabela

Table 11. Achievements of the FSP, 1995: Communication.

	REGIONAL	IN-COUNTRY
Indonesia		FSP News
Lao PDR	Annual Workshop "Feed Resources in a Climate of Change"	FSP News
Malaysia		FSP News
Philippines	FSP News (August) SEAFRAD Newsletter (October)	FSP News
South China		FSP News
Thailand		FSP News
Vietnam		FSP News

Table 12. Collaboration, linkages, and networking.

General	FAO Regional Working Group on Grazing and Feed Resources; FAO Regional Project on Better Use of Locally Available Feed Resources
Indonesia	ACIAR Leucaena Project; ICRAF
Lao PDR	Lao-IRRI Project; CONCERN; Lao-Swedish Forestry Project; European Community; Japanese Overseas Cooperation Volunteers; Australian Tree Resources Centre, CSIRO; ACIAR Leucaena Project; World Vision, Australia; University of Hohenheim; Oxford Forestry Institute
Philippines	ACIAR Leucaena Project; Regional Performance Trial Agencies through PCARRD
Vietnam	ACIAR Leucaena Project; University of Hohenheim

Prospects for Introducing Forages in Smallholder Farming Systems in Southeast Asia

P. Horne[1], W.W. Stür[2], F. Gabunada Jr.[2], and P. Phengsavanh[3]

In Southeast Asia, smallholder livestock production systems are usually part of intensive, mixed-farming systems. Few smallholder farmers are specialized livestock producers and, those who are, tend to concentrate on the few remaining extensive grazing lands. The poorer section of the farming community grows food crops for subsistence, and these are considered to be of paramount importance. In these traditional systems, livestock are used for draft and transport, for preserving money which can be liquidated easily, and for generating income. In upland farming systems, livestock may account for more than 50% of the cash income of smallholder families.

On small farms, ruminants are fed on naturally occurring vegetation and crop residues. These feed resources have little or no value for other purposes, and thus are free and require no labor for establishment and maintenance. Planting special forage crops or supplementing animals with commercial feeds is seldom practiced on small farms and tends to be used only in market-oriented situations such as dairying or feed lots.

In recent years, the increasing demand for meat has outstripped production, resulting in higher prices for livestock products in many countries in the region. The need for higher ruminant production has been recognized by governments and international agencies, and programs promoting large and small ruminant production have been initiated in many countries. Indeed, higher livestock prices have led to considerable interest among farmers in expanding ruminant production. When farmers get into cattle fattening or breeding, they quickly find that naturally occurring feed resources are becoming increasingly scarce and they need to look for other feed sources. Growing forages is one option, and farmers are looking for forages that fit into their farming system, to supplement existing feed resources. In upland areas, forages can also help control soil erosion, suppress weeds, and ameliorate the soil during crop fallows. There is a need to develop sustainable farming systems in the uplands, which are catchment areas for water used in downstream agriculture and for human consumption.

To be adopted by smallholder farmers, forages species must not only be well adapted to the particular environment but also be compatible with and complement other farm activities. The key to the successful generation of forage technologies, that are acceptable to farmers, is the active involvement of farmers in the process (farmer participatory research- FPR). Once "adoptable" forage technologies are available, another challenge will be to develop delivery systems that will make these species and technologies available to other farmers in the region.

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Opportunities for forage production

Planted forages have the potential to substantially increase the amount and quality of forage supply and to supplement low-quality, naturally occurring forages and crop residues. The following examples show where planted forages can contribute to the development of productive and sustainable ruminant production systems:

- Legumes for weed and erosion control in agroforestry and plantation systems.
- Grass legume associations for grazing in tree plantations.
- Legumes and grass legume associations for fallow improvement in upland cropping systems.
- Forages for cut-and-carry feeding systems grown as hedgerows or fodder banks in rainfed lowland and upland cropping systems.
- Grass legume associations to improve natural/induced grasslands.
- Multipurpose tree legumes for fodder banks, fence lines, and contour hedgerows in lowland, upland, grasslands, agroforestry, and plantation system.
- Legumes for leaf meal production in upland cropping systems.

Legumes for weed and erosion control in agroforestry and plantation systems

Legumes may be used to control weeds and erosion in forestry, agroforestry, and plantation systems. In Mindanao, Philippines, *Stylosanthes guianensis* CIAT 184 was found to effectively control erosion during planting and suppress growth of *Imperata cylindrica* in planting strips of young forestry plantations. In forestry and agroforestry situations, livestock offer a short-term source of cash income for farmers investing in long-term forestry development, whereas forages not only are a source of feed, they also reduce soil erosion and control weeds. Unfortunately, so far there are few examples of the integration of ruminants with forestry plantations in the region.

A recent addition to the legumes used as cover crops in plantations is *Arachis pintoi* for coffee, banana, oil palm, macadamia, and hearts of palm plantations in Central America (dela Cruz *et al.* 1994) and *Arachis glabrata* for granadilla, avocado, banana, tea, and coffee plantations in South Africa (Stür and Ndikumana 1994).

Grass legume associations for grazing in tree plantations

There are more than 20 million ha of coconut, rubber, and oil palm plantations in the region (Horne *et al.* 1994, Stür *et al.* 1994).

Forage opportunities are related largely to the amount of light available for forage growth under tree plantations. High productivity is limited to a 3-5 year period during tree establishment in rubber and oil palm, but good long-term opportunities for integrating forage under coconuts exist. Naturally occurring forages can be grazed by ruminants without detrimental effect on coconut production but over time, grazing leads to weed invasion (unpalatable species, particularly woody plants) and eventually production loss. Stocking rates and liveweight gains are generally low. Introduced forages can more than double cattle production under coconut with minimum inputs. They provide stability by suppressing weeds, resulting in sustainable livestock production with income from the cattle component, sometimes exceeding that of copra production (Stür *et al.* 1994).

Legumes and grass legume associations for fallow improvement in upland cropping systems

Shifting cultivation or sedentary upland agricultural systems are often in fragile ecosystems. Livestock play an important role in these systems. Forages, particularly legumes, offer a means of improving and stabilizing the fallow or ley areas, reducing erosion, and controlling weed growth for cropping areas, in addition to providing feed for ruminants. Farmers rely heavily on ruminant livestock to provide a source of savings, cash income, draft power, and animal products.

In eastern Indonesia, the adoption of leucaena-based systems of terracing and live fallow/ley has allowed for the replacement of shifting cultivation with stable sedentary systems (Piggin and Parera 1985). Leaves from the tree legumes are used as livestock feed during the fallow period; the trees are cut at the end of

the fallow period, allowing the planting of a 1- to 2-year crop before the legumes are allowed to grow back.

Few farmers have adopted green manure crops although green manure has been shown to improve yield of subsequent food crops. One reason for the low adoption may be that green manure crops have no value apart from their use as green manure. Undersowing forage legumes into food crops may be more successful since these can be grazed during the dry season when feed is scarce.

Stylosanthes guianensis has been undersown successfully into upland rice crops in Laos (Roder and Maniphone 1995) and the Philippines. Other species with potential include *Stylosanthes hamata*, *Aeschynomene histrix*, and *Pueraria phaseoloides*. For longer-term fallows, grass legume associations may be more useful than legumes alone. Grasses that have been successfully undersown into upland rice include *Paspalum atratum*, *Brachiaria humidicola*, and *B. decumbens*.

Forages for cut-and-carry feeding systems grown as hedgerows or fodder banks in rainfed lowland and upland cropping systems

Pennisetum purpureum and hybrids are the most widely adopted planted forages in the region. They have the potential to provide large quantities of a medium-quality basal feed throughout the year. The use of high-yielding grasses has been successful on semi-commercial dairy and feed lot farms but, too often, these grasses fail in smallholder situations because of low soil fertility and lack of fertilization. High-yielding grasses require a high soil fertility and good soil moisture for high production and fail to persist as soil fertility declines with successive cuts. The use of more hardy and persistent grasses, such as some *Brachiaria brizantha* accessions and *Paspalum atratum*, may be more successful in smallholder situations.

There may be potential to grow herbaceous legumes such as *Desmanthus virgatus* or *Stylosanthes guianensis* in a fodder bank for dry season supplementation of crop residues and natural grasses. Multipurpose trees and shrubs (MPTS) can also be used.

In hilly lands, contour hedgerows are designed to control soil erosion as well as to provide fodder for ruminants in the dry season. Criteria for suitability include effectiveness in reducing runoff, production and maintenance of green leaf in the dry season, and time required to control hedgerow species during the crop growing season (to minimize competition with crops). Useful species include MPTS (see section on Multipurpose tree and shrub legumes), bunch-type grasses such as *Panicum maximum*, *Pennisetum purpureum*, *Brachiaria brizantha*, and *Paspalum atratum*, and erect herbaceous legumes such as *Desmanthus virgatus*, *Desmodium rensonii*, and *Stylosanthes guianensis*.

Grass legume associations to improve natural/induced grasslands

In Southeast Asia there are only relatively small areas of natural grasslands. Most occur in areas with a long dry season and low-fertility soils.

Forage opportunities are limited because of environmental conditions limiting forage productivity. Often, natural grasslands are used for cattle breeding, supplying cattle for intensive fattening systems close to the market. For example, feeder cattle for fattening in Batangas, Philippines, either are imported or come from extensive livestock production areas such as the island of Masbate. In Batangas the cattle are fattened on by-products of crops such as sugarcane.

In Amarasi, Timor, Indonesia (extensive natural grasslands), planted forages are used for fattening to provide high liveweight gains. *Leucaena leucocephala* and other tree legumes are grown and the leaves from these trees plus banana stems are used for cattle fattening, with liveweight gains of 0.5 kg/head/day (Barlow *et al.* 1990). This is a substantial increase from the approximately 0.2 kg/head/day achievable on naturally occurring forages in that area.

Multipurpose tree and shrub legumes for fodder banks, fence lines, and contour hedgerows in lowland, upland, grasslands, agroforestry, and plantation systems.

MPTS may have a role in almost all land use systems because of their versatility. Commonly used species include *Leucaena leucocephala* and *Gliricidia sepium*. In many areas, smallholder farmers use tree legumes as fence (particularly *G. sepium*) and this is probably the most frequent use of tree legumes. However, there is good

potential to use tree legumes as supplement to other feed resources, particularly in the dry season, grown either in rows (fences or hedgerows) or in fodder banks.

Legumes for leaf meal production in upland cropping systems

The use of legumes for leaf meal production for poultry, pigs, and ruminants is a viable option for farmers. Several thousand hectares of *Stylosanthes guianensis* CIAT 184 and *S. scabra* cv. Seca are planted for this purpose in southern China and there is potential in other countries. Producing leaf meal provides a cash income which may make the growing of legumes, during crop fallows or in rotation with crops, attractive to small farmers. The key to the success of leaf meal production may be access to markets.

In the Philippines, *Leucaena leucocephala* was used extensively for leaf meal production before the psyllid invasion and many of these areas have recently started to come back into production because of reduced psyllid damage.

Seed Supply Systems

It is necessary to develop forage seed or vegetative propagation supply systems to make adapted forages available to farmers in the region. Without effective supply systems, forage research will not benefit smallholder farmers. Commercial seed production of forages is often difficult in the humid tropics. In Southeast Asia there are few examples of successful seed production schemes (i.e. northeast Thailand). There is almost no commercial seed produced in Indonesia, Philippines, Laos, and Vietnam.

Why have introduced forages not been adopted more widely?

There is good evidence that introduced forages have increased crop and animal production in agro-ecosystems in Southeast Asia. However, there are few areas where introduced forages are used extensively (e.g., high-yielding grasses on dairy farms, seed production in northeast Thailand, pastures under coconut in the South Pacific). This is especially true for smallholder farmers, who have often been ignored in the process of developing forage technologies, being more-often seen as the "end-of-the-line passive recipients". Forage introduction has been a process of vertical transfer, with introduced forages evaluated and adapted by researchers and then given to extension workers for promotion among farmers.

The general response of researchers to the low rates of adoption of introduced forage species by smallholder farmers has changed over the last twenty years (Table 1). One assumption of the early forage evaluation work in Southeast Asia was that you could identify "appropriate" forage species objectively, on the basis of adaptation to climate, soil, and researcher's perceptions of farming systems. Based on this assumption, many species better adapted to environmental conditions in Southeast Asia than the available Australian cultivars were identified on research stations, but few were widely exploited by smallholders. One reason for this was a lack of suitable multiplication technology (seed or vegetative propagation systems), which meant that species were not tested on farm. However, even where planting material was available, adoption rates were low. The low adoption rates were commonly interpreted as resulting from (1) reluctance of farmers to accept new technologies and (2) insufficiently active extension agencies. Much development effort was, therefore, directed at improving extension capabilities.

Although this summary is overly-simplistic, it is clear that adoption of forages by smallholders in the region has remained low despite substantial research effort to improve it.

Another way of interpreting the low adoption rates is to accept that it is difficult to identify "appropriate" forage species independent of smallholder farmers' perceptions and needs. It is, therefore, not sufficient for a forage species to be adapted to the soils and climate of a region and be palatable to livestock to ensure that it will be useful to and used by smallholder farmers. Farmers commonly have criteria for evaluating forage species which differ significantly from those that a researcher may deduce. So, for example, the focus of forage research on selecting higher yielding forage varieties may completely ignore other selection criteria which farmers consider important. Where researchers

may see opportunities for increased productivity or profits, farmers may see only higher risks and labor demand (Ørskov and Viglizzo 1994).

Table 1. Changes in professional attitude to low rates of adoption of forages in Southeast Asia (adapted from Chambers and Guijt 1992).

PERIOD	Reasons for low adoption rate	Approaches to remedy the problem
1970s	Farmers' ignorance	Extension and education
1980s	Farm-level constraints	Removal of the constraints
1990s	Inappropriate technology	Farmer participation (?)

Farmer Participatory Research (FPR)—will it make a difference?

In all farming communities, many innovative farmers experiment with and develop new methods and technologies on their own. The vertical transfer process of technology transfer ignores the valuable information that such farmers have to offer. An important reason why FPR has significant potential to improve adoption rates of forages is that it provides a methodology for **actively** involving farmers as equal partners in research-related decisions throughout the FPR process.

Through farmer participation in forage introduction programs, we can

- better understand farmers' needs from the very beginning of the introduction program,
- integrate local technical knowledge into forage technology development,
- obtain feedback about farmers' needs and objectives for on-station research,
- improve the chances of effective adoption of new forage species, because the farmers have been involved in developing and evaluating them from the beginning, and
- improve cost effectiveness of research by avoiding research on species that farmers perceive as being of little use.

Figure 1 illustrates how and when smallholder farmers can participate in forage introduction, evaluation, and development. When commencing FPR on forages in an area where little is known about how farmers perceive feed problems, the starting point should be to use participatory diagnosis techniques to better understand the opportunities for forages in the existing farming system. Diagnosis (similar to participatory rural appraisal) is a process whereby groups of farmers identify the limitations and possibilities they have in common, based on their perceptions of their agricultural activities. It is important to carefully select the farmers for diagnosis to ensure that the group invited represents the perceptions of the people affected by or interested in forage technologies. In diagnosis, the role of the researcher is to facilitate group discussion and use a wide range of tools (such as seasonal calendars, village mapping, long-term calendars, transects, and brainstorming) to allow farmers themselves to identify and discuss problems and possible solutions and to establish priorities for future action.

From a diagnosis, the farmers and researchers can gain a clear understanding of the community's priorities for forage introduction. Diagnosis can answer questions such as "What problems are critical to the community?", "How do farmers deal with those problems now?", and "How would they like to change this in the future?" An example of such a community

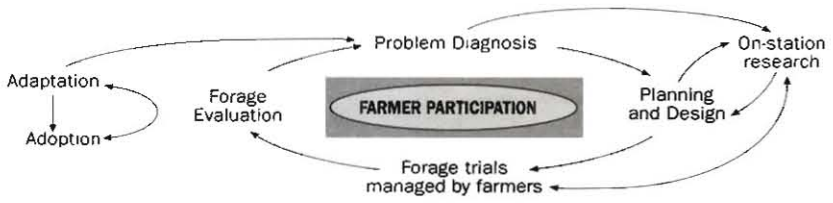

Figure 1. Steps in farmer participatory research.

diagnosis is given in Figure 2, where a group of farmers in a village in Leyte, Philippines, identified their main feed resource problems, ranked them according to importance, drew feedback links between the problems, and identified what they have done to solve those problems and what problems they would like to work on with researchers in the future. This took less than two hours for the farmers to formulate.

Diagnosis forms the basis on which the farmers and researchers together can establish trials in which the farmers evaluate the new technologies. The trials are prepared, managed, and evaluated by the farmers, giving feedback to the researchers about what criteria are important to the farmers in making their evaluations. The researcher's role in trial planning and evaluation is to ensure that the trials are planted in a way that will give meaningful data, to provide neutral information about technology options, and to encourage the farmers to express freely their opinions about the different technologies.

It is not necessary to give details about the many methods available for FPR with forages, as these have been written about extensively elsewhere (for example, Chambers 1994 a,b,; Ashby 1990; Ashby (in press); FSP 1995). However, some important principles of FPR are worth noting (Ashby 1996; Chambers 1994b):

- Farmers are natural researchers who can identify research priorities, observe, compare, analyze, and draw conclusions about trial results.
- Farmers should, from the beginning, participate actively in all research-related decisions. Simply conducting forage trials on a farmers field does not make the trials "participatory."
- Farmers have the right to know and evaluate all options before making any decisions regarding forage technologies.
- Researchers should make a broad range of forage technologies available to the farmers and provide neutral information about them.
- Researchers need to acknowledge that farmers are experts in their own farming systems and have much useful information to give. The concept of downward or "vertical" transfer of technologies from researchers to farmers has not been effective.
- FPR is **not** a method of recommending or transferring technology. It is not an alternative to extension but an aid to more successful adoption from extension.

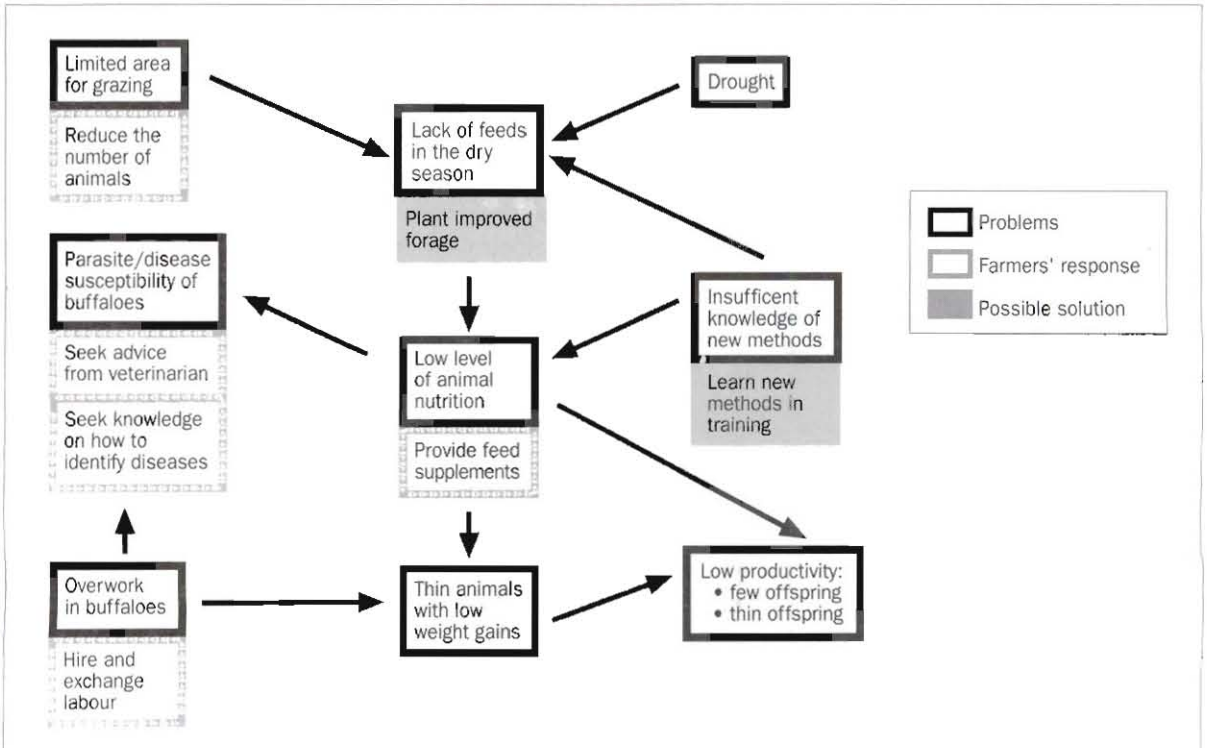

Figure 2. Feed resources problem diagnosis by smallholder farmers in Matalom, Leyte, Philippines.

- FPR is **not** an alternative to on-station research but an aid to it. Each can benefit from feedback from the other.

The relationship between farmers and researchers significantly determines the success of a FPR project. To be successful in FPR, researchers need to develop skills in establishing neutrality, inspiring confidence from farmers, being flexible in their use of methodologies, encouraging farmers without influencing them, listening to and respecting farmers' opinions, using probing questions, and facilitating groups so that all farmers participate. These skills are deceptively difficult. They require researchers to acknowledge their biases and try to understand the farmer's perspective.

The forage technology options mentioned in the first part of this paper are simply **options that require evaluation by farmers**, who will then provide feedback on their merits and failings. Sometimes farmers will provide other uses for the forages researchers did not consider, and sometimes ask for technologies the researchers have not considered. Either way, the goal of aiding adoption of introduced forages will be advanced.

Opportunities for Participatory Research in the Forages for Smallholders Project

At what specific stages in a research program can farmers' inputs assist with forage technology development? The Forages for Smallholders Project (FSP) uses FPR methods to foster better adoption of forage technologies by smallholders. Farmers are currently (or will be) actively involved in:

- assessing farmers' priorities in forage research and defining of research objectives through diagnosis,
- evaluating large numbers of forage species to eliminate species farmers strongly dislike,
- comparing the most promising forage species to determine what types of forages farmers perceive as most or least promising and the specific reasons why one option is more or less appealing than others to farmers, and
- evaluating the advantages and shortcomings of technologies many farmers consider the best.

Figure 3 illustrates the activities followed in developing appropriate forage technologies for smallholder farmers in the FSP. The stages at which FPR is being used are presented in Table 2. Problem diagnosis is seen as guiding the decisions about which species will be initially evaluated. Through the active involvement of farmers, the large initial collection of forage species can be reduced to 10 or 15 adapted and potentially appropriate species. These will then be carried forward to multiple on-farm evaluations by farmers. From these evaluations, several broadly adapted and appropriate species for each farming system will be identified and, with the active involvement of farmers, local multiplication systems (seed or vegetative propagation) will be investigated.

FPR is a long-term undertaking but the likely reward is improved forage adoption. The potential benefits of FPR are nicely summed up in a short parable from the Philippines.

> Three doctors were sitting in the shade of a tree in a village, watching a man walk toward them. The man was walking in a strange way

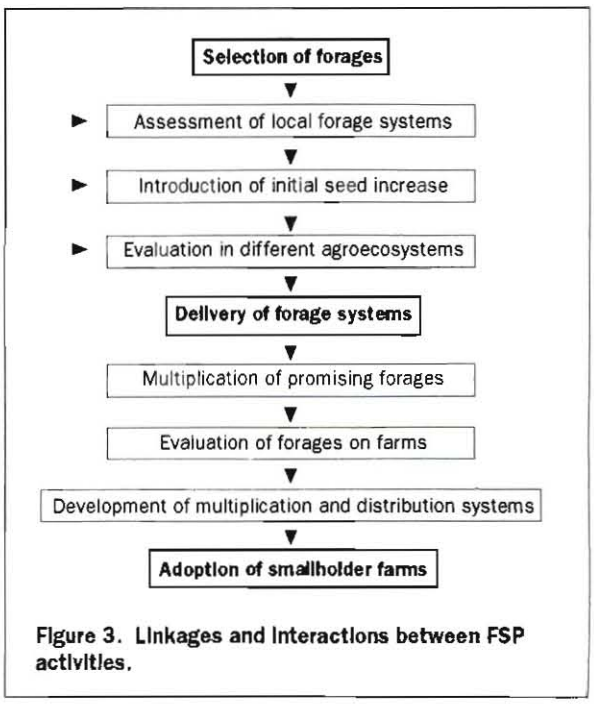

Figure 3. Linkages and interactions between FSP activities.

Table 2. Opportunities for participatory research in the FSP.

ACTIVITY	Non-PR	PARTICIPATORY RESEARCH		
		Diagnosis	Planning/Trialing	Evaluation
Assessment of local forage systems		•		
Introduction and initial seed increase	•			
Evaluation in different agro-ecosystems	•			•
Multiplication of promising forages	•			
Evaluation of forage on farms			•	•
Development of forage multiplication and distribution systems	•	•	•	•
Farmer training in forage management	•			

and the doctors decided to try to guess what was wrong with him before he arrived. "Of course," said the first, "he has a bad knee. You can see this from the way he walks". "No," said the second, "he has a bad back. You can see this from the way he leans over." "You are both wrong, "said the third, "he has a stomach ache and is in pain." When the man arrived they asked him if he was sick. He straightened up and, in a surprised way, said "Why, no! I'm just in a hurry to go to the toilet." All three doctors laughed but a woman standing nearby said, "Next time, don't treat anyone until you have asked him/her first what is wrong. The same goes for our village. Don't just go on with your projects. Ask the people first what their problems and needs are." If the doctors had followed their own perceptions, the man would have been treated for problems he didn't have. If the doctors had used a PR approach, they would have discovered that what was really needed was a latrine closer to the man's house!

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Forages for Smallholders Project—Country Reports of Activities and Results

FSP Activities and Results in the Philippines

P. Faylon and E. Lanting[1]

The Philippines R & D program for Forage, Pasture, and Grassland Commodity was evolved to support the development and enhancement of the country's livestock (ruminant) industry. Because of limited resources, the R & D areas identified (Table 1) were prioritized, vis-a-vis the urgency and magnitude of the problem. In like manner, to attain the objectives of the national program, the implementing strategies and priority R & D activities to be pursued up to year 2000 were identified (Appendix 1). These R & D projects are envisioned to develop the technology needs of the backyard and commercial livestock raisers.

The Forages for Smallholders Project (FSP), whose aims include to increase the availability of adapted forages for different agroecosystems with focus on smallholder farming system, complements the Philippines' current forage and pasture R & D initiatives. Its implementation boosts our present efforts on varietal collection, selection, evaluation, and development of seed production techniques.

FSP-Philippines Activities 1995

The activities of FSP-Philippines for 1995 focused on the introduction, evaluation, multiplication, and consequently, utilization of adapted species in different agroecosystems: agroforestry, upland cropping systems, plantation (coconut), and rainfed lowland rice systems. The project sites and collaborators in each target agroecosystem were identified and activities have commenced in varying degrees. The basic considerations in selecting project sites were the following:

- there is obvious need for forages, both in quantity and quality, for livestock production;
- the area is representative of the target agroecosystem, and is strategically located, i.e., easily seen by prospective technology users; and
- presence of prospective collaborators—contact person, organized farmers, and if possible, active area development programs/

Table 1. Priority R & D areas for forage, pasture & grasslands commodity, 1990-2000.

PRIORITY	RESEARCH AREA
1	Integration of fodder crops and utilization of farm by-products in various cropping systems
2	Management and utilization of pasture in open grassland and tree plantation
3	Germplasm evaluation and seed production
4	Socioeconomics and policy studies
5	Crop protection

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projects being implemented by local government units and other nongovernment organizations for linkages (logistical support and multiplier effect).

The activities pursued in 1995 can be divided into

1. Evaluation of forages,
2. seed production,
3. on-farm activities,
4. training, and
5. other activities.

1) Species Evaluation in Different Agroecosystems

This activity dovetails the Philippines' existing forage species performance evaluation program. The regional performance evaluation (RPT) network comprises fourteen agencies (Figure 1). The member agencies are situated in sites representing the different agroclimatic conditions of the country. The livestock production systems being addressed, the testing sites, and the species being evaluated are listed in Appendix 2. RPT's major activities are focused on (1) species evaluation, (2) advanced and on-farm trials, and (3) technology promotion (development). R & D activities are conducted both on-station and on-farm and are generally researcher-managed.

The species performance evaluation is a continuing activity to establish the basic/agronomic data of a species/cultivar in a particular agroecosystem or varied soil conditions (low pH, waterlogged, etc). Results of these trials will provide back-up data for the FSP's evaluation activities on farmer's field. Advanced and on-farm trials are concerned with evaluations of species' associative/combining ability and feeding/grazing experiments, which will determine the species' feeding quality. The development or technology promotion aspects of the project deals with the following: production of planting materials (seeds and vegetative) of the most promising species, for distribution to interested farmers; training for both farmers/ranchers and R & D workers; establishment of demonstration areas; and production of brochures, leaflets, and other extension materials.

2) Pilot Forage Seed Production

PCARRD has envisioned a Philippine forage/pasture seed industry. This vision has been discussed with several individuals and agencies, for possible linkage and logistical support.

Consequently, a pilot forage seed production project was approved and is being funded by PCARRD and the Department of Agriculture (DA) Region II. The project, started in April 1995, is being implemented in two sites in northern Philippines by two DA Stations—the Livestock Experiment Station (LES) in Gamu, Isabela, and the Research Outreach Station (ROS) in Aglipay, Quirino. The LES is headed by Mr. Vicente Pardiñez and the ROS by Mr. Charles Cabaccan.

The two sites were selected based on the following factors:

- favorable agroclimatic conditions for forage seed production, e.g., distinct wet and dry seasons, etc;
- proximity to livestock production areas;
- availability of technical personnel and logistical support;
- accessibility; and
- availability of other resources, such as land area, processing facilities.

In each site, seven species/cultivars are evaluated - six recommended by FSP for release throughout Southeast Asia and Cook Stylo which is now extensively used in Philippines. Each site is 7,000 m^2, or 1,000 m^2 plot for each species/cultivar.

Brachiaria and Stylo seeds were harvested in October 1995. Replanting of *Andropogon gayanus* was done because of very low seed germination.

FSP provides the critical technical assistance in all aspects of the project, including hands-on training of project staff on seed harvesting. It also provides inputs, i.e., seeds/vegetative planting materials, fertilizers, and herbicides.

Increasing the volume of seeds of promising lines and development of multiplication systems will be addressed in later dates by FSP and the RPT network.

3) Participatory On-Farm Evaluation of Forages

Participatory on-farm evaluations of forage crops are progressing well in Cagayan de Oro and Matalom, Leyte. These sites have been involved with the project since FSP-Phase I. Current activities and progress are discussed in detail by Gabunada (1996, this volume).

The FSP National Coordinator and the Project Officer conducted initial discussions with other prospective collaborators and visited possible project sites to expand the project to other target agroecosystems (Table 2).

It is expected that with the successful completion of the in-country training course on participatory research, more R & D workers will collaborate in this undertaking.

4) Training in Participatory Research

A four-week International Trainers' Training Course on Participatory Research was organized by the FSP Project Management Office and IRRI. The course was held in ViSCA, Baybay, Leyte, and IRRI, Los Baños, Laguna, Philippines, from 10 July to 4 August 1995. The course helped participants understand the roles of researchers and farmers in PR, practice the necessary skills, and learn methods for evaluating technologies with farmers. The course was participated in by forage researchers from Indonesia, Lao PDR, Malaysia, Philippines, Thailand, Southern China, and Vietnam. There were four participants from the Philippines.

The first in-country training course on PR was held at the Isabela State University, Echague, Isabela, Philippines, 9-20 October 1995. It was designed to expose FSP collaborators and prospective collaborators to PR methodology, in particular, to help them understand the key concepts and their roles in PR, practice and internalize the required skills, and learn the different methods of participatory evaluation and opportunities of PR vis-a-vis FSP.

The course was attended by 17 researchers from various Philippine R & D agencies. It was coordinated by the FSP-Philippines Coordinator and funded jointly by FSP and PCARRD.

5) Other Activities

FSP initiated the operationalization of the Southeast Asia Feed Resources Research and Development (SEAFRAD) Network. The network's first newsletter, the SEAFRAD News, was published in October 1995. Another issue was produced in December 1995.

Direction for 1996

The FSP-Philippines' future direction is basically toward the development of methodologies and mechanism that will hasten the adoption of forage technologies by smallholder farmers. A number of major activities have been programmed for the next four years (1996-2000):

- A stronger and effective working structure with project collaborators will be established and sustained;

Table 2. FSP Site descriptions.

Collaborating Agency	Location	Agro-ecosystem
1. Department of Agriculture-Bureau of Animal Industry	Sorsogon, Bicol Region Philippines	Under plantation (Coconut)
2. Philippine Carabao Center	Muñoz, Nueva Ecija Central Luzon, Philippines	Rainfed lowland rice systems
3. Department of Agriculture-Region 7	Argao, Cebu City Central Philippines	Upland cropping systems
4. Mag-uugmad Foundation Incorporated	Cebu City Central Philippines	Upland cropping systems
5. Philippine Coconut Authority-Davao Research Center	Davao City Southern Philippines	Under plantation (Coconut)
6. Southern Mindanao Agricultural Programme	Davao City Southern Philippines	Agroforestry/Upland cropping systems
7. University of Southern Mindanao	Kabacan, North Cotabato Southern Philippines	Rainfed lowland rice system

- Participatory diagnosis and evaluation (with farmers) will be expanded to other target agroecosystems;
- Farmers' trainings on forage agronomy and seed production will be conducted;
- Forage crop species performance evaluation in different agroecosystems will be pursued to provide back-up data for evaluation activities on farmers' fields;
- Forage seed production in smallholder farms to provide farmer with readily available and cheaper planting materials and/or as a viable business enterprise will be developed;
- Linkages with other sectors for logistical support, information exchange, multiplier effect, etc., will be forged and strengthened; and
- An effective system for forage multiplication and distribution will be developed.

Table 3 presents the detailed activities, by site, for implementation in 1996.

Table 3. Proposed FSP activities in 1996.

SITE AND COLLABORATORS	AGROECOSYSTEM	ACTIVITY	DURATION
Region 2, Cagayan Valley	Range (upland)	1. Maintain and manage 1000 m² plots of *Andropogon gayanus* CIAT 621, *Brachiaria brizantha* CIAT 6780, *B. decumbens* cv. Basilisk, *B. humidicola* cv. Tully, *Centrosema pubescens* CIAT 15160, *Stylosanthes guianensis* CIAT 184, and *S. guianensis* cv Cook for seed production.	Jan-Dec 1996
Site 1: CVIARC-LES Gamu, Isabela (Mr. Vicente Pardiñez and Sergio Darang)	special activity long dry season		
Site 2 CV-UPROS, Aglipay, Quirino (Mr. Charles Cabaccan and Mr. Rodrigo Cabaccan		2. Collect data on flowering and seed production characteristics of above cited species.	Oct 95-Oct 96
		3. Expand seed production of selected species on station.	Jul 96
		4. Develop farmer seed production schemes. • identify target farmers/area • organize field days • conduct farmer training in seed production	1996
		5. Develop a forage seed marketing systems	1997
Region 5, Albay	Plantations (Agroforestry)	1. Establish multiplication area of most promising forages in Buyuan and establish a sound working relationship with key farmers in the areas (H. Diesta and R. Arevalo).	May 95-early 1996
Albay Provincial Veterinary Office (Dr. Jose Losa and Mr. Rolando Arevalo)	cattle under coconuts (beef and some dairy)	2. Conduct on-farm evaluation of a range of forage technologies (H. Diesta and Alex Castillo; funded by PCARRD).	Oct 95-early 1996
Bureau of Animal Industry (Ms. Helen Diesta and Ms. Anita Deocareza)	mixture of semi-intensive and extensive systems	3. Conduct farmer participatory evaluation of forages (R. Arevalo, H. Diesta, F. Gabunada, W. Stür).	Early 1996
BUCAF (Mr. Gerardo Ocfemia)	mainly small-holder farmers	4. Collect secondary data (R. Arevalo).	Mar 96-May 96
	neutral to slightly acid soils	5. Conduct farmer participatory diagnosis of feed resources and forages, and planning of on-farm work (R. Arevalo, H. Diesta, F. Gabunada, W. Stür).	May 96-May 96 (one week)
	2000 mm AAR	6. Start farm evaluation.	Aug 96-May 1996
	4-mo dry season (Feb-May)		

Table 3. Proposed FSP activities in 1996.

SITE AND COLLABORATORS	AGROECOSYSTEM	ACTIVITY	DURATION
Region 7, Argao, Cebu	Sedentary upland cropping system	1. Establish forage multiplication/demonstration area in research station, and assign farmer cooperator	Sep 95-early 96
Southern Cebu Farming Systems Research and Development Station (SCFSRDS), Department of Agriculture Regional Field Office 7	calcareous soil (pH 8-10)	2. Select village farmers for on-farm work.	Mar 96
	hilly/steep (40% slope)	3. Conduct farmer participatory diagnosis.	Apr 96
Mr. Ronnie Jamola/ (Alicia Cosep)	5-6 month dry season maize and coconuts are main crops	4. Conduct participatory planning and establishment of forage evaluation plots.	Jun 96
	maize for subsistence coconut and vegetables for cash	5. Conduct farmer participatory evaluation.	May 97
	carabao and cattle used for draft	6. Distribute planting material distribution of selected forages.	Jun 97
	cattle is the dominant ruminant raised in backyard system		
	farm size is small (<1 ha app); most are owned		
	cut-and-carry important aspect of ruminant feeding		
Region 8, Matalom, Leyte			
FARMI, ViSCA (Dr. Edwin Balbarino)	Sedentary upland cropping system	1. Establish forage multiplication/initial testing sites managed by farmer groups "alayon"(Barangay San Salvador and Montealegre)	Sep 95-early 96
	low-fertility soils	2. Distribute forage planting materials (2-3 species) for individual testing by interested farmers.	Sep 96-early 96
	2000 mm AAR	3. Establish backup multiplication and demonstration area of forage species.	Sep 95-early 96
	4-mo dry season (Feb-May)	4. Conduct participatory evaluation of forages with farmers.	Mar 96
	ave farm size 1.3 ha, mostly tenanted by smallholder farmers	5. Conduct farmer training on forage and livestock management.	May 96
	lower portion: undulating acid soils, upland rice-based	6. Distribute planting materials selected by farmers during participatory evaluation.	Jun 96
	upper portion: hilly, calcareous soils, maize-based		
	carabao, cattle, and goat raised by tethering in fallow areas		
	subsistence farming dominant		
	carabao is the major source of draft power		

Table 3, continued

SITE AND COLLABORATORS	AGROECOSYSTEM	ACTIVITY	DURATION
Region 10, Cagayan de Oro City City Veterinary Office and Cagayan College (Dr. Perla T. Asis)	Sedentary upland cropping system hilly/steep (up to 50% slope) slightly acid to slightly alkaline soils (pH 6-8) 2000 mm AAR 2-3 mo dry season ave farm size >1.5 ha, mostly claimed public lands maize is main crop; bananas and root crops also planted cattle and carabao are the major ruminants raised by tethering in uncropped areas cattle is the dominant ruminant for draft favored over carabao	1. Establish forage multiplication/initial testing sites managed by farmers' associations (Barangay Pagalungan). 2. Conduct participatory evaluation of forages with farmers. 3. Conduct farmer training on forage management. 4. Distribute planting material of forage species selected by farmers during evaluation. 5. Establish demonstration area for grazing (Cagayan Capitol College) 6. Conduct small-plot experiments on cut-and-carry with or without fertilizer (Cagayan CapitoCollege)l 7. Conduct small-plot experiments on cover crops/ pioneer species (Cagayan Capitol College). 8. Conduct tree-legumes small-plot experiments (Cagayan Capitol College).	Dec 95-early 96 May 96 May 96 May 96 Jun 96 Jun 96 Jun 96 Jun 96
Region 11, Philippine Coconut Authority (PCA), Davao Research Center Dr. Severino Maggat/ Mr. Junaldo Mantequilla	Plantations (Agroforestry) cattle grazing under coconuts variety of farm sizes, predominantly smallholders 2000 mm AAR no dry season, or short dry season medium fertility soils around pH 6	1. Conduct multiplication of a range of forages for on-station and on-farm experiments. 2. Evaluate forage technologies for grazing under coconuts (7 grass or grass legume associations grown in grazed 5 x 5 m plots). 3. Evaluate legumes for use as cover crops in coconut plantations. 4. Establish demonstration plots of grasses for cut-and-carry in small plots. 5. Select a target area for farmer participatory research • collect secondary data • farmer participatory diagnosis and planning of on-farm research 6. Begin on-farm research.	Oct 95-Apr 96 May 96-Oct 98 May 96-Oct 98 May 96–Oct 96 Mar 96-Oct 97 Oct 96

Table 3, continued

SITE AND COLLABORATORS	AGROECOSYSTEM	ACTIVITY	DURATION
Region 12, **Philippine Carabao Center, University of Southern Mindanao, Kabacan, North Cotabato** (Prof. Cornelio Subsuban/ Mr. Jeffrey Rabanal)	Mixed small farms system (sedentary upland, rainfed lowland, plantations) moderately fertile soils 2000 mm AAR no dry season or short dry season	Evaluate cut-and-carry species; tree legumes; cover crops fruit trees; and legume leaf meal production.	1996

Appendix 1. R & D program strategy and major activities, 1990-2000.

Implementing strategy	R & D Activity
Incorporation of legumes into native pasture to improve the feeding value of forages and to improve soil productivity through biological nitrogen fixation	*Research* • Improvement, management, and utilization of improved grass-legume, focusing on promising forages species • Conduct of basic research on pasture crop dynamics, plant-microbe interactions and crop physiology *Development* • On-farm trials on overseeding of legumes on native pastures and improved grass-legume combination, vis-a-vis stocking rates, promising species • Massive promotion of technologies developed
Integration of fodder production schemes into small farming system to maximize utilization of farm by-products	*Research* • Development of production modules, vis-a-vis, fitting forages under existing cropping patterns/farming systems *Development* • On-farm testing of modules developed • Massive promotion of technologies developed
Systematic collection, screening, and evaluation of forage and pasture	*Research* • Varietal collection, species evaluation and selection, and seed production technology • Integrated performance evaluation of forage and pasture crops in different ecological zones/agroclimatic conditions and soil conditions *Development* • Seed production of recommended forage and pasture species

Appendix 2. Production systems, assigned forage species, and RPT-member agencies.

	IMPLEMENTING AGENCY/LOCATION	Assigned Genus/Species	
		Grasses	Legumes
CUT AND CARRY	1. Mariano Marcos State University (MMSU), Ilocos Norte	*Pennisetum* *Panicum* *Setaria*	*Leucaena* *Gliricidia* *Desmanthus*
	2. Bureau of Animal Industry (BAI) Batangas and Laguna		*Leucaena* *Desmodium* *Desmanthus*
	3. Isabela State University (ISU) Isabela	*Brachiaria* *Andropogon* *Pennisetum*	*Stylosanthes* *Leucaena*
	4. Pampanga Agricultural College (PAC), Pampanga	*Brachiaria*	*Leucaena* *Gliricidia* *Desmanthus* *Flemingia* *Desmodium* *Acacia* *Macroptilium*
	5. Visayas State College of Agriculture (ViSCA) Leyte	*Pennisetum* *Panicum* *Setaria*	*Leucaena* *Gliricidia* *Desmodium*
	6. West Visayas State University (WVSU) Iloilo	*Pennisetum*	*Leucaena* *Gliricidia* *Stylosanthes*
	7. University of Eastern Philippines (UEP) Nothern Samar	*Panicum* *Pennisetum* *Setaria*	*Desmodium* *Arachis*
	8. Abra State Institute of Science and Technology (ASSIST) Abra	*Pennisetum*	*Centrosema*
	9. University of Southern Mindanao North Cotabato	*Pennisetum*	*Desmodium* *Desmanthus*
	10. Bureau of Animal Industry (BAI) Sorsogon	*Pennisetum*	
PLANTATION CROPS	1. Bureau of Animal Industry (BAI) Sorsogon	*Bracharia*	*Centrosema* *Arachis*
	2. Camarines Sur State Agricultural College (CSSAC)	*Bracharia*	*Stylosanthes*
	3. Visayas State College of Agriculture ViSCA, Leyte	*Setaria* *Panicum*	*Centrosema* *Stylosanthes*
	4. University of Southern Mindanao (USM), North Cotabato	*Panicum* *Cynodon* *Setaria* *Paspalum*	*Centrosema* *Stylosanthes*
RANGE/GRAZING	1. Cagayan State University (CSU) Cagayan	*Brachiaria* *Panicum* *Andropogon*	*Centrosema* *Stylosanthes*
	2. Central Luzon State University (CLSU) Nueva Ecija	*Brachiaria* *Panicum*	*Stylosanthes* *Centrosema*
	3. Central Mindanao University (CMU) Bukidnon	*Brachiaria*	*Stylosanthes* *Macroptilium* *Centrosema* *Arachis*

Farmer Participatory Research Activities at Two Sites in the Philippines—Initial Results and Learnings

Francisco Gabunada, Jr.[1]

Farmer-participatory research activities have commenced at two sites in the Philippines. These are Cagayan de Oro City in southern Mindanao, and Matalom, Leyte in Eastern Visayas. At both sites, smallholder upland farming systems predominate. This paper presents the initial results of and learnings from participatory research in the sites.

Cagayan de Oro

The Cagayan de Oro site is located at Pagalungan, an upland barangay 17 km from the city. The site was chosen for the following reasons:

- Farmers' groups (rural-based organizations, or RBOs) actively involved in agricultural and livelihood improvement activities exist,
- there is active involvement and good working relationship between the local government unit, through the city veterinary office, and the farmers' groups,
- farmers have expressed their need to improve feed resources and livestock production (cattle dispersal and forage promotion have been started with the city veterinary office and the Pilot Provincial Agricultural Extension Project [PPAEP]), and
- the demand for livestock products is increasing because of the rapidly growing economy of the urban center.

The Farming System

Subsistence farming is practiced in the area. Food crops include maize (major), rootcrops (sweet potato, cassava) and banana. Coconut, mungbean, cowpea, and peanuts are also planted for cash income. Farms are steep with up to 50% slope and thus prone to erosion. Soil pH ranges from 6 to 8.

About half (49%) of the farmers are public land claimants, the rest are either owner cultivators (34%), tenants/shareholders(18%), leaseholders (5%), or landless farm workers (2.5%). Most farmers (98%) earn an average monthly income of about US$80.

Ruminants raised include cattle, carabaos, and goats. These are tethered in vacant areas to feed on native vegetation (*Imperata cylindrica, bagokbok, tigbaw,* and vines). Cattle is the dominant animal (3 cattle:1 carabao) used for draft due partly to scarcity of wallowing areas for carabaos. The use of supplements (cut forage near rivers, banana trunk, and rice bran) is minimal, and used only during the dry season or when animals are being used for draft.

Feed resources have become inadequate. During the dry season, the native vegetation becomes rank and dry. Moreover, *Chromolaena odorata* (locally known as *"hagonoy"*) dominates the grazing areas. Farmers have to spend more time grazing their animals, and animal performance is poor.

[1]Forages for Smallholders Project, CIAT, c/o IRRI, P.O. Box 933, 1099 Manila, Philippines.

Recently, farmers have started planting forages on their farms. These include napier (*Pennisetum purpureum*), *Desmodium rensonii*, and *Arachis pintoi*.

Collaborators

The primary collaborator is the City Veterinary Office (CVO) through its Livestock Production Section. The office assigns one livestock technician for every 5 barangays to work with the farmers and farmers' organizations. The office also provides livestock health services and organize cattle dispersal programs.

Another collaborator is the Cagayan Capital College (CCC) located in an adjacent barangay. The college has been the site of initial forage multiplication and testing.

A nongovernment organization (NGO) in the area has assigned a community development worker to take care of the existing RBOs.

Two farmers' groups (RBOs) in the barangay work with the project. The Tribal and Settlers Association (TRISA, 38 members) and the Centro Farmers' Association (FA, 38 members) work with the NGO and CVO on cattle dispersal and forage production.

A good working relationship among these collaborators has been established through the PPAEP.

The head of the Livestock Production Section, CVO, is the contact person of FSP. Communication is through visits, mail, telegram, and telephone. The CVO is capable of communicating with the collaborators in Cagayan de Oro through visits or through telephone (within the city). The office has necessary transport facilities for mobility.

FSP Activities and Initial Results

The following activities are carried out:

1. Species multiplication,
2. staff training,
3. participatory diagnosis and planning,
4. species testing by farmers.

1) Species multiplication

Species multiplication at CCC and in Pagalungan. This was done through the PPAEP in August 1995. *Arachis pintoi* CIAT 18744, *Desmodium heterophyllum* CIAT 349, and *Brachiaria dictyoneura* CIAT 6133 were planted in both sites. *Leucaena leucocephala* K636 was likewise established at CCC.

2) Staff training

Participation of CVO staff in a hands-on training conducted by FSP at IRRI. During the training, the prospects of conducting farmer-participatory activities were discussed. PPAEP, which shouldered most of the expenses of the trainees, will end in early 1996. A recently started cattle dispersal and forage promotion activities were to be carried out by CVO.

3) Participatory diagnosis and planning

Participatory diagnosis and planning of activities with farmers was done in November 1995. Staff from CVO and the CCC, and the community development worker of the NGO worked with the FSP staff. The activity involved two days of planning, review of secondary data, and selection of barangay and farmer groups; two days of visits to the site to interact with individual farmers; and one day for farmers' group meeting (attended by 35 farmers from TRISA and FA).

During the participatory diagnosis, farmers

- prepared a seasonal calendar for activities and problems related to crops, livestock, and feed resources (Table 1);
- identified and prioritized livestock-related problems with emphasis on feeds; and
- planned activities to address the most important constraint—feed.

The major findings were:

- Feed is inadequate, leading to poor animal performance and even death. *Chromolaena odorata*, a weed, relatively new to the area, has infested about two-thirds of the grazing areas. During the dry season, feed supply becomes even more scarce. Consequently, farmers have to spend more labor bringing animals to farther grazing areas (increasing risk for theft) or gathering forage. Farmers perceive that time will come when they cannot graze their animals on areas they do not own.
- A few farmers have started planting forages on their own farms, either in plots separate

Table 1. Seasonal calendar prepared by farmers in Pagalungan, Cagayan de Oro.

	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
A. Crops																		
Maize							Pl[1]		H[1]	Pl		H	Pl		H			
Sweet potato					Pl	Pl	Pl			H	H	H	H	H	H			
Cassava					Pl	Pl					H	H						
Cowpea										Pl		H						
Mungbean										Pl		H						
Peanut										Pl		H	Pl		H			
Coconut	Harvested throughout the year																	
Banana																		
B. Rainfall (no. of seeds indicating rainfall intensity)[2]					3	9	10	8	7	6	5	4	1	0	0	2		
C. Feed scarcity[3]	+	++	++	++	++			++	++		++	++	+	++	++	++	++	
D. Feeds used aside from grazing																		
Cut forage[4]	•	••	••	••	••			••	••		••	••	•	••	••	••	••	
Maize bran[4] (For working animals only)				••	••			••	••		••	••				••	••	
Banana trunks[4](for working animals only)				••	••													
E. Animal diseases																		
Respiratory diseases			•	•	•	•				•	•	•			•	•	•	•

[1]Pl = planting, H = harvesting
[2]Numbers indicate the amount of rain as perceived by farmers (the higher the number, the more rain)
[3]+ scarce, ++ = very scarce
[4]• = sometimes given, •• = often given

from crops or as contour hedgerows. They feel the need for expanding this and finding suitable species. For instance, some have observed the lack of persistence in napier grass under frequent cutting.

- There is a need to find ways of controlling *Chromolaena odorata.*
- Farmers favor establishing forages on their own farms although they keep their animals far from their houses at night. Destruction by other animals (grazers and pigs) is more likely since their houses are in clusters.
- The farmers decided to try a variety of forage species in a common area, for a start. They signified their readiness to provide labor for establishment and maintenance through the commonly practiced *"pahina"* (cooperative work). The two farmers' groups (TRISA and FA) agreed to work together under the coordination of CVO. Fencing materials were requested to keep the area safe from unwanted grazing. The group intends to choose from the forages in the area and get planting materials from it.

4) Species testing by farmers

Establishment of forage multiplication/initial testing area managed by farmers. Planting materials were taken from FSP site in IRRI and the multiplication area of CCC. Forage species with potential for grazing, as hedgerows/fencelines and cover crop/pioneer species, were tested (Table 2).

Learnings

The activities at Cagayan de Oro indicated that:

- Effective communication is necessary for coordination of activities. Because of distance and the fact that collaborators/farmers have other activities, arrangements need to be done well in advance. Rapport among those involved is also very important.
- Considerable time and effort are needed for planning the activities. Collaborators and farmers need to be aware of what will be done. Because participatory activities involve team effort, everyone should have a common understanding of the activity.

Table 2. Species tested at Pagalungan, Cagayan de Oro.

USE	SPECIES
Grass legume associations for grazing	*Brachiaria decumbens* CIAT 606 + legumes[1] *Brachiaria humidicola* CIAT 6133 + legumes *Paspalum guenoarum* BRA 3824 + legumes
Legumes as cover crop or pioneer species	*Stylosanthes guianensis* CIAT 184 *Centrosema acutifolium* CIAT 5277
Upright grasses and legumes as hedgerows	*Andropogon gayanus* CIAT 621 *Brachiaria brizantha* CIAT 26110 *Panicum maximum* CIAT 6299 *Paspalum atratum* BRA 9610 *Pennisetum purpureum* (local) Florida napier grass *Desmodium rensonii* *Gliricidia sepium* *Leucaena leucocephala* K636 *Leucaena pallida* CQ 3439

[1]legumes were *Stylosanthes guianensis* CIAT 184, *Arachis pintoi* CIAT 18744 + *Centrosema pubescens* CIAT 1516

- Collaborators must devote some time to discussing the principles and important aspects of participatory research before planning field activities.
- Farmers also need to understand the concepts of participatory research. Their role as equal partners who have important ideas to contribute, not as persons who need to be taught by researchers, must be emphasized.
- Secondary data are important but must be treated only as means to an end. Although it will be useful for those not familiar with the site to have ample time to review the data, this type of data should be treated only as a guide for finding issues to discuss with the farmers.
- It should be stressed that participatory diagnosis does not limit itself to farmer group meetings. A very important consideration is to visit remote farms/farmers.

Matalom, Leyte

Matalom was chosen for the following reasons:

- Farmers have felt the need and expressed willingness to improve their limited feed resources and livestock production,
- there are farmers' groups (locally known as "*alayon*") engaged in participatory activities of trying out technologies to improve the agricultural livelihood, and
- strong collaborative activities of the local government, line agencies (agriculture, agrarian reform, health, social welfare), NGO, farmers' organization, and agricultural research and development workers exist.

The farming system

Farming is mainly for subsistence; an average farmer cultivates 3 parcels with a total area of 1.3 ha. Lower areas, which are undulating and have acid soils (pH 4-5.5), are grown mainly to upland rice. Maize is the main crop in the more hilly calcareous soil (pH > 7) areas. Rootcrops, banana, and rainfed lowland rice (in valleys) are grown in both soil types. Peanuts, mungbean, and coconut are minor crops for income generation. Crop-fallow rotation is practiced due to poor and declining soil fertility caused by erosion. Fertilizer and purchased inputs are not used.

Carabao (for draft), cattle, and goats are raised, and sold when cash is needed. These animals are tethered in vacant/fallow areas occupied by native vegetation (*Axonopus compressus*, *Paspalum conjugatum*, and *Chrysopogon asciculatus*). Very little supplementation and purchased inputs are used.

Farmers traditionally raise animals to augment their income from cropping, ruminant population has increased.

Poor soil fertility, limited grazing areas, and dry periods result in insufficient feed quality and quantity and farmers have become more interested in improving their feed resources. Many have started establishing forages either as contour hedgerows or in small plots. Farmer groups have recently taken out cattle loans to augment their income.

Collaborators

The FSP directly collaborates with the Farm and Resource Management Institute (FARMI) of the Visayas State College of Agriculture. FARMI is conducting participatory research and development activities with farmer groups.

Both FARMI and the farmer groups are members of a local network called "Matalom 2000", participated in by the local government unit, line agencies, and NGO in Matalom. This working body aims to coordinate activities of the member organizations for the development of Matalom.

Communication between FSP and FARMI is through telephone, mail, and electronic mail. Matalom-based FARMI staff are equipped with transport for mobility.

FSP Activities and Initial Results

The activities involving FSP forages for 1995, and initial results, are as follows:

1) Preliminary experiments and regional evaluation

- Preliminary trial: oversowing of legumes into upland rice for fallow improvement and grazing. Five grass and 26 legume species (Table 3) were undersown into upland rice a month before harvesting. No weeding was done and heavy grazing commenced in summer. Among the species that have survived are *Brachiaria humidicola* cv Tully, *Paspalum atratum* BRA 9610, *Chamaecrista rotundifolia* cv Wynn, *Desmodium heterophyllum* CIAT 349, *Desmodium ovalifolium* CIAT 350, *Stylosanthes guianensis* (CIAT 184, CIAT FM series), and *Stylosanthes hamata* cv Verano.
- Evaluation of species used as hedgerows in sloping lands. Eight grass and eight legume species (Table 4) were established as hedgerows in an acid soil area. These species are intended for farmer-participatory evaluation in summer 1996.

Table 3. Species tested for oversowing into upland rice at Matalom, Leyte.

Legumes	Grasses
Aeschynomene americana cv Glenn	*Andropogon gayanus* cv Kent
Aeschynomene americana cv Lee	*Bothriochloa insculpta* cv Bisset
Aeschynomene histrix CIAT 9690	*Bracharia decumbens* cv Basilisk
Calopogonium muconoides CIAT 17856	*Brachiaria humidicola* cv Tully
Centrosema acutifolium CIAT 5277	*Paspalum atratum* BRA 9610
Centrosema Hybrid CIAT 438	
Centrosema pascuorum cv Bundey	
Centrosema pascuorum cv Cavalcade	
Centrosema pubescens CIAT 15160	
Chamaecristra rotundifolia cv Wynn	
Desmodium heterophyllum CIAT 349	
Desmodium ovalifolium CIAT 350	
Lablab purpureus cv Rongai	
Lablab purpureus cv Highworth	
Macroptilium gracile cv Maldonado	
Macroptilium lathyroides cv Murray	
Macroptilium martii CPI 49780	
Stylosanthes guianensis CIAT 184	
Stylosanthes guianensis CIAT FM05-1	
Stylosanthes guianensis CIAT FM05-2	
Stylosanthes guianensis CIAT FM05-3	
Stylosanthes guianensis CIAT FM07-1	
Stylosanthes guianensis CIAT FM07-2	
Stylosanthes guianensis CIAT FM05-3	
Stylosanthes hamata cv Verano	
Stylosanthes scabra cv Siran	

Table 4. Species evaluated as hedgerows in sloping lands at Matalom, Leyte.

Grasses	Legumes
Andropogon gayanus CIAT 621	*Cratylia argentea* CIAT 18516
Brachiaria brizantha CIAT 6780	*Desmodium heterophyllum* CIAT 349
Brachiaria brizantha CIAT 16318	*Desmodium ovalifolium* CIAT 3666
Brachiaria brizantha CIAT 16835	*Desmodium rensonii* (ex) Davao
Panicum maximum (local)	*Gliricidia sepium* (local)
Paspalum atratum BRA 9610	*Stylosanthes guianensis* CIAT 184
Pennisetum purpureum (local)	*Stylosanthes guianensis* CIAT FM05-3
Setaria splendida (local)	*Zornia glabra* CIAT 7847

- On-farm testing of *Stylosanthes guianensis* CIAT 184 oversown into upland rice for fallow improvement. *Stylo* 184 was oversown into upland rice a month before harvest. The area will be put under fallow and compared with natural fallow. The activity is intended primarily for demonstration.

2) Participatory and diagnosis and planning

Results of the participatory diagnosis done as a part of the practicum during the PR training was validated through individual and farmersí group interaction. The need for forages and for training of farmers on livestock and forage production was identified.

In a meeting with farmer-leaders and FARMI collaborators, the following activities were approved for implementation.

- Initial testing/multiplication sites will be established in two barangays, one in San Salvador (acid soil) and another in Montealegre (calcareous soil). These activities will be managed by the respective farmer groups in the barangays.
- A backup multiplication site managed by FARMI will be established.
- Planting materials (two species each) will be provided to leaders of other farmer groups. This was felt necessary so that the farmers will have a basis for comparison with the species to be evaluated.
- Participatory evaluation will be conducted in the 1996 dry season.

3) Species testing by farmers

Establishment of initial testing/multiplication plots and distribution of planting materials to farmer group leaders. Seven grasses and eight legumes were tested (Table 5). The species were selected based on the results of previous species testing in the area and the purpose for which farmers intend to use the forages, such as contour hedgerows, grazing, and fallow improvement.

Twenty-seven farmers received planting materials for individual testing.

Table 5. Species tested by farmer groups in Matalom, Leyte.

Species	San Salvador	Montealegre
Grasses		
Andropogon gayanus CIAT 621	x	x
Brachiaria brizantha CIAT 6780	x	x
Brachiaria decumbens cv Basilisk	x	x
Brachiaria humidicola CIAT 16886	x	x
Panicum maximum CIAT 6299	x	x
Pennisetum purpureum cv Capricorn	x	x
Legumes		
Aeschynomene histrix CIAT 9690	x	
Arachis pintoi CIAT 22160	x	x
Centrosema autifolium CIAT 5277	x	x
Centrosema pubescens CIAT 15160	x	
Desmanthus virgatus CPI 40071		x
Desmodium rensonii (ex) Davao	x	x
Flemengia macrophylla CIAT 17403	x	x
Gliricidia sepium (local)	x	x
Leucaena leucocephala K636		x
Stylosanthes guianensis CIAT 184	x	x

Learnings

The conducted activities in Matalom, Leyte, showed that:

- There is a need to assure availability of planting materials for replanting. A good option is to establish seeds in a nursery where water is available.
- Monitoring is necessary, especially during the establishment of the plots. Farmers may hesitate to implement activities such as weeding. Accidental weeding can occur because of unfamiliarity with the species.
- Farmers'comments/observations must be noted from time to time, not just on the designated evaluation schedule. Farmers may forget some aspects if the time from establishment to evaluation is long.

Plans

Participatory evaluation is scheduled in summer of 1996. Farmers' training is also planned. Distribution of planting material of selected species is planned in the wet season of the year. By then, farmers themselves can test how these forages fit into their farming systems.

Site-specific researchable areas that cannot be resolved by farmer-participatory activities, which might be identified during the conduct of these activities, will be addressed by CCC for Cagayan de Oro and by FARMI for Matalom. Disseminating and facilitating adoption of generated technologies will be the responsibility of the CVO in Cagayan de Oro and Matalom 2000 network in Matalom, Leyte.

FSP Activities and Results in Indonesia

M. Tuhulele[1]

In April 1991, the Directorate General of Livestock Services started a program of distributing cuttings of *Pennisetum purpureum* (napier), giant napier, and *Setaria sphacelata* var. splendida to smallholder farmers in Indonesia. The main objective was to increase the supply and quality of forages. However, it was reported that only 40-60% of the established plants survived, many died during the dry season. Factors that contributed to low survival were acidity and low fertility of many soils in western Indonesia, the long dry season in the eastern part, and reluctance of farmers to fertilize forages. Extension efforts to encourage farmers to use manure or commercial fertilizer have failed.

Since April 1992, the distribution program has added legume seeds/planting materials to the package. With the exception of *Gliricidia sepium* (gliricidia), many of the legume plants did not survive, or showed poor growth in many areas. One problem with *Gliricidia* is that cattle do not favor it at first, necessitating an adaptation period. Outside Java and Bali, there are still vast areas of wasteland and farmers prefer to look for native grasses, even if they have to walk a long distance, rather than trying *Gliricidia*.

One reason for the poor performance of the legume species in western Indonesia may be that many of the available cultivars are poorly adapted. Most of the species are commercial Australian varieties which are often well-adapted to eastern Indonesia (which has a similar environment to parts of tropical Australia), but are not well-adapted to the western part.

The Forage Seeds Project offered an opportunity to try a range of new forages. Several adaptation trials on forage and legume accessions from CIAT and CSIRO were conducted over a wide range of soil and climatic conditions; soil type ranged from sandy to clay with pH from 3.5 to 7.0, and annual rainfall ranged from 1500 to 4000 mm. The trials were started in January 1992.

The final meeting of the Forage Seeds Project, held in Samarinda, Indonesia, 23-28 October 1994, was attended by representatives from CIAT, CSIRO, China, the Philippines, Lao PDR, Vietnam, China, Thailand, Malaysia, and Indonesia. It was concluded that the following introduced forage accessions have great potential for the entire region:

- *Andropogon gayanus* cv. Planaltina (CIAT 621)
- *Brachiaria brizantha* cv. Marandu (CIAT 6780)
- *Brachiaria decumbens* cv. Basilisk
- *Brachiaria humidicola* CIAT 6369, cv Tully, CIAT 6133
- *Centrosema pubescens* CIAT 15160
- *Stylosanthes guianensis* CIAT 184

[1]Directorate General of Livestock Services, Jalan Harsono Rm. No. 3, Gedung B, Lantai II, Rangunan, Jakarta Selatan 12550, Indonesia.

The meeting also considered that other species that showed potential at some sites should be tested further.

The Forage Seeds Project was followed by the Forages for Smallholders Project (FSP), which started in January 1995. Its aims are:

- to identify adapted and appropriate forage species, with emphasis on agroforestry and upland agriculture,
- to achieve integration of these species into smallholder farming systems by working directly with farmer groups, and
- to develop systems to make planting materials of these forages available to farmers in other regions.

Current situation

1) East Kalimantan

Cameron *et al.* (1995) reported that five grasses and two legumes performed well over a range of sites. The grasses were *A. gayanus* cv. Planaltina, *B. decumbens* cv. Basilisk, *B. brizantha* cv. Marandu, *B. humidicola* CIAT 6369, and *P. maximum* cv. Riversdale, and the legumes were *C. pubescens* CIAT 15160, and *S. guianensis* cv. Pucallpa (CIAT 184). Later, because of shortage of seed and vegetative planting material, seed of *A. gayanus* cv. Kent and *B. humidicola* cv. Tully (commercial cultivars from Australia) were also distributed to farmers. These two cultivars now grow well at test sites. Tully, which is very aggressive, seems to have potential to become a weed.

Arachis glabrata, another promising species, should be further evaluated because of its persistence in shade. Other species that should be tested further, because of some capacity to suppress *Imperata cylindrica*, are *Centrosema macrocarpum*, *C. acutifolium*, and *Desmodium ovalifolium*. *Paspalum guenoarum* and *P. atratum* are favored by farmers and should also be further evaluated.

2) Central Kalimantan

In Central Kalimantan, some other species, besides those recommended at the meeting, show good performance. These are *Digitaria swynnertonii*, *Brachiaria dictyoneura*, and *Flemingia macrophylla*.

In March 1995, cuttings of *Paspalum atratum* were sent to Tahai in Kapuas District, and Kanamit. The last monthly report indicates that these species grow well, are eaten by cattle, and are favored by farmers.

The Central Kalimantan area, which is very difficult to reach especially during the wet season, will not be included as a major project site. The local staff, however, who have been enthusiastic and effective, will be involved in training and networking activities.

3) South Kalimantan

The activities in South Kalimantan are still restricted to the government seed multiplication center, UPT Pelaihari.

In addition to the species recommended at the meeting, *Paspalum atratum*, *P. guenoarum*, *Cratylia argentea*, and *Flemingia macrophylla* show good performance. To date, seed of *C. argentea* (37 kg), *F. macrophylla* (40 kg), and *C. pubescens* (17 kg) have been produced. Some of this seed has been sent to other UPTs and Regional Offices for further evaluation, but no data have been reported from UPT Pelaihari.

4) UPT Serading, Sumbawa

Most of the species planted, consisting of 13 legumes and 7 grasses, came from Australia. Emergence of most of the lines – cultivars *Brachiaria humidicola* cv. *Tully*, *B. decumbens* cv. *Basilisk*, *Andropogon gayanus* cv. Kent, *Stylosanthes hamata* cv. *Verano*, *Lablab purpureus* cvv. Highworth and Rongai, *Macroptilium atropurpureum* cv. Aztec, *M. lathyroides* cv. Murray, *Clitoria ternatea* cv. *Milgarra*, and accessions of *Clitoria ternatea*, *Macroptilium bracteatum*, *Vigna trilobata*, and *Centrosema plumieri* – is good or excellent. No further reports on the seed production of these species have been received.

5) Other UPTs

The seed from CIAT and CSIRO was distributed to other UPTs and provinces. Most of the grasses were distributed by cuttings since seed production is very poor. The legumes stylo and centro set good seed, but because the UPT staff have little experience with harvesting, most seed was lost through shedding.

Future activities

Future activities to develop adapted and appropriate cultivars have been planned. A preliminary survey of the agroecosystems of some of the target areas has been conducted and two target sites were selected in East Kalimantan. There has been no decision on definite sites in other areas. Participatory diagnosis with local farmers will be conducted at all sites. Some information on the target areas, and the reason for selection will be described in a later section of this paper.

The criteria for selecting a site include :

- willingness of the farmer group in the area to work with the FSP (i.e. perceived need for more feed);
- a group of 20-30 members, the majority being active members (as opposed to passive owners);
- security of tenure;
- a good field extension worker (PPL) or key farmer who is willing to work with the project and a subject matter specialist (PPS) who can supervise the work; location accessible throughout the year.

Description of target areas

1) Makroman and Sepaku in East Kalimantan

Makroman was selected as a rainfed lowland system and Sepaku II as a natural Imperata grassland area. Both sites meet most of the selection criteria.

Both areas have potential for beef cattle production. Sepaku II was chosen as a pilot site for integrated cattle management (feed, AI, animal health, and breeding). The soil is mostly podzolic, with pH between 4.5 and 6.0. The villages have their own PPL, who will work together, with Ir. Ibrahim (PPS, Provincial Livestock Service) as the coordinator.

2) Aceh Province

One or two villages in Aceh Province will be selected as natural grassland sites. The villages in the District of Aceh Besar have potential for evaluation of different options for these degraded grazing areas, where cattle population is high.

3) North Tapanuli District, North Sumatra

A further investigation on the potential of Balige subdistrict in North Tapanuli District should be conducted. Balige is a lowland ricefield area, and the farmers appeared enthusiastic and keen to try new varieties of forage. They currently grow some napier, giant napier, and signal grass.

4) North Sulawesi

For sites in a plantation area, the districts of Bolaang-Mongondouw and Gorontalo in North Sulawesi will be surveyed further. These are vast coconut areas, where the coconuts are more than 20 years old. Most of the area under the coconut trees is open and available for grazing animals.

A target agroecosystem for the FSP is agroforestry, but we have not found a suitable area. Except for Sepaku II and Makroman, FSP activities for new target areas have started with a preliminary survey.

Other activities

1) Training

An in-country training course on Participatory Research is scheduled in March 1996 in Samarinda, East Kalimantan. The instructors will be those who attended the Training for Trainers Course on Participatory Research, in IRRI, Los Baños. The participants will be fellow researchers from the Animal Research Center, extension workers, and other people responsible for forage and animal production programs in their provinces.

A 10-day in-country course on Seed Production and Management was conducted at Bogor by the Directorate of Livestock Production. The course provided basic knowledge and practices on seed production and management. The lecturers were the faculty of Animal Husbandry in Bogor, the Seed Laboratory of Bogor Agriculture University, and the Centre for Soil and Agroclimate Research.

2) Newsletters

The first issue of FSP News was translated into Indonesian to enable the field workers, most of whom do not speak English, to understand. The English version was distributed to universities, provincial livestock officers, and others interested in forages. The first issue of the SEAFRAD Newsletter was distributed also to universities, provincial livestock officers, and other interested individuals.

3) Coordination

By the mandate of the Director General of Livestock Services, the Director of Livestock Production is responsible for the overall activities of FSP in Indonesia. The Head of the Subdirectorate of Forages is appointed as coordinator for the field activities. At the provincial level, the Head of the Provincial Office is responsible for activities in his working area. He is assisted by a PPS, who coordinates the PPLs and who has direct access to the farmers in his working area.

To facilitate the integrated approach in FSP programs, colleagues from R & D Agencies will be involved in future activities.

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FSP Activities and Results in East Kalimantan

E. Nursahramdani and Ir. Ibrahim[1]

The Third Regional Meeting of the Southeast Asia Regional Forage Seeds Project held in Samarinda, Indonesia, 23-28 October 1994, was attended by representatives from CIAT, CSIRO, the Philippines, Lao PDR, Vietnam, China, Thailand, Malaysia, and Indonesia. It was concluded that some of the forage species introduced by the Forage Seeds Project have great potential for further development in the region.

East Kalimantan conducted adaptation trials on forage and legume species from CIAT and CSIRO at five sites differing in soil pH, from January 1992 to December 1994.

The results of the trials are in line with the recommendation of the meeting. The following grass and legume species are well-adapted to the soil and climatic condition in East Kalimantan:

- *Andropogon gayanus* cv. Planaltina (CIAT 621)
- *Brachiaria brizantha* cv. Marandu (CIAT 6780)
- *Brachiaria decumbens* cv. Basilisk (CIAT 606)
- *Brachiaria humidicola* CIAT 6369
- *Centrosema pubescens* CIAT 15160
- *Stylosanthes guianensis* CIAT 184

Other species such as *Paspalum atratum* BRA 9610, *Desmodium heterophyllum* cv. Johnstone CIAT 349.

The Forage Seeds Project was followed by the Forages for Smallholders Project (FSP) which started in January 1995. The aims of the FSP are:

- To identify adapted and appropriate forage species, with special emphasis on agroforestry and upland agriculture,
- to achieve integration of these species into smallholder farming systems by working directly with farmer groups, and
- to develop systems to make planting materials of these forages available to farmers in other regions.

Based on these aims, the FSP will conduct activities in the villages of Sepaku and Makroman in East Kalimantan.

Project site description

East Kalimantan

East Kalimantan lies between 4° 24' North Latitude and 2° 25' South Latitude, and between 113° 44' and 119° East Longitude. It covers an area of 211,440 sq. km and lies between Sabah (Malaysia) to the North and South Kalimantan Province to the south, and between West and

[1]Dinas Peternakan Propinsi, Jl. Bhayangkara No. 54, Samarinda, East Kalimantan, Indonesia.

Central Kalimantan Provinces, and Sarawak (Malaysia) to the west and to Makassar Strait to the east.

East Kalimantan is a humid tropical area. Temperature ranges between 24° and 32°, with a relative humidity between 80 and 90%. Annual rainfall ranges from 800 to 3000 mm in coastal areas and from 2000 to 3000 mm in the inland areas. The rainfall data from 1989 to 1991 show that December to May have the highest rainfall, and September the lowest.

The topography is undulating to hilly, with slopes varying between 3 and 4 %. Soils are generally red yellow podzolic soils. With a shallow topsoil, soil fertility is low. Other soil types are alluvial and brown forest soils. Most of East Kalimantan area is erosion prone. In 1990, the erosion-prone area covered about 15 million hectares, or 76% of the total area. This condition is related to topography and human factors. Without special conservation efforts, soil erosion could be disastrous.

Ruminant population (as of December 1995) consists of beef and/or draught cattle (82,000 head), dairy cattle (72), buffalo (23,000), goat (64,000), and sheep (3,000). Based on these numbers, it is estimated that the demand for forages will be more than 4,400 tons of fresh forages per day.

Sepaku II, Subdistrict of Panajam, District of Pasir

Sepaku II was a transmigration area (started in 1971) under the technical control of the Ministry of Transmigration. Since 1975, it has been under the administration of East Kalimantan Province.

The total area of the village is about 3,000 ha, consisting of rainfed ricefields (126 ha), fallow lands (1,542 ha), and upland areas (1,332 ha). Most of the area is hilly upland covered by Imperata cylindrica, which makes land preparation difficult.

The population is about 3,077 or 678 households. Most of the income is generated from agriculture. The cattle population is 1,130 head (832 females & 298 males), and goats (400 head). The farmers own cattle through a government credit scheme. Cattle are used for draft power, transportation, and as a cash saving. The breeds of cattle are of Brahman descent and Bali cattle.

The animals are free grazing or tethered on Imperata areas during the day, and brought to the shed in the evening. Most of the feed supply comes from Imperata and a mixture of native grasses, napier, King grass, and Setaria splendida in the evening. Cattle are sometimes given rice bran.

Since February 1994, the FSP has introduced several grass and legume species. These are *Andropogon gayanus* cv. Kent, *Brachiaria brizantha* CIAT 6780, *Brachiaria decumbens* cv Basilisk, *Brachiara humidicola* cv. Tully or CIAT 6369, and *Stylosanthes guianensis* CIAT 184. Only Kent and CIAT 184 were sown from seed the other species were planted from rooted cuttings, obtained from the species evaluation plot in Loa Janan and Talangsari.

The forage species were planted first in a farmer group nursery. Later the grass cuttings were distributed to members. To date, 40 members of the group have planted *B. brizantha* CIAT 6780, and 43 have planted *A. gayanus* cv Kent.

The farmer group is called Lestari (meaning sustainable), and is chaired by Mr. Soeharto.

Makroman Village, Subdistrict of Samarinda Ilir, Samarinda Municipality

Makroman is a transmigration area which was settled in 1974. The total area is about 2,095 ha, consisting of 1,330 ha of lowland rice fields, 270 ha of homesteads, 172 ha of fallow lands, 245 ha of estate lands, and 98 ha of other upland crops.

The soil type is red clay-loam. The topography is flat (59%) to undulating (41%). Ambient temperature varies between 28 and 320 C, with a relative humidity of 65 - 80%. Annual rainfall ranges from 1,500 to 2,500 mm.

The human population is 4,382 people. About 2,392 people (1,048 families) derive their income from farming, or from working as laborers, traders, or government employees/ military.

Landholdings vary from 2 to 3 ha/family (2 ha of wetland rice and 1 ha of upland crops). Most farmers plant rice, upland crops, vegetables, and estate crops, such as cacao, pepper, and coffee. They grow two rice crops, alternating these with maize, soybean, and peanut. The upland crops are cassava, and fruit trees such as jackfruit, mango, and rambutan.

Livestock ownership is 2-3 head/family, purchased through a government credit scheme. Livestock are kept in stalls, sometimes allowed to graze on fallow lands. Livestock in stalls are

fed with native grasses, agriculture by-products, and sometimes King grass.

In 1994, the Forage Seeds Project introduced *Brachiaria brizantha* CIAT 6780 and *Paspalum atratum* BRA 9610. Planting materials were brought from the adaptation plots in Talangsari and Sindangsari. Activities are conducted with the members of a farmer group called Maju (meaning progressive), chaired by Mr. Ruslan. The group has 22 members who own 45 cattle and 100 goats.

Seven members of the group have grown a range of forage species: *Andropogon gayanus* cv. Kent, *Brachiaria humidicola* CIAT 6369, *Brachiaria brizantha* CIAT 6780, *Paspalum atratum* BRA 9610, and *Stylosanthes guianensis* CIAT 184. These species are planted either as companion crops with upland crops, or in small plots (fodder banks).

Current activities

By the mandate of the Directorate General of Livestock Services, the Regional Office has appointed some of its staff to coordinate the implementation of FSP in the field.

For each site, one Field Extension Worker (PPL) is appointed to monitor the activities in his/her working area, and to guide the farmers. Difficult problems, the PPL cannot cope with, are discussed with the responsible staff (PPS) in the Provincial Office.

FSP activities started in 1992. To date, the following activities have been undertaken in East Kalimantan:

- Target locations have been set up,
- candidate participating farmers have been contacted,
- candidates for field extension workers have been named,
- forage species have been planted, and
- demonstration plots have been set up.

Future activities

To introduce and develop forage species, the following activities are planned:

- Setting up of new demonstration plots,
- extension activities to motivate farmers to plant their own forages,
- farm-field days with participating farmers,
- setting up of seed farmer-managed production plots and plots for planting materials
- regular meetings with farmers, to share experience in forages.

FSP Activities in Lao PDR

Viengsavanh Phimphachanvongsod[1]

The Lao PDR is a landlocked country with a total area of 236,800 km and a population of 4.6 million people. About 85% of the population practice agriculture in various forms. The land for agriculture is classified into highland, plateau, and lowland. The livestock subsector is primarily smallholder based and very traditional. Cattle and buffalo are mainly kept in the free range system. The major feed for ruminants are native grasses, rice and straw, and tree leaves.

In 1995, the FSP commenced activities in three areas. These were

- Namsouang - rainfed lowland rice
- Xiangkouang - natural or induced grasslands
- Luang Phabang - upland shifting cultivation

Site description

Namsouang

Namsouang is representative of rainfed lowland rice system. The average annual rainfall is 2,100 mm with the peak of the rainy season in August. The soil is heavily leached and generally acidic with pH 4.4-5.8.

The farming system is mainly rainfed lowland rice with one crop grown per year. In areas where irrigation facilities are available, a second rice crop is grown in the dry season.

Livestock form part of an integrated crop/livestock production system. Livestock provide traction, transport, field fertilizer, and household cash income. During the dry season and early wet season, the ruminants graze mostly on rice stubbles, and on grasses that remain in the ricefields after harvest. In the wet season, the animals are restricted to upland grazing areas.

The target farmers are smallholder lowland rice farmers.

Xieng Khouang (Ladsene)

Xieng khouang is located on a highland plateau with an average temperature is 18.6°C and an average annual rainfall of 1,600 mm with the peak of the rainy season occurring in July. The soil is an infertile sandy loam, strongly acid (pH 4.1) and very phosphorus deficient.

The farming system is rainfed rice. Farmers own very small ricefields and produce rice for their own consumption only. They keep animals for household cash income. There are large areas of potential grazing lands (natural/induced grassland) in Xieng Kouang.

The target farmers are smallholders with access to grazing land.

Luang Phabang

The FSP project has activities at two sites: Houay Pay village and Houay Khot station

The soil on Houay Pay is sandy with pH 4.5-5.5. The soil in Houay Khot is a clay loam with pH 4.5-5. In both areas, the farmers practice

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upland shifting and agroforestry. Slash-and-burn farming is practiced on mountain slopes.

Family income is derived mainly from selling livestock. The main feed resources for ruminants are native grasses and tree leaves. In the dry season, the ruminants graze freely. In the wet season, the grazing area is very limited.

The target farmers are ethnic hilltribes who practice shifting cultivation.

Activities in 1995

The activities carried out at these sites in 1995 are shown in Table 1.

Additionally, assessment of local forages systems were carried out in Savannaket/Champasak (Pek grassland, smallholder rainfed rice farmers), and Luang Namtha/Oudomxay (upland shifting cultivation/agroforestry; ethnic hilltribes who practice shifting cultivation) with the view of commencing forage evaluation in these areas.

Other Activities include collaboration with the Nabong Agriculture College to produce a book on how to run field experiments with forages. We have also contacted several projects and NGO's working on livestock and agroforestry systems in upland areas and hope to collaborate with them in the future. We are going to establish a *Leucaena* evaluation nursery in collaboration with an ACIAR project.

Future activities

Activities planned for 1996 are presented in Table 2.

Table 1. FSP activities in 1995.

Activity	Vientiane	Xieng Khouang	Luang Phabang
Assessment of local forage systems	•		
Introduction and initial increase of forages	•	•	•
Evaluation in different agroecosystem	•	•	•
PR of farming system (PD)	•	•	•
English language training	•	•	
Training in participatory research			•

Table 2. Future FSP activities.

Activity	Sites				
	Vientiane	Xieng Khouang	Luang Phabang	Luang Namtha/ Oudomxay	Savannakhet/ Champasak
Assessment of local forage systems		96	96	96	
Introduction and initial increase				96	96
Evaluation in different agroecosystem	96	96	96	96	96
Seed increase of promising lines	97		98		
Participatory diagnosis	96	96	96	96	96
On-farm evaluation of forages	96	96	96	97	
Farmer training in forage management	96	96	96	97	
Development of multiplication systems	97	97	97	98	98
English language training			96	96	96
Training in participatory research	96				
Training in forage agronomy	96	96	96	96	96

FSP Activities in Vietnam

Le Hoa Binh[1]

The Forages for Smallholders Project (FSP) in Vietnam was initiated in February 1995. Dr. W. Stür and Dr. P. Horne visited potential sites with researchers of the National Institute of Animal Husbandry. In May 1995, Vietnamese researchers and Dr. P. Horne visited the Bavi district (Bavi Tan linh, Van hoa, and Xian khanh communes) and identified two research sites for evaluating 70 forage species (20 grasses and 50 legumes).

Site description

Bavi District, located 50 km from Hanoi, was selected as a representative site of sedentary upland agricultural systems of North Vietnam.

The average temperature is 23.1°C and annual rainfall is 2,100 mm. Soil pH is about 5.5. (Kcl). Forest trees such as Eucalyptus and Acacia: and cassava, maize, rice, beans for rotation, and tea are grown on the slopes. Rice (1 or 2 crops/year) is grown on the lowland areas. Maize, sweet potato, potato, soybean, and peanut are also grown. Farmers raise buffalo, cattle, goat, pig, and chicken in small scale. Ruminants are fed mainly on native vegetation. No forage species are planted.

Activities in 1995

Seventy forage species (20 grasses and 50 legumes) were planted at two sites: at Khang Farm of King Pond and at the Goat and Rabbit Research Center (Table 1).

For each species the following data were recorded:

- Number of original plants
- Average height and width (cm)
- Soil cover (%)

Table 1. Forages planted at Khang Farm and at the Goat and Rabbit Research Center.

Grasses	No. of species	Legumes	No. of species
Andropogon	1	*Aeschynomene*	8
Bothriochloa	2	*Alysicarpus*	4
Brachiaria	6	*Arachis*	4
Cenchrus	1	*Centrosema*	7
Dicanthium	1	*Chamaecrista*	3
Digitaria	3	*Clitoria*	2
Panicum	1	*Desmodium*	5
Paspalum	3	*Macroptilium*	7
Urochloa	1	*Macrotyloma*	1
		Stylosanthes	4
		Teramnus	1
		Vigna	3
		Zornia	1

[1]National Institute of Animal Husbandry, MAFI, Thuy Phuong, Tu Liem, Hanao, Vietnam.

- Yield rating (0-10)
- Leafiness (%)
- Flowering (0-3)
- Seed production (0-3)
- Disease damage (0-4)
- Insect damage(0-4)
- Water stress (0-4)

Initial results showed that even without fertilizer and irrigation, the following species produced high yield:

Grasses

Andropogon gayanus cv. Kent; CIAT 621
Panicum maximum CIAT 6299
Brachiaria brizantha CIAT 6780
Paspalum atratum BRA 9610

Le gumes

Aeschynomene histrix CIAT 9690
Stylosanthes hamata cv Amiga
Aeschynomene brasiliana CIAT 8628
Stylosanthes guianensis CIAT 184
Chamaecrista rotundifolia CPI 86172

We have introduced promising forage species to other sites that have similar agroclimatic condition using the following approach:

- Invited nearby farmers (surrounding the site) interested in forage production to visit, discussed with them the advantage of forage production, and selected the species suitable for them;
- multiplied promising forage species to supply to farmers;
- introduced forage production techniques to farmers;
- worked with farmer groups to share experiences;
- established a network to improve forage production activities among smallholders, we organized a training course on forage production techniques and management for staff and farmers;
- sent FSP news and SEAFRAD newsletters to 60 people in 14 Institutions in the country.

Future activities

1996

- Establish 2 new sites in the hilly and mountainous areas in the north (Bac Thai) and in the central part (Binh Dinh) of Vietnam;
- continue the introduction and selection of promising forage species;
- undertake the multiplication and development of promising forage species in sites that have similar agroclimatic conditions;
- conduct in-country training courses on participatory research.

1997

- Expand selected forage species to large-scale production;
- investigate aspects of productivity and quality of selected forage and effect of forage production on soil fertility;
- investigate the growth of forage species (used as animal feed) in shade.

1998

- Study technical measures to improve productivity of forages species and their uses on soil fertility protection (by rotation and mixing of grass and legume);
- develop forage species that can be grown in shade, to produce more feed and make full use of cultivable lands.

1999

- Introduce forage production technologies in the different agro-ecological conditions in Vietnam;
- conduct training on forage establishment and management technologies;
- review and evaluate project activities. The activities will involve the cooperation of the extension service, cooperatives, farmers, and animal husbandry associations.

To disseminate information about the project, newsletters will be published and distributed throughout the country.

FSP Activities in Thailand

Chaisang Phaikaew[1], Ganda Nakamanee[2] and Kiatisak Klum-em[1]

Farm income from major cash crops such as rice and cassava has been declining for several years, largely because of lower prices for these products. There is a need to diversify farm income by integrating more livestock into the farming system, buffer the effects of a poor return from any particular activity. Forage production is a key to livestock development and improved pasture and fodder crops are now cultivated to provide high quality feed to animals. Grasses commonly grown in Thailand are *Brachiaria ruziziensis, Brachiaria mutica, Panicum maximum,* and *Pennisetum purpureum.* There is a need to develop forage technologies suitable for smallholder farmers.

Thailand is a partner in the Forage for Smallholders Project (FSP), coordinated by CIAT and CSIRO, and funded by AusAID. The goal of the project is to increase the availability of adapted forages and the capacity to deliver them to smallholder farming systems, in particular, agroforestry and other upland systems.

Activities in 1995

The following is a summary of activities in 1995.

- Distribution of FSP News
  The first issue of the FSP News was distributed to forage workers in Thailand. The aim is to encourage cooperation and communication among workers actively engaged in pasture R&D.
- Training in participatory research
  Ms. Ganda Nakamanee and Mr. Kiatisak Klum-em attended the regional training course on "Participatory research in feed resource" at IRRI, Philippines, 10 July to 5 August 1995.
- Introduction and initial increase of forage species
  In 1995, four accessions of *Arachis spp.*, seven of *Brachiaria brizantha,* and one of *Panicum maximum* were introduced from the FSP in the Philippines. These were grown at the Pakchong Animal Nutrition Research Center in the northeast region (14° 42° N latitude) of Thailand. The average temperature is 25.6 °C and average annual rainfall is 1,200 mm, with the peak of the rainy season in August-September. The soil is reddish brown lateritic and is characterized by sandy clay loam, slightly acid reaction, and medium organic matter content. The aim for the first year is to build up seed stocks for future testing.

Future activities

- In-country training
  Farmer participatory research is a useful method for encouraging farmers to test new technologies. To develop researchers' knowledge and skills in participatory research, a

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training course will be conducted at the Pakchong Animal Nutrition Research Center, Pakchong, Nakornratchasima from 19-29 February 1996. The training course is jointly sponsored by FSP and the Department of Livestock Development. The objective is to enable participants to know when and how to apply participatory research (PR) methodology. PR has potential in the identification of forage opportunities in the selection of adapted and appropriate forage species; and in forage multiplication.

- Species evaluation

Thailand's most important forage plant is *Brachiaria ruziziensis* (ruzi grass). This species was introduced to Thailand more than a decade ago. It is now well accepted by farmers because of ease of establishment and high seed yield, although its dry season productivity is low. Other *Brachiaria* species such as *B. decumbens* have shown better adaptation to drier environments than has ruzi grass, but seed yield and seed quality are low. To overcome these problems, we are trying to find a *Brachiaria* species with high seed yield potential and good dry season performance. About 25 *B. brizantha* and *B. decumbens* accessions will be imported from CIAT. Only small quantities of seed will be available, so we will start with small-plot evaluation. The grasses will be sown in April in plastic bags and transplanted in the field in June. Plots will be fertilized with 156 kg/ha N. Data on flowering time, inflorescence density, seed yield, seed set, and seed quality will be measured throughout the growing season.

- Farmer participatory research

After the PR in-country training course at Pakchong, we will conduct farmer participatory research with the farmer group used in the training course. The activity will be a continuation of work carried out during the training. It will involve participatory evaluation of forages, and further participatory planning of research and on-farm experiments and problems and possible solutions identified during PR.

- Participation in SEAFRAD Network

Expectation

We expect that by the end of the project in 1999, we will have:

- a reliable and productive species for upland cropping systems, rainfed lowland rice systems, and agroforestry;
- farmers participating in pasture development; and
- well-trained staff in forage R&D.

FSP Activities in China

Liu Guodao and He Huaxian[1]

Activities in 1995

- The FSP News (August 1995, No. 1) was translated into Chinese and sent to agronomists and extension workers. Feedback from recipients showed that there is considerable interest in FSP activities.
- A booklet titled "Techniques for Stylo Cultivation and Utilization" was produced in chinese (500 copies). The booklet was the basis for a training course, and will be used as a farmers' handbook.
- A handbook on the major tropical forage species was compiled (in chinese) and printed and is now available to farmers.
- Farmer Training Course

Thirty-four farmers received training in the cultivation of *Stylosanthes guianensis* CIAT 184 from 21 to 26 November 1995 in Wenchang, Hainan. The course included lectures (2 days), a field visit to Qenchang (1 day), a field visit to CATAS (1 day), and discussions (1 day). The course taught the farmers how to grow and use Stylo. The main training material used in the course was the booklet "Techniques for Stylo cultivation and utilization." In Wenchang, farmers saw *Stylo* cultivation and several leaf meal production factories. In CATAS, the farmers were introduced to other new forage species.

During discussion, the following questions were asked:

	Yes response (%)		Yes response (%)
Have you heard about stylo?	62	for feed cattle?	43
Have you seen stylo?	26	for feed pigs?	61
Do you grow stylo?	9	for cover crops under fruit trees?	29
Do you want to grow stylo?	82	after watermelon?	
If you want to grow stylo, do you want to grow it for leaf meal production?	39	Do you want to try some new species?	75
for feed goats?	68	Do you want to participate in on-farm forage research?	69

- Selection of key farmers for on-farm research

We selected four families who expressed commitment to act as key farmers in on-farm research: Three in Hainan and one in Guangdong:

Family 1: 4 persons, Wenchang, Hainan, leaf meal production

Family 2: 3 persons, Dongfang, Hainan, mango plantation

Family 3: 6 persons, Danzhou, Hainan, goats and fish

Family 4: 9 persons, Meizhou, Guangdong, cattle and fish

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Activities planned for 1996

- Evaluation of new *Stylosanthes guianensis* germplasm for anthracnose resistance and their suitability for leaf meal production;
- Investigate the effect of cutting management of *S. guianensis* CIAT 184 on persistence;
- Monitor population dynamics of *S. guianensis* in leaf meal production fields;
- Work with smallholder farmers using farmer participatory research methodology to improve the efficiency of stylo leaf meal production with the aim to improve the economic return for the farmers; and
- Extend the stylo leaf meal production technology to other smallholder farmers through field days and farmer training.

FSP Activities in Malaysia

Chen Chin Peng[1], Wong Choi Chee[1], and Aminah Abdullah[2]

The development of the ruminant industry has lagged behind the nonruminant sector for almost 40 years. Ruminant production is mainly in the hands of smallholders who, despite heavy financial and technical assistance from government through research institutions and development agencies, are less organized and productive than their counterparts in the non-ruminant sector.

Ruminants production based on improved tropical pastures in Malaysia has not been profitable. One reason for this failure is that more than 50% of the operational funds were required for maintenance fertilizers. Thus, despite a favorable climatic environment for plant growth, the livestock industry has not been able to exploit forages as a base for livestock production.

The Department of Veterinary Services has recently changed its policy towards smallholders and is now promoting commercial livestock farming. Smallholders, who own 2-3 head of animals, are encouraged to expand livestock production. Livestock-tree cropping production systems are seen as the major area where livestock development can be expanded. Additionally, mini-livestock-farms are being set up on grazing reserve land and idle ricefields. Intensive livestock management will be the key to ruminant production development. Future research on tropical forages will concentrate on specific needs.

FSP Activities in 1995

Seed Production

The lack of suitable forage planting materials (vegetative or seed) has hindered forage development programs. Imported forage seeds are expensive and difficult to obtain, and their quality is uncertain. With the MARDI/DVS - FSP collaboration and support, studies on promising forage species for seed production were carried out, and encouraging results have been obtained on the following species: (1) Guinea grass (*Panicum maximum* cv Vencedor 129 kg/ha and common *P. maximum* 118 kg/ha), (2) *Brachiaria ruziziensis* grass (257 kg/ha), and (3) *Stylosanthes guianensis* CIAT 184 (100-180 kg/ha). Although the quantity of seed produced is small, it is substantial for deve-lopment and a record in forage seed production in the country. After the first phase of the FSP, seed study work continues, in line with the need of the livestock

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industry. Studies on two more forage species – *Aeschynomene americana* cv. Glenn and *Arachis pintoi* cv. Amarillo – have been completed. Seed yields of *A. americana* cv. Glenn and *A. pintoi* cv. Amarillo were 125 kg/ha and 1,200 kg/ha, respectively.

Five smallholder farmers involved in sheep, beef, and dairy production have successfully produced seed for their own need. A local highway engineering firm has requested 15 tons of *B. ruziziensis* in a single purchase, for its highway turfing project.

Our target is to mobilize more farmers toward the end of the FSP (by the year 2000) to produce seed for soil erosion control, recreational area landscaping, and livestock production.

Livestock-tree cropping production

The emphasis on livestock-tree cropping production system in both research and development in the last 20 years has changed the course of livestock production in the country. Nevertheless, only a limited number of plantations have gone into livestock-tree cropping, indicating that there is a need to intensify the dissemination technology through extension and training. At this stage, participatory research into the reasons for lack of adoption may be appropriate.

The present forage R & D program places little emphasis on improved tropical pasture evaluation and assessment. Nevertheless, access to forage germplasm held by CIAT and ATFGRC (Australian Tropical Forages Genetic Resources Centre) is needed to serve particular needs. We are particularly interested in acid-soil-tolerant germplasm with high seed production potential.

Staff Development

Malaysians working on forage resources are lacking experience to handle complicated commercial livestock enterprises. Training in and exposure to all aspects of forage resource development and utilization is required. There are only a few forage workers in the country. At the state level, there is hardly one technician per state, and these technicians are usually also responsible for other aspects of livestock production, not only forages. There is a need to encourage more Malaysians to work in the forage area.

Information systems

Malaysia is happy and willing to contribute its share in activities carried out under the FSP umbrella. We suggest that a calendar of project activities concerning SEAFRAD, regional meetings, newsletter and information linkages, farmer training, is prepared.

Concluding notes

In 1993, Malaysia imported almost 50,000 metric tons of beef, and this has increased annually by 2% for many years. Despite favorable climatic conditions for growing plants, there is an acute shortage of forage resources for livestock at the farm level. On the other hand, the wealth of research information generated is not being utilized to the fullest, and this has put researchers in a dilemma. They face criticism, both local and internationally for the lagging behind of the ruminant livestock industry in Malaysia.

Malaysia has been classified as a "developed" country by the FSP. It is high time we pondered on going into a regional livestock production services in "developing countries" in the region - a paradigm shift?

The demand for red meat will continue to rise in the future. Malaysia must develop its feed resources to sustain the required livestock production. Tropical forages will be needed but profitable forage production has not been achieved in the past - the dilemma continues.

Selected Papers from Other Projects

Current Status of and Prospects for Tropical Forage Seed Production in Southeast Asia: Experiences and Recommendations from Thailand

Chaisang Phaikaew[1]

The demand for forage in Southeast Asia has increased rapidly. Dairy production is expanding in all countries in the region. Research has shown that dairy farmers will profit more by increasing the proportion of improved pasture in the feed and reducing dependence on expensive concentrates. The major constraint to this is the difficulty of providing forage of sufficient quantity and with adequate nutrients throughout the year (Hare 1995). The expansion of beef and dairy production in Southeast Asia has increased the demand for pasture seed, because vegetative cuttings cannot meet such demand. In Thailand, pasture legume and grass seed production has increased to more than 1,200 tons of seed in 1994. The demand for seed increases each year and there is potential for further increases in seed production in Southeast Asia.

Current status of pasture seed production in southeast Asia

Southeast Asian countries have a long history of producing seed of cover crop, legumes which are used in plantations. The production of other herbage seed, a more recent development, is now well established in Thailand. Smaller quantities of seed have also been produced in other countries, e.g. China, Malaysia, Philippines, Lao PDR, Indonesia, and Vietnam. At present, tropical forage seed production is dependent on domestic markets, and each country is trying to produce its own seed requirements.

China

Hainan Province is the main area for tropical forage seed production in China. In the last 11 years, 265 tons of forage seed was produced (Guodao *et al.* 1994). Commercial seed of *Stylosanthes guianensis* is produced mainly for leaf meal production and for use as cover crop in tree plantations. Other legume seeds produced include *S. hamata* cv. Verano, *S. scabra* cv. Seca, and *Macroptilium purpureum* cv. Siratro. Grass seed includes *Paspalum plicatulum, Melinis minutiflora, Setaria sphacelata* cv. Kazungula, and *Brachiaria decumbens* cv. Reyan III. There are plans to set up a seed production center on Hainan Island to produce commercial volumes of high-quality seed of recommended forage and pasture crops.

Malaysia

A joint program for pasture seed production in Malaysia has been worked out between the Malaysian Agricultural Research and Development Institute (MARDI) and the Department of Veterinary Service (DVS). MARDI conducts research on seed production of promising species. The DVS, which spends about RM (Malaysian Ringgit) 0.3 million per year on imported pasture seed, has started to produce seed of a few species on Sintok Farm in northern Malaysia (Chen *et al.* 1994). In 1994, about 1,500 kg of seed of *Stylosanthes guianensis* CIAT 184, *Brachiaria ruziziensis*, common *Panicum maximum*, and *Panicum maximum* cv. Vencedor was produced.

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Although the quantity of seed produced is relatively small, the ability to produce forage seed has a significant effect on the livestock industry in Malaysia. In the past, it was felt that Malaysia could not produce forage seed due to the climate. Several promising species were listed for further study. These are *Arachis pintoi* cv. Amarillo, *S.guianensis* CIAT 21, *S.guianensis* FM 07-2, and *Paspalum atratum* CIAT 9610.

Philippines

The Bureau of Animal Industry produces small quantities of pasture seed mainly for its own use. Larger quantities are imported from Australia (*Brachiaria decumbens* and *B. humidicola*). There is no commercial forage seed production as yet. The Department of Agriculture in Isabela and Quirino Provinces, in collaboration with the FSP, has started seed production producing experimental seed of *Brachiaria decumbens* cv. Basilisk, *B. humidicola* cv. Tully, *B. brizantha* CIAT 6780, *Andropogon gayanus* CIAT 621, *Stylosanthes guianensis* CIAT 184 and cv. Cook, and *Centrosema pubescens* CIAT 15160 (W.Stür, pers. com.).

Indonesia

Indonesia has not gone into commercial forage seed production. Some pasture seed is produced on Livestock Stations of the Directorate General of Livestock Services but mainly for their own use. A smallholder seed production scheme was initiated under an IFAD Livestock Dispersal Project in Lombok, but it ended when the project terminated due to lack of effective marketing. Small quantities of seed, mainly *Andropogon gayanus* cv. Kent, were produced by smallholder farmers involved with the FSP in 1994. Seed of six other grasses and 21 legume species were also produced (Tuhulele *et al.* 1994). Poor seed production in some parts of Indonesia are due to high rainfall and insufficiently short days for flowering.

Vietnam

There are no available data on forage seed production in Vietnam. Some seed is produced from experimental plots of *Brachiaria ruziziensis, Stylosanthes hamata,* and *Leucaena leucocephala.* Ha (1994) reported that Vietnam expects to establish seed production units in the northern, central, and southern parts. Training courses in tropical forage seed production have been conducted for the staff.

Lao PDR

There is no commercial seed production in Lao PDR. Small quantities of seed have been produced by the Department of Livestock and Fisheries at the Nam Suang station, mainly for their own use. With a favorable environment, Lao is interested in developing a seed industry. Laos had a small village seed production program based on *Stylosanthes hamata* cv. Verano for several years but this was discontinued due to lack of funds for purchasing the seed from the involved farmers (Phengvichith 1994).

Thailand

The Division of Animal Nutrition under the Thai Department of Livestock Development (DLD) has implemented a government-supported pasture seed scheme for village farmers. The project started in 1976 and more than 8,200 tons of tropical pasture seed has been produced since 1984 (Fig.1).

The two main species for seed production are ruzi grass (*Brachiaria ruziziensis*) and Verano stylo (*Stylosanthes hamata* cv. Verano). About 70% of ruzi grass seed and 90% of Verano stylo seed have been produced by the village farmers on contract to the DLD. More than 3,000 small farmers harvest and sell seed annually to the DLD. The balance of the seed is produced on 30 animal nutrition stations spread over Thailand. Fifteen of these stations are in northeast Thailand and these have produced most of the required seed.

Village farmers also harvest seed of purple guinea grass (Panicum maximum T 58) for sale to the DLD. The DLD stations also produce smaller quantities of *Stylosanthes guianensis* cv. Graham, *Centrosema pubescens, Desmanthus virgatus, Macroptilium atropurpureum, Leucaena leucocephala, Cajanus cajan, Panicum maximum* cv. Hamil and common, *Paspalum plicatulum, Setaria sphacelata, Andropogon gayanus, Brachiaria decumbens,* and forage sorghum.

A range of the following experimental lines have been studied and small quantities of seed have been produced:

- *Paspalum atratum* BRA 9610
- *Arachis pintoi* cv. Amarillo
- *Cassia rotundifolia* cv. Wynn
- *Stylosanthes guianensis* CIAT 184
- *Macroptilium gracile* cv. Maldonado
- *Aeschynomene americana* cvv. Lee and Glenn

In the early stage of pasture development (1976-1990), legume seed was 60-80% of the total forage seed (Fig.1). Most of the legume seed was used for oversowing communal grazing land all over the country and for grass-legume pastures. The recent expansion of beef and dairy production has increased the demand for grass seed, and grass seed production by farmers accounted for a major part of seed produced in the last few years. This is mainly ruzi grass, used for backyard pasture. The total demand for legume seed has not changed much, but has reduced in proportion. In 1993, 290 tons of legume seed was produced, which account for 30% of the total (950 tons) grass and legume seed production.

Ruzi grass seed production has increased from 18 tons in 1984 to 1,021 tons in 1994, and ruzi seed production during the last 12 years was more than 4,300 tons (Table 1). Ruzi seed production by smallholders started in 1986 (Phaikaew *et al.* 1993). Now, ruzi seed accounts for 90% of all grass seed or 81% of the total pasture seed production in Thailand. Purple guinea grass seed has increased rapidly, due to its high forage yield, leafiness, and seed which is of better quality than that of other guinea varieties.

More than 3,700 tons of forage legume seed has been produced since 1976 (Phaikaew 1994). A pilot project set up in 1976 and managed by village farmers undertakes large-scale production of Verano stylo seed. In 1994, anthrachnose destroyed Graham stylo at Kudrung station. The disease reduced seed yield of Graham stylo from the target yield of 12.4 tons to only 2 tons in 1994 and 0.2 tons in 1995. Seed production of key legumes is detailed in Table 2.

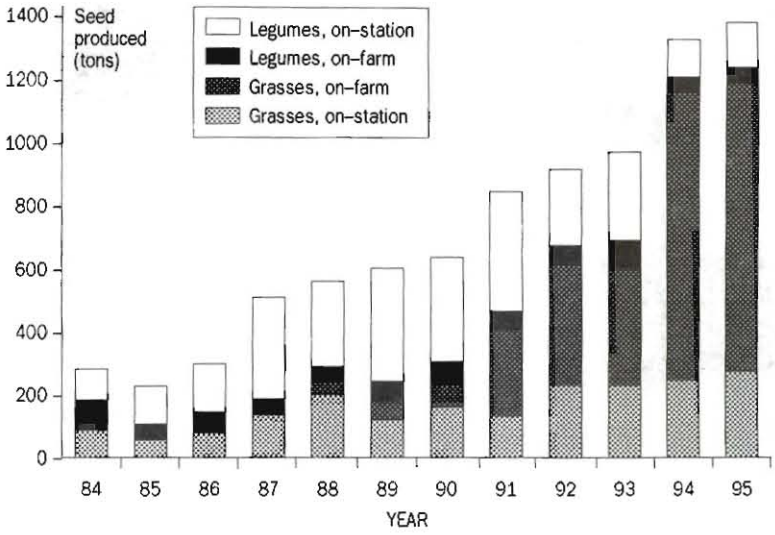

Fig. 1. Forage seed production in Thailand, 1984-1995

Experience of and recommendations from Thailand

Factors contributing to the success of forage seed production

1) Favourable climate

The main seed production area in Thailand is in the northeast region, (14° to 19°N, 1200 mm AAR, 100-300 m asl). Climatic conditions in the area are favorable for seed production of tropical pasture species (Phaikaew *et al.* 1993) because of well-defined wet and dry seasons which facilitate seed harvesting and drying. Seed production is concentrated in ten provinces: Khon Kaen, Roi-Et, Mahasarakham, Sakon Nakorn, Udornthani, Chaiyapoom, Korat, Surin, Burirum, and Kalasin.

2) Extensive preparatory research

Extensive research on seed production characteristics of many species has been conducted to determine their potential for commercial seed production. Studies include flowering characteristics and seed development, cutting and fertilizer management, harvesting techniques, seed processing, and seed quality. Seed of species

Table 1. Seed production (tons) of various grass species in Thailand, 1984-1995.

Year	*B. ruziziensis*		*P. maximum*		*P. plicatulum*	Sorghum	Other	Total
	Station	Farmer	Station	Farm	(Station)	(Station)	Grasses	
1984	18	-	13	-	2	8	42	83
1985	33	-	9	-	6	4	2	54
1986	46	-	10	-	5	3	3	67
1987	117	0.6	9	-	9	6	1	143
1988	168	34	17	-	13	7	0.7	240
1989	100	55	5	-	5	2	0.1	167
1990	125	83	7	-	8	11	0.6	235
1991	105	262	11	-	19	3	4	404
1992	195	437	8	-	6	21	0.3	667
1993	184	426	13	5	14	16	1	660
1994	198	824	5	23	18	15	4	1,085
1995	164	740	48	90	19	20	19	1,100

showing potential is then produced on a limited scale on government research stations, before pilot testing and large-scale farmer production.

Once a species is in farmer production, research continues, to improve production efficiency. For example, harvesting ruzi grass seed by manual shaking has been improved by the "living sheaf" method and development of seednet receptacles (Kowithayakorn and Phaikaew 1993, Phaikaew and Pholsen 1993, Phaikaew *et al.* 1993). Seed heads are tied into groups one or two weeks before harvest. The seedhead groups are then shaken every two or three days into a large seednet receptacle. Seed harvesting is quick and efficient; one person can harvest 10 kg of ruzi grass per day.

The seed harvesting methodology for purple guinea grass has been improved. Phaikaew *et al.* (1995) reported that covering the tied seedheads with a net nylon bag, with an outlet for extracting seed every 3-5 days, resulted in higher seed yield and better seed quality than the shaking method. The bag covering method gave pure-seed yield of 780 kg/ha and a higher net profit for the farmer, compared with the shaking method (570 kg/ha).

3) Pilot project

Tropical pasture seed production in Thailand has evolved through research, pilot projects, and a government-supported seed enterprise (Hare 1993). In 1975, a pilot project involving production of Townsville stylo seed by village farmers was established to investigate the feasibility of seed production by village farmers. The project made government organizations aware that village farmers can produce large quantities of higher quality seed using manual harvesting and cleaning techniques. In 1981, more than 1100 village farmers produced 187 tons of Verano seed at an average yield of 910 kg/ha (Hare 1985). The pilot projects on Verano stylo in 1977, ruzi grass in 1986, and purple guinea grass in 1992 have led to large-scale seed production by village farmers.

4) Government support

Government support for village includes:

- Selecting farmers and training of these farmers on establishment, management, harvesting, and cleaning of the seed crop;
- giving farmers contracts to buy seed produced by the farmer at a guaranteed price; and
- providing technical support to farmers from planting to harvesting of seed.

The government plays a major role in seed processing and marketing, and sets realistic price incentives for the farmer. Seed cleaning, quality testing, packaging, storage, and distribution are supported by the government through the DLD.

5) Increased market demand for further seed

The demand for pasture seed by different government projects is high. These projects include

a) Increasing the efficiency of milk production,
b) beef and dairy promotion in the project to restructure the agricultural system, Ministry of Agriculture and Cooperatives,

Table 2. Seed production (tons) of various legume species in Thailand, 1990-1995.

Legume species	1990	1991	1992	1993	1994	1995
S. hamata cv. Verano						
• Station	35	31	11	17	10	20
• Farmer	325	296	173	231	140	130
• Total	360	327	184	248	150	150
S. guianensis cv. Graham						
• Station	9	4	4	13	2	0.2
• Farmer	-	-	5	5	-	-
• Total	9	4	9	18	2	0.2
Leucaena leucocephala						
• Station	6	6	11	9	8	9
Centrosema pubescens						
• Station	4	6	7	14	14	7
Other legumes						
• Station	1	1	2	1	1	12
TOTAL	380	344	213	290	175	179

c) department's project for livestock extension, and
d) distributing and selling to the remaining farmers and other agencies.

Limitations

1) Government support

Farmer seed production would not be possible without government support, because the government acts as the major buyer of seed. The quantity sold directly from farmer to farmer is probably only about 10% of the total volume.

We need to involve the private sector in seed marketing and gradually turning marketing over to the private sector. Doing this will almost certainly involve big differences in price between species, as these should reflect more closely the different production costs.

There is a proposal to look into the possibility of forming farmer seed production cooperatives, which will include seed processing and marketing. This would reduce the dependence of the industry on government support.

2) Limited range of species of pasture seed

Our success so far has been limited to a few species, mainly ruzi, purple guinea grass, and Verano stylo. We need to expand the range of species grown, to service a wider range of livestock markets (e.g., high-quality forage for dairy production, salt-tolerant forages), amenity roadside plantings for recreational use, rehabilitation of degraded land, for turf (including golf courses) and even ornamental use. In Southeast Asia, there is a need to develop a broader range of salt-tolerant pasture species, and to improve existing salt-tolerant species (e.g., Rhodes grass) because salinization is a great problem in some tropical countries. The trend (particularly in temperate countries) has been toward the rapid expansion of seed production of turf and amenity grasses, in some cases exceeding forage seed production (Loch 1995). For example, Oregon started growing forage grasses, but now about 60% of their seed production is from turf and amenity grasses. These two areas of seed demand are, at present, approximately equal in Europe, but the demand for forage seed is declining whereas that for turf and amenity is increasing.

The replacement rate of perennial pasture will be a major factor determining the future demand for this seed.

3) Trade links and seed certification

We need to develop international trade links: importing species that we find difficult to produce (e.g., signal grass) and exporting those that we produce very well.

We also need to develop a certification scheme for pasture seed. This scheme will be designed to maintain genetic integrity, to minimize the risk of physical contamination by seeds of other cultivars, and in some cases to

ensure freedom from seedborne diseases. The seed certification scheme should conform to international standards as set by the Organization for Economic Cooperation and Development (OECD). The presence of the widely known OECD label can be an advantage when exporting seeds.

Prospects

In Southeast Asia, some demands for forage seed cannot be met by in-country production. Thus, there are good prospects to increase forage seed production within countries and to develop trade between countries in the region. For these to happen, we have to develop seed production of the widely adapted species of the region, seed quality standards, and seed certification. Seed storage and seed packaging should be the priority in humid tropical conditions.

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New Leucaenas for Southeast Asian, Pacific and Australian Agriculture

H.M. Shelton[1]

Leucaena leucocephala (leucaena) has been one of the most productive and versatile multipurpose tree legumes available to tropical agriculture. In its native range, it has been used by man for several millennia, and continues to be conserved and cultivated by farmers from Texas to Peru. From this region, it has spread to most countries of the tropical world where it continues to be a productive multipurpose tree legume in many countries, including Australia.

Leucaena has demonstrated wide environmental adaptation and a great variety of uses. Among the tropical tree legumes, it is the premier forage species. It has proven equally important as a broad-acre grazing species for tropical Australia and as a cut-and-carry fodder species for smallholders in Southeast Asia. It has made a major contribution to alley cropping and other agroforestry and landscape stabilization practices. In countries such as the Philippines, leucaena continues to make a major contribution to fuelwood supply. It possesses a combination of attributes, perhaps without parallel in other species.

The limitations of leucaena, however, are now better understood and include susceptibility to the psyllid insect pest (*Heteropsylla cubana*), lack of adaptation to cool temperatures or frost, and lack of tolerance for strongly acid or waterlogged soils. The damaging effect of the psyllid, in particular, has halted promotion and new plantings in many regions. Without new strategies to tackle these limitations, the great expectations predicted for leucaena during the 1970s and 1980s will not be realized. Other limitations include poor seedling vigor, high seed production causing concern about weediness, and only moderate wood quality for fuelwood or construction purposes.

It is now generally recognized that the present germplasm used around the world is genetically very narrowly based on one species (*L. leucocephala*), a self-fertilized polyploid with low genetic diversity. The huge areas of leucaena naturalized globally represent only a small fraction of the genetic resources available in the *Leucaena* genus. An example of this is the range of susceptibility to the psyllid insect which exists within the *Leucaena* genus (Table 1).

There are thus strong reasons to re-examine the *Leucaena* genus and to develop some of the lesser known species for the benefit of the farming systems and rural communities of the tropical world. The genus contains perhaps 23 species, many of which have characteristics potentially very useful to agriculture. Opportunities to exploit the lesser known species directly, or to develop through interspecific hybridization new cultivars that incorporate the beneficial qualities of two or more species, exist.

The Australian Centre for International Agricultural Research (ACIAR) has agreed to fund a program of research into leucaena, with the overall aim of developing new leucaena cultivars for tropical agriculture. The two major emphases of the program are the identification of agronomically more diverse and superior germplasm, and the study of the forage quality

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Table 1. Susceptibility of *Leucaena* species to psyllid (*Heteropsylla cubana*) damage.

Species/subspecies	Mean[1]	Range	S.E.M.[2]
L. collinsii collinsii	1.3	1.1 - 1.6	0.16
L. esculenta	1.7	1.1 - 2.0	0.21
L. lanceolata sousae	3.4	3.0 - 3.9	0.28
L. pallida	3.8	1.8 - 6.5	0.45
L. pallida x L. leucocephala	4.0	2.9 - 4.3	0.18
L. macrophylla	4.4	4.3 - 4.9	0.17
L. diversifolia stenocarpa	4.5	1.3 - 7.8	0.46
L. diversifolia diversifolia	5.0	3.8 - 6.8	0.26
L. collinsii zacapana	5.1	3.6 - 5.9	0.59
L. shannonii	5.5	5.0 - 6.0	0.18
L. salvadorensis	5.8	5.8 - 5.9	0.24
L. lanceolata lanceolata	5.9	5.4 - 7.1	0.41
L. leucocephala glabrata	6.6	5.5 - 7.8	0.14
L. leucocephala leucocephala	6.7	5.6 - 7.8	0.18

[1] Psyllid damage rating (1 = resistant, 9 = highly susceptible).
[2] Standard error of mean.

characteristics of the improved germplasm. Toward the end of this three-year research program, some preliminary extension activity will begin. This paper describes the activity in some detail.

Initial procedures

The concept for the project evolved from an international workshop held at Bogor, Indonesia, in January 1994. Sixty-six delegates from 21 countries attended. Institutional support came from ACIAR, University of Hawaii, Oxford Forestry Institute, CIAT and ICRAF (from Africa and Asia), International Science Foundation, and The University of Queensland.

The workshop led to the creation of an international network (LEUCNET) to promote leucaena research, development, and communication worldwide. R & D priorities were established and an international Steering Committee was formed. The outcomes of the workshop were published in a booklet outlining the charter, modus operandi, and priorities of LEUCNET. The workshop also led to the establishment of this ACIAR project.

Objectives and outputs

The three major research objectives of the ACIAR project and subprograms are:

1. Identify new cold-and frost-tolerant, acid soil-tolerant, and psyllid-resistant provenances and hybrids. This will include
   - evaluation of foundation leucaena collection, and
   - coordinated multisite germplasm evaluation.
2. Evaluate and select superior provenances and hybrids for high forage quality. This will involve study of
   - acceptability/palatability of new leucaenas, digestibility and chemical composition of new leucaenas,
   - supplementary feeding value of new leucaenas,
   - animal production from new leucaenas,
   - genotypic, environmental, and management
   - effects on condensed tannins, and
   - effect of leucaena tannins on protein nutrition of ruminants.
3. Select and distribute elite germplasm, disseminate information on leucaena production and use to producers. This will involve
   - establishment of seed orchards, and
   - pilot extension programs.

The major output of the research will be the availability of a greater range of high-quality, high-protein leucaena forages for ruminant

feeding, leading to increased liveweight gains and increased reproductive rates in ruminants, and to greater stability and productivity of tropical farming systems. The new provenances will greatly extend the environmental range for which leucaena germplasm will be available. This benefit will be particularly apparent during periods of poor feed supply (e.g., dry season) and will have impact on all collaborating countries. Other benefits, primarily to collaborative partners, will be the improved availability of fuelwood and lumber, and more productive and better adapted leucaena lines for local farming systems.

The principal research programs and subprograms are listed in Table 2. The research programs are summarized in Figures 1 and 2.

Management

The managing agent for the project is The University of Queensland. Collaborating institutions overseas are the Rural Development Bank, the University of Technology (UNITECH), and the Department of Agriculture and Livestock (DAL) in Papua New Guinea; the Bureau of Animal Industry Forage Research Division in the Philippines; and the Faculty of Biology at Hanoi University in Vietnam. The Oxford Forestry Institute will provide seed and advice on the multisite evaluation subprogram and the establishment of seed orchards. Close associations with CIAT Tropical Forages Program (Southeast Asian Region) and OFI programs will ensure transfer of findings to the Southeast Asian and African regions, respectively.

In Australia, the Queensland Department of Primary Industry (QDPI), (Commonwealth Scientific and Industrial Research Organization (CSIRO) and the West Australian Department of Agriculture (WADA) will be involved in the multisite germplasm evaluation.

Where appropriate, project research will be integrated with postgraduate training degrees offered by The University of Queensland. Both Australian and collaborating country students will participate in the program. This strategy greatly increases the scope of the program.

Communication of research findings to international groups outside the project will be via the newly formed LEUCNET.

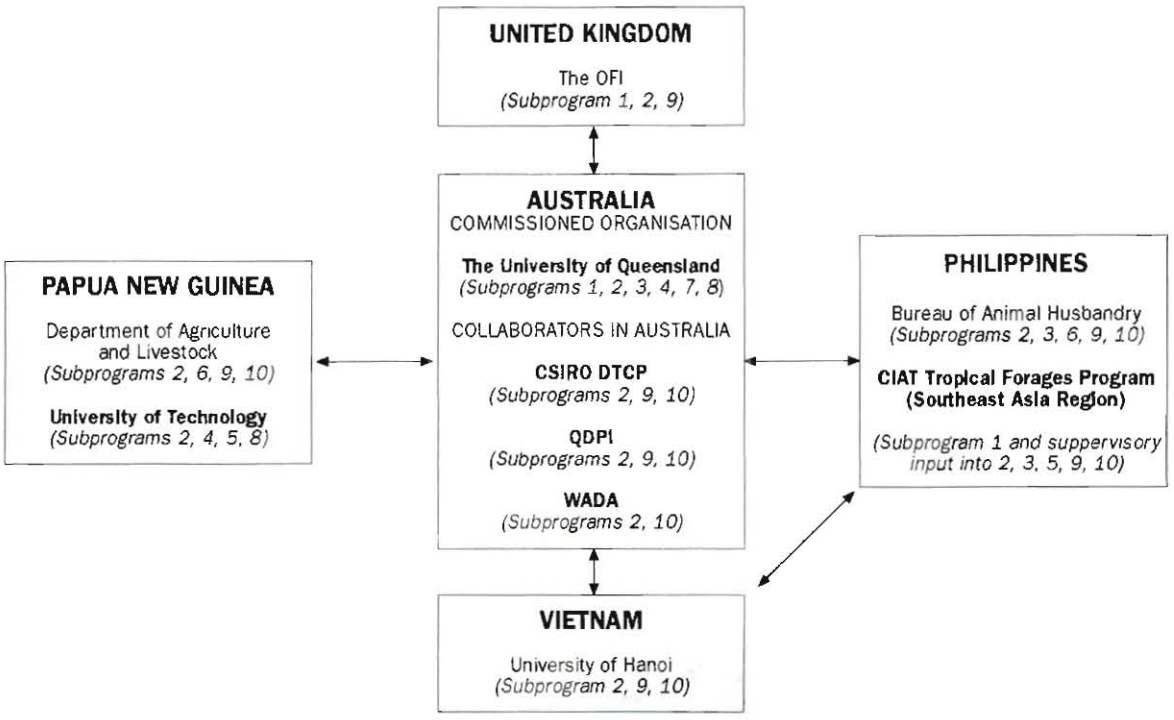

Figure 1. Research summary by country.

Table 1. Scientific outputs and applications.

Objective	Subprogram	Scientific Output	Potential Application
1.Identify new germplasm	Evaluation of foundation leucaena collection	Data on agronomic and morphological characteristics of entire collection of leucaenas. Catalogue describing *leucaena* seed international germplasm banks.	Overview of potential value of 17 lesser known species of leucaena for fodder purposes. Identification of new sources of psyllid resistance and cool tolerance.
	Coordinated germplasm evaluation	Detailed genotype and environmental responses of selected provenances across a broad range environments. Will permit powerful analysis of GxE interactions of germplasm.	Permit selection of best available germplasm for forage or wood purposes. Germplasm identification of psyllid tolerance or resistance, cold or frost tolerance, and acid soil tolerance.
2. Evaluate for high new forage quality	Acceptability/palatability of new leucaenas	Data on acceptability and palatability of lesser-known leucaenas to ruminants.	Allow selection of new species and provenances acceptable to ruminants for further agronomic studies. Unpalatable provenances will be studied only for wood production.
	Digestibility and chemical composition of new leucaenas	Data on digestibility, proximate analysis, and effects of condensed tannin on protein digestibility	Allow preliminary overview of forage quality of new provenances. Promising provenances will be selected for *in vivo* and grazing studies.
	Supplementary feeding value of new leucaenas	Data on the value of selected new leucaenas as sole and supplementary feeds for small ruminants	Provide understanding of supplementary protein value of new provenances in smallholder ruminant systems.
	Animal production from new leucaenas	Data on the animal production potential of selected key leucaena provenances and their reaction to direct grazing.	Allow assessment of the value of new provenances Will also provide valuable demonstration of the use of leucaena for animal production.
	Genotypic, environmental, and management effects on condensed tannins (CT)	Data on range of CT levels among provenances and the effects of environment and management on CT	Will allow selection of low tannin leucaenas and lead to management strategies to lower tannin content for ruminant livestock.
	Effect of leucaena tannins on protein nutrition of ruminants	Data on chemistry and activity of leucaena tannins in terms of ability to complex protein.	Provide understanding as to why provenances different CT levels may have similar protein precipitation activity. Selection of new leucaenas can then be based on both amount and type of CT.
3. Distribute germplasm and information to producers	Establishment of seed orchards	Data on establishment and management of seed orchards.	Seed of more productive, psyllid-resistant, cold-tolerant, acid-tolerant leucaenas made available to farmers Spillover effects from project due to OFI and CIAT involvement.
	Pilot extension programs	Demonstration areas of new leucaenas established. Newsletter articles, videos, and fields days prepared.	Producers begin to adopt new leucaenas.

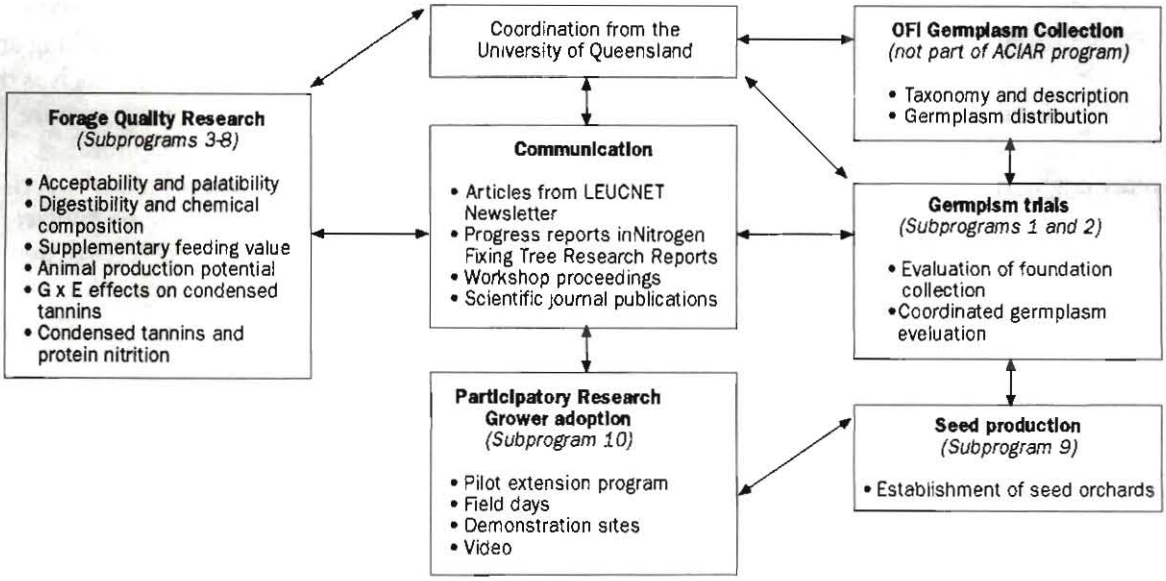

Figure 2. Research by subprogram.

Application of research and extension strategies

The application of research findings and the extension strategies to be used are of vital interest to this project. However, although pilot extension activity will start in the later part of the project, extension programs are likely to be a major thrust of any replacement project. The methods used to extend the findings will vary with country.

Australia

In Australia, the QDPI and WADA will be key organizers and conduits for channeling new cultivars and management recommendations to producers. Where possible, key producer groups will be involved to ensure ownership and involvement of producers. An example is the Leucaena Growers Association in the Ord River Irrigation Scheme in Western Australia which facilitates demonstration and application of new technology.

Although many Australian producers have heard of leucaena, many do not have a detailed understanding of the enormous benefits that can accrue to "grass-fed" cattle producers from its use. Many of those who do attempt to establish leucaena are frustrated by failure or very slow early growth necessitating up to 4 years delay before full grazing can be achieved. The objective of pilot extension programs will be, first, to raise the perception of the value of leucaena in northern Australia and, second, to supply detailed establishment and management information to enable producers to successfully establish leucaena in a minimum time frame.

Techniques that will be used in pilot extension activities due to begin in the last year of the present 3-year project will include field days, farmer training camps, videos, and dissemination of information via media outlets. Research impact assessments done in conjunction with Meat Research Corporation (MRC) personnel showed that the development of new leucaena cultivars in Australia could increase the potential area for sowing leucaena, from 21 million ha to 40 million ha. Our more immediate objective is to achieve an area of 0.5 million ha sown to leucaena by the year 2000.

Papua New Guinea

In PNG, the Smallholder Rural Projects Management Company (SRPM), a fully owned subsidiary of the Rural Development Bank, will be involved in extension work with smallholder farmers. The SRPM will supplement the activities of the Provincial Extension Service, which is currently facing difficulty due to financial limitations placed on public service departments.

SRPM, Lae

SRPM was established recently to provide an extension support program for clients of the Rural Development Bank of PNG. The goal of SRPM in Lae (Regional Office) is to respond to rapidly changing economic conditions in the livestock industry by providing essential extension-driven management services to a much-increased number of clients, mainly in the Markham Valley and Sialum areas of Morobe Province. Morobe will be established as the source of technical expertise in livestock while greatly improving the quality of the Bank's portfolio of cattle lending. Moreover, a series of development out-visits will include Wau, Menyamya, Oro, Upper Ramu Valley, and possibly East Sepik.

There are 45 client farmers (cattle projects) in the Markham Valley (site of subprogram 6). They are organized into 5 groups called ëextension bases,' of 9 farmers each. An extension base has farmers within close proximity and is served by one SRPM extension officer. Keith Galgal oversees the livestock development and extension program of SRPM and the Rural Development Bank, with a major commitment in the Markham Valley. One of SRPM's targets is to improve 2 ha of pasture per client per year. Leucaena will be introduced to at least two farmers of each extension base for the purpose of demonstration, viz. leucaena cv. Taramba, initially.

SRPM will also conduct two farmer training sessions for each quarter of the year; one on pasture improvement and the other on animal husbandry. These training sessions will include field days and demonstration farms where leucaena's usefulness to agriculture and grazing will be highlighted to a specific target group of end-users of new leucaenas.

An effective SRPM/DAL-Erap link is being maintained by sharing resource personnel in research and extension, and facilities for farmer training at Erap. DAL officers will be responsible for developing and maintaining of the leucaena germplasm collection and seed orchard at Erap. A more diversified utilization of the new leucaenas will be promoted through the SRPM/DAL linkages.

The University of Technology, Lae

The University's main functions are teaching and research. However, specific research, such as the Evaluation of New Leucaenas for Agriculture, is valuable in teaching relevant agricultural practices. Most graduates draw on this experience and exposure later, and maintain contact for updates of technology when involved in extension and development projects with DAL, the Rural Bank, and the Industries, etc.

The University Farm is also being promoted as a demonstration farm for new crops, techniques, and appropriate modern agricultural practices. The Farm is open to any visitor to the University or farmers from anywhere in the country.

The University Farm is also involved in the National Youth Development Program, where unemployed youth who show talent and interest are placed with various institutions and business houses for 3-6 months to learn and improve skills of their interest. Youths who have been attached to the University Farm have gone back to their villages but maintain contact to guide them in their small agricultural enterprises. The promotion and use of new leucaenas for agriculture in this context are promising.

Philippines

Based on the results of germplasm evaluation, the most promising *Leucaena* accessions will be propagated in the community. Meetings with the local extension people and government officials will be held to discuss the mechanics of the project. One to two village(s) in the northern part of the country will be selected as project site(s). The presence of an organized group of livestock raisers, willingness of farmers to cooperate, presence of credit facilities, i.e., rural banks, and nearness to livestock market are the major criteria in site selection. A rapid appraisal survey aiming at determining the socioeconomic profile of the would-be cooperators, developing the required mechanism for the effective dissemination of the technology, and determining the acceptability of the technology in the community will be conducted before the project implementation.

Initially, 5 farmers owning two or more head of cattle will be selected as cooperators. Selection will be based on the outcome of the survey. Aside from technical assistance, other inputs such as seeds/seedlings and fertilizer will be provided by the project. Target areas for planting will include communal ground, farm boundaries, and vacant areas within the backyard. Leucaena will be utilized mainly either as feed supplement to existing feed resources, i.e., crop by-products and residues, or as fuelwood, or both. To ensure success of the project, the necessary maintenance activities, particularly animal feeding and health practices, and marketing will be closely supervised and monitored. The project benefits also will be evaluated in terms of additional liveweights. Feedback mechanisms will also be established to evaluate farmers' responses to the technology.

The technology will be expanded to other villages through farmer training, field days, and publication of leaflets in the local dialects.

The project staff will establish strong linkages with the local extension people, local government units, and farmersí cooperatives. Assessment meetings will be held. The local broadcast/print media will be tapped as tools for extension.

Vietnam

The extension service in Vietnam operates via the Central Government Ministry through Provincial Centres to the local district level. The district centres assist farmers by disseminating of new germplasm, implementing on-farm demonstrations, and developing farmersí skills in utilizing new material or techniques. The leucaena evaluation program will be linked with the extension service at all stages.

Impact assessment

Environment

The project will have a positive impact on the environment. In Australia and collaborating countries, the highly productive and sustainable nature of leucaena plantings for both forage and fuelwood reduces the pressure on fragile natural ecosystems. Leucaena can sustain high stocking rates, thus allowing producers to reduce stocking rates on the surrounding more fragile pasture communities. The ability of leucaena to continue to produce limited but high-quality leafy sprouts from its woody branches during severe drought ensures high activity of rumen microflora and a continuing high intake of poor-quality grass. During drought, cattle with access to leucaena are noticeably heavier and healthier. Fattening and finishing cattle on leucaena also is far more natural and environmentally friendly than feedlotting.

Leucaena in the past has shown weediness potential due to very high seed production, characteristic of the original genotypes that were spread around the world. Even so, these weedy leucaenas became naturalized only on disturbed lands and there is little evidence that they invade undisturbed ecosystems. New leucaenas selected from this project will have a lower seed production potential, and consequently have higher biomass yield potential, and will be less of a weed threat. However, new provenances will be carefully evaluated for weediness potential in subprograms 1 and 2. Weediness potential will be assessed by measuring or observing the following parameters:

- amount of seed production,
- natural dispersal mechanisms of seed,
- level and duration of endogenous dormancy,
- longevity of seed in soil,
- palatability of leaf and young stem to ruminants, and
- vigor and adaptive range of provenances.

In the Philippines and Vietnam (and other tropical countries), fuelwood is harvested daily to meet cooking and other energy needs, placing great pressure on less sustainable forests. In addition, the pressure of limited land has caused farmers to clear ever steeper slopes for agricultural production. Leucaena has the potential to reduce the environmental pressure on these farming systems by providing a robust forest which can regenerate after clearing and cropping activities. On sloping land, the establishment of dense leucaena along contours will greatly reduce runoff following storms and increase water infiltration, thus reducing soil erosion.

Similarly, leucaena can increase sustainable supply of poles and materials for building construction and for stakes in vegetable gardens.

Gender

In the collaborating partner countries, responsibility for the daily collection of forage for livestock and fuelwood for cooking often rests with women and children. Therefore this project, which aims to increase supply of these resources to villagers, is likely to have positive effects for women and children.

Smallholders often keep ruminants as assets to be used in times of need. For instance, they are often sold to pay for special family expenses such as education for children, building a new house, weddings, and funerals. The improved availability of high-quality feed will increase the supply of animal protein as well as cash flow to villagers. Improved ruminant production from leucaena may, therefore, benefit the whole family.

Better Use of Locally Available Feed Resources in Sustainable Livestock-Based Agriculture in Southeast Asia

L. T. Hieu, K. Sato, and T. R. Preston[1]

The Food Agricultural Organization (FAO)/ Government Cooperative Programme GCP/ RAS/143/JPN on "Better use of locally available feed resources in sustainable livestock-based agriculture in South East Asia region" is a technology transfer and farmer-training project. It is a regional project funded by the Government of Japan and executed by the FAO, and involves Cambodia, China, Lao PDR, Philippines, and Vietnam.

The objectives of the project are:

- To establish the livestock production system with locally available feed resources and without the import of cereal grains and protein feeds in the region;
- To increase the feed production available to resource-poor farmers who have no access to conventional feeds due to economical and or physical reasons; and
- To protect the environment through better use of feed resources in terms of a sink for carbon dioxide, fixation of atmospheric nitrogen, and oxidation of methane.

Technical activities

Electronic mail system

The objective of establishing an electronic mail system was to build the infrastructure of a regional network so that the five participating countries can share responsibility for research, training, and exchange of information on the use of locally available feed resources for livestock production.

The E-mail system has already had a big impact in Vietnam. It provides a convenient and cheap means of communication all over the world and facilitates domestic information exchange. CanTho University uses the system as an affordable local area network. This university has set up some eight subnodes within its system. These nodes are used to exchange internal information between faculties, departments, and the office of the Rector. In Vietnam, university libraries cannot afford to subscribe to major scientific journals. The E-mail system alleviates the lack of information at an affordable cost.

In Cambodia, the project office is linked with Internet through the 'FORUM' network. The FAO Representative's office and the WFP in Phnom Penh are also connected to Internet through FORUM.

Biodigester

Although the anaerobic biodigester is only a secondary activity of the project, farmersí interest makes this activity our achievement with the greatest impact. In Vietnam, more than 500 biodigesters were installed last year. Several demonstration digesters were installed and training courses were conducted in Ho Chi Minh City, Long An, Tay Ninh, and Ben Tre provinces. Farmer acceptance of this technology has been very rapid. Farmers have started to install the systems with their own funds and farmers teach neighboring farmers.

[1] University of Agriculture and Forestry, Thu Duc, Ho Chi Minh, Vietnam.

Vietnam has developed a unique integrated farming system, called VAC. It consists of a garden, fish pond, and pig pen. Farmers produce green vegetables with water from the pond, raise pigs, and feed fish with pig manure. Recently they have added biodigesters to the VAC systems.

In Cambodia, many nongovernment organizations (NGOs) have introduced biodigesters to farming communities. Chinese or Indian type biodigesters require large amounts of cement and labor, and are not suitable for poor farmers. Since the biodigester was reported to control certain bacteria and parasites, rural sanitation programs in Cambodia have adopted the technology. They combine a human lavatory with biodigester to produce enough gas for cooking. Two to three pigs, one cow, and a family's excreta are enough to produce the gas required for a family. Thirty-seven biodigesters were installed this year with funds from the project. There are two main constraints to the dissemination of the technology in Cambodia: the unavailability of credit and the unavailability of the plastic tube which is imported from Vietnam or Thailand.

More recently, plastic tubes are being produced by factories in Lao PDR.

In the Philippines, demonstration biodigester units installed in selected villages of Batangas, Laguna, Tarlac, and Iloilo serve as show windows for visiting farmers, extension workers, and staff of government institutions and NGOs. This low-cost biodigester is gaining popularity because it is simple and cheap.

China continues to install cement-type biodigesters because the Chinese-style biodigester is well established in the country and the low temperature seems to be unsuitable for the simple plastic biodigester.

Sugar cane juice or sugar palm juice feeding

The project has demonstrated a range of feeding systems in the tropics.

In the Philippines, muscovado sugar (local brown sugar) is successfully used as the basal diet for pigs. Farmers gain higher profit from raising pigs on muscovado than by selling it directly. A paper and a poster on the utilization of muscovado sugar for pigs in Tarlac won the 'Best Paper Award' during the National Research Symposium of the Department of Agriculture in August 1995. This symposium gave this project the opportunity to disseminate the muscovado technology to leading researchers, extension workers, and administrators throughout the Philippines.

In Cambodia, sugar palm trees are grown widely in the countryside. Sugar palm has a high capacity to produce food energy from sunlight. Farmers make brown sugar during the dry season, but the market for palm sugar is limited. Mr. Khieu Borin, a student of the MSc training course funded by SIDA-SAREC, is conducting extensive research on the production and use of palm sugar for pig feeding. Our project is also examining the potential of palm sugar as pig feed on farms. Farmers gain more profit from raising pigs with palm sugar than from selling palm sugar to the local market.

This year, 29 pigs were distributed to demonstration farms. The farmers use sugar palm juice during the dry season, and traditional feed when the palm juice is not available. Farmers now want to adopt the new feeding system. With sugar palm juice and dried fish, they can produce healthy pigs and shorten the raising period from 12-15 months to 7-9.

In Vietnam, feeding pigs with sugar cane juice is practiced by more than 100 farmers in Tuyen Quang and Bac Thai Provinces. Wherever sugarcane is relatively cheap and pig meat is expensive, feeding sugarcane juice to pigs is profitable.

In China, it takes time to adopt this technology because sugarcane commands high price at the sugar factory.

Urea treatment of fibrous crop residues

Fattening indigenous breeds of cattle on urea-/ammonia-treated wheat and rice straw has proved to be very successful in China. More than 3 million smallholder farmers treated over 6 million tons of straw, to produce 300,000 tons of beef in 1993.

The UNDP/FAO Project (CPR/88/057/A/01/12) had a big impact on using urea-treated wheat straw for beef fattening. The government of China supports the effort and encourages the use of the urea treatment to other fibrous residues. Our project has taken advantage of this project and tries to develop new applications. Urea treatment is successful in China because urea is subsidized by the government. In other

urea is subsidized by the government. In other countries, urea treatment is not always economic because beef is relatively inexpensive and sometimes cattle and buffalo are used only as draft animals. In Cambodia, urea-treated rice straw improved the condition of animals and their performance, but farmers do not have enough straw for feeding for the whole year. The unavailability and high price of urea are other constraints.

Urea Molasses block

Urea molasses block (UMB) has many variations in its composition. Every researcher group makes and tests its own UMB at the farm level. In Laos, UMB is produced in Vientiane and Borikhamsay Province with different formulae. The ingredients of the feed block are rice bran, urea, salt, lime, cement, and clay. In Xieng Khouang, an acid-soil plateau, bone meal is added to the blocks to overcome the phosphorus deficit. A total of 10 tons of UMB has been produced in Laos under the project this year.

In Vietnam, one of the project staff at CanTho University is trying to organize a UMB production site and distribute UMB to farmers through veterinary drugs retailers. The constraints of this technology are the unavailability and the high price of molasses, which are usually controlled by sugar factories. The majority of farmers do not have access to the sugar factories and it is difficult to buy molasses in local markets.

Shrimp head and fish molasses silage feeding for pigs

In Thanh Hoa Province, Vietnam, shrimp heads are collected from shrimp processing factories and ensiled with molasses. Provisional data indicate that this feed is promising as a protein and energy supplement for pigs.

In Iloilo, Philippines, fish-molasses silage is fed to pigs in Iloilo. Farmer cooperators in the project have found that preparing this diet is less laborious than the traditional way of feeding Ipomoea spp., which they cook daily.

Multipurpose trees

In Vietnam, feeding trials with Trichanthera, Acacia, jackfruit, and banana leaves have been conducted at the Experimental Station Farm in BaVi. Trichanthera, introduced from Colombia, was planted in Tuyen Quang (50 farmers), Hue (15 farmers) Thuan An (5 farmers), and CanTho (1250 m^2), and fed to pigs and goats. *Acacia mangium* and *Gliricidia sepium* fodder has been extensively fed to goats at the University of Agriculture and Forestry of Ho Chi Minh City. Seed of *A. mangium* was sent to Cambodia from Vietnam. It was seeded in this rainy season and distributed to farmers.

In Laos, *Calliandra calothyrsus* was seeded in Xieng Khoang. *Leucaena leucocephala* and *C. calothyrsus* will be tested in Borikhamsay Province.

In the Philippines, farmers are willing to plant and feed *Trichanthera* to sheep and pigs.

Aquatic plants

The growth of duckweed (Lemna spp.) with biodigester effluent, and its use as a partial replacement for soybean meal for pigs, is being studied at the University of Agriculture and Forestry of Ho Chi Minh City. Good results were obtained in the preliminary feeding trial with local pigs. Farmers in Phuoc Long village near Ho Chi Minh have established ponds to produce duckweed for ducks and pigs. Mr. Bui Xuan Men, a student of the MSc program, conducted research on the use of duckweeds for Muscovy ducks.

Duckweed was seeded in various ponds in Cambodia. In some villages farmers have already established ponds under the UNICEF family food programme. Although they intended to use the pond for irrigation of vegetables, they can also use the pond for water plants and raise fish at the same time.

Conclusion

After two years of the project, we are getting a positive response from the farmers and strong support from the government of the participating countries. Especially in Vietnam, we interact with many organizations, such as international NGOs, local women's unions, local farmer associations, universities, the National Research Institute, and Extension Services. With the close

collaboration of the IFS's grantees and of the MSc students of the SIDA-SAREC programme in Vietnam and Cambodia, the project gains practical knowledge in the use of locally available resources.

Cambodia has demonstrated substantial progress with the assistance of various NGOs. 'LWS' strongly supports the project's technologies and encourages the field activities with the Department of Animal Production. 'FORUM' supports the E-mail connection to the Department of Animal Husbandry.

Laos set up its demonstration sites in three places and a biodigester was installed by the local staff. Phosphate deficiency in Xieng Khonang was overcome by using the Multi-Nutritional Block.

China has shown steady improvement with strong support from the central government as well as local authorities. It has focused on urea treatment of fibrous agricultural by-products because of its economical and sociological situation.

The Philippines has started raising pigs on muscovado sugar and fish molasses silage.

With the increasing world population and the limited grain production, grain production should be for human food as a priority. The surplus can be for animal production. The animal industry, therefore, should reduce its dependence on feed grain. Only if all kinds of nongrain feed resources are fully used can a sustainable development of animal industry be achieved. China is a good example. In the last few years, its grain production has stagnated, but the animal production still increased at an annual growth rate of 10%. The reason is that various locally available feed resources have been used. We believe our project will have a good impact in Southeast Asia.

Crop-Livestock Integration in Southern Thailand: Prospects and Constraints

P. Sophanodora[1]

Agriculture in Thailand has concentrated on monoculture production systems for the last three decades, as a strategy to maximize food production. Increases in the production of some crops have been due mainly to the expansion of the area of cultivated land. This has led to the use of marginal lands, as can be seen in the number of farmers in Thailand currently facing crop failure in varying degrees, or unprofitable operations. In addition, signs of land degradation, such as low crop yields, soil erosion, and even landslides, are evident in some areas. During the same period, there has been strong growth in the industrial and urban sectors, bringing about other socioeconomic problems, such as rural migration and shortage of farm labor.

The Royal Thai Government recently proposed a plan to restructure agricultural production systems, involving reduction of the total area dedicated to the production of specified crops, diversification of cropping, and integration of crop-livestock production systems.

In southern Thailand, three major crop-livestock integration projects are in progress (Table 1). These are a) the renovation of the Typhoon Gay disaster area for beef cattle production, b) the development of beef production in 5 provinces in the lower south, and c) the introduction of cattle to marginal rice and coffee production areas.

This paper will look at the constraints and prospects relating to these development plans, with particular emphasis on feed resources.

Current situation

Renovation of the typhoon Gay disaster area for beef cattle

In late 1989, two provinces in the upper south (Chumporn and Prachub Kirikan) were struck by typhoon Gay and those suffered great damage, including the destruction of a production

Table 1. Crop-livestock projects actively planned or being implemented in southern Thailand.

Project Site	Projected	No. of households	Project Duration
a) Chumporn and Prachub Kirikan Provinces	9000	1000	1991-1995
b) Satul, Songkha, Yala Pattani and Narathiwat Provinces	6375	3125	1994-1998
c) Marginal rice and coffee production area	18500	not available	1994-1996

Source: Department of Livestock Development, 1994.

[1]Depatment of Plant Science, Faculty of Natural Resources, Prince of Songkla University, Hat-Yai, 90110, Thailand.

area of about 250,000 ha of rubber, coconut, and fruit crops. The renovation project was implemented during 1991-1995, with the objective of distributing 9,000 beef cattle to 1,800 farm households. The first group of about 1,000 pregnant Australian Brahman was introduced in late 1992 for distribution to about 200 farmer households in the project areas. However, because of late and insufficient preparation of forage resources, the imported cattle suffered weight loss and abortions; less than half were accepted by farmers, and the remaining were relocated to central Thailand. What we have learned from this is the fundamental importance of preparing sufficient feed resources to sustain the imported cattle while awaiting distribution to farmers.

Beef cattle promotion in the lower south

Selected farmers will be given 2 pregnant cattle each to develop beef production in this region. An area of about 2,500 ha is also planned for the establishment of a communal grazing area, to be sown with ruzi (*Brachiara ruziziensis*), hamil guinea (*Panicum maximum* cv. Hamil), purple guinea (*P. maximum* T58), and Verano stylo (*Stylosanthes hamata* cv. Verano). Individual backyard pasture establishment is also being encouraged. Selection of farmers, and livestock and feed resource management training, are currently being implemented. The project is still in progress but experience gained from a previous project is being carefully used to ensure success. It is to be noted that socioeconomic and traditional farm practices tend to restrict the progress of the project. These areas are dominantly Muslim and most of the farmers earn their living from fishing and rubber tapping.

Agricultural system restructuring project

The project is a national plan aiming to diversify from production of four unsustainable crops (rice, cassava, coffee, and pepper) to other production systems. Several packages of production systems have been developed and farmers are encouraged to participate and make independent choices. Soft loans from the Bank of Agriculture and Agricultural Cooperation have been provided to assist with diversification to recommended systems. One system is the crop-livestock integration system. In southern Thailand, it is expected that about 5,900 ha of coffee-producing land will be used to support about 18,500 cattle. No data on the plan to integrate rice and cattle production in the area are available, but it is expected that some marginal rice-producing areas in Patthalung and Nakorn Si Thammarat Provinces will be converted under the project.

Recently, under the IMT-GT project (Indonesia, Malaysia, Thailand-Growth Triangle), a private-sector agreement for cooperation to supply meat for export to Malaysia and Indonesia was signed. This is another project that will enhance crop-livestock integration in southern Thailand.

Dairy development, vaccination and animal insemination service, forage production and livestock marketing projects are also being planned to complement the major beef cattle projects. Generally, these projects are initiated by either local or central government officers and extension and promotion are carried out by the local government agencies. Some projects ignore the importance of farmer participation.

Problems and constraints

Low soil fertility, unavailability of suitable species, and the type of agricultural system adopted are constraints that must be considered in the establishment of pasture for animal production in southern Thailand.

Soil fertility

Most soils in southern Thailand are very poor (Table 2). Major limiting nutrients are P, N, and K, and several micronutrients (S, Mg, Cu, Zn, etc.) will become limiting if major nutrients are added without them (Nilnond *et al.* 1986, Suthipradit *et al.* 1992, Malakarn 1994, Sukthangpee 1995).

The studies also reported that applying basal fertilizer is essential for successful establishment of the sown forage species. The Department of Livestock Development (DLD) recommends application of lime of 100 kg/ha and complete fertilizer as basal fertilizer and for topdressing after each cut.

In an experiment on the establishment of forage legumes (*Stylosanthes hamata* cv. Verano and *S. scabra* cv. Seca) into communal native grass swards, Malakarn (1994) found that basal fertilizer at 8-8-4 kg/ha of N, P, K significantly increased total dry matter of the swards. The response was stronger in swards oversown with legumes than pure native grass swards.

These reports indicate the importance of basal fertilizer in the satisfactory establishment of pasture. In practice, however, this importance is always overlooked, because of the relatively high cost of fertilizer. Also, the recommended fertilizer often is not available in local markets. For these reasons, many beef cattle projects have failed to establish good pastures in the beginning, resulting in insufficient feed supply.

Table 2. Major nutrient limitations in soils of southern Thailand.

SOILS SERIES	MAJOR LIMITATION	TEST CROP	REFERENCE
14 soil series derived from different parent materials	P, N, K, S, Ca, Cu, Zn	Maize	Nilnond *et al.* 1986
Ban Ton	N, P	Ruzi grass	Egara *et al.* 1989
Kok Kian	P, N, Ca	Peanut	Suthipradit *et al.* 1990
Vi Sai	P, K, Mg, Cu, Mo	Verano stylo, Centro America Jointvetch	Suthipradit *et al.* 1992
Ban TonJo & Ba Jo	P, N	Verano stylo, Seca stylo	Malakarn 1994
Vi Sai	P, N, S	Paragrass	Sukthangpee 1995

Adapted species and availability of planting material

Seeds of ruzi (*B. ruziziensis*), Hamil guinea (*P. maximum* cv. Hamil), plicatulum (*Paspalum plicatulum*), hamata (*S. hamata* cv. Verano), and centro (*C. pubescens*) are commonly available through the local DLD extension officer. Our experience, however, shows that ruzi is not well-suited to the alluvial soil in southern Thailand, where flooding can easily occur after successive rainy days. Para grass and plicatulum grasses are better adapted to alluvial soils (Sophanodora 1995), but little planting material, with the exception of plicatulum seed, is available to the farmer. Unfortunately, the palatability and nutritive value of plicatulum grass are poor, especially when the grass becomes older. Guinea and para grasses respond well to fertilizer, but do require high fertilizer input for good establishment and yields. Chemical fertilizer is seldom applied by small farmers, hence the growth and yields of planted pastures are poor, and forage has low nutritive value (Sukthangpee 1995). Locally produced seed stock have poor seed quality because of unfavorable climatic conditions during seed ripening and processing. Some seed lots, given free to farmers, fail to germinate, leading to delays in pasture establishment, and thus project failure due to lack of pasture for the animals.

In one grazing experiment, Wanwisa (unpublished data) found an average daily gain of 0.53±0.18 kg/hd/d in 75% Holstein Freisian weaners during 4 months of continuous grazing on mixed pasture (*Panicum maximum* cv. hamil, *Paspalum plicatulum, Brachiaria mutica* mixed with *Centrosema pubescens*,and *Stylosanthes hamata* cv. Verano) which had received a basal fertilizer (20-20-20 kg/ha N, P, K), compared with only 0.12 ±0.05 kg/hd/d in the treatment without fertilizer. Wanwisa reported significant differences in total dry matter yield between the two treatments. There were also huge differences in the botanical composition of the swards; plicatulum grass becoming a major component (60-78%) in the treatment without fertilizer, and hamil and para grasses (31-53% and 12-19% respectively) in the treatment with fertilizer (Figure 1).

Brachiaria humidicola, known in Thailand as "creeping signal" has recently been recommended as an adopted species well-suited to southern Thailand. This species is well-adapted to acid and infertile soils and has good shade tolerance. It is more nutritious than plicatulum (Table 3). Unfortunately, seed production of this species is very low. In addition, some farmers are reluctant to grow it because it is an aggressive species which easily competes with young rubber or oil palm trees.

Agricultural systems

Most agriculture in southern Thailand is dominated by plantation crops such as rubber, oil palm, fruits and coconuts (Sophanodora 1995). Rice production, the second important system, can be found on alluvial soils and around Songkhla Lake. The integration of cattle with plantation systems is less practiced than cattle-rice integration, but some farmers are using cattle or goats as weeders in oil palm and coconut plantations. Few farmers have sown improved pasture for their animals. Hence, animals rely mainly on native weed species which are abundant during the rainy season but scarce during the dry season. In addition, the animals, if not confined or tethered, can create problems for neighbouring farms.

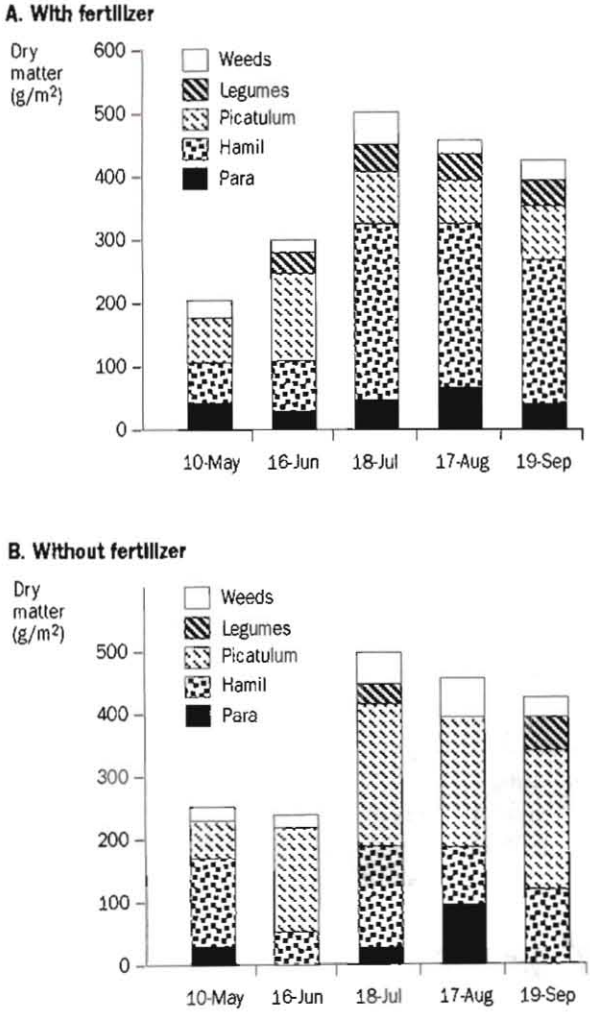

Figure 1. Dry matter yield (g/m²/period) and botanical composition in the mixed swards with fertilizer (a) and without fertilizer (b) grazed by 4 weaners at a stocking rate of 0.6 hd/ha.

Integration of cattle with rice production is commonly practiced, and dairy cattle raising is highly successful in Patthalung Province where rice is the dominant crop. Paspalum and para grass are sown in some abandoned ricefields, but the Agrarian System Research and Development project of FNR found that forage supply for dairy cattle is sufficient, especially during the rice growing season. Dairy farmers in Patthalung Province spend about 48% of total production costs on feeds (Ayut and Aat 1993). This expense could be reduced and much greater benefits could be expected if sufficient forage could be obtained. Rice straw and native weeds are commonly used as cattle feed. Terwoort and Koffeman (1993) have suggested that urea mineral molasses block (UMMB) supplementation for dairy cows could significantly increase milk production in the region.

Animal breed

Smallholder farmers, owning 2-2.5 ha of land per household, are the primary target group for encouraging the integration of livestock with existing cropping systems. At this farm size, the optimum number of animals per household can be estimated at 5 beef cows or 2-3 dairy cows. There are no strict recommendations on the type of animal-beef or dairy cow, or goat-selected according to what is considered best suited to local conditions.

Native animal breeds have lower productivity than crossbreeds. Kochpakdee *et al.* (1994) reported that the reproductive performance of the crossbred of Anglo Nubian x native Thai goats grazed on improved pasture with fertilizer was better than that of native Thai goats.

Crossbred Native x American Brahman is considered to be well-adapted to the humid tropics; however, local markets favor red cattle over white cattle. Attempts have been made to introduce other breeds, such as the DroughtMaster, Kampaeng Saen, and Australian Brahman, to improve our native cattle herds. No conclusion has been reached regarding the adaptability of the introduced breeds, but they normally require better animal husbandry and more feed (Sornthep 1995).

Table 3. Nutritive values of *Brachiara humidicola* and *Paspalum plicatulum* at different cutting intervals (Anant *et al.* 1990, Sasithon and Saranya 1990).

Attribute	*B. humidicola* at cutting interval (days)			*P. plicatulum* at cutting interval (days)		
	30	45	60	30	45	60
Voluntary intake (g/kg)	102	97	91	-	39	38
Dry matter digestibility (%)	50	54	55	-	39	38
Total digestible nutrients (%)	48	45	47	-	35	35
Digestible energy (kcal/kg)	2.16	2.03	2.05	-	2.90	0.50
Crude protein (%)	13.9	12.8	8.1	-	6.9	5.7

Socioeconomics

Socioeconomics is another important area that needs to be considered. Traditionally, southern Thailand farmers have been most familiar with rubber production. But the accelerated development of the industrial and aquaculture sectors has led to labor shortages in the agricultural sector. Many dairy farmers in Patthalung Province are leaving the agricultural industry because most of their family members have left, or plan to leave, for industrial or urban service-related jobs.

Conclusions

To plan a project, that will deliver successful and sustainable results, the whole system and its integrated components must be taken into consideration. Physical (e.g. land, climate), biological (e.g. crop, livestock, agricultural systems) and socio-economic (e.g. household, labor, marketing, and economic justification) factors must be taken into account. These factors and their interrelation need to be identified, and the plan discussed among researchers, extension officers, bankers, and participating farmers.

There are prospects for crop-livestock integration in southern Thailand, despite the failure of some projects. Reasons for project failure include:

- Lack of effective planning;
- lack of trained extension staff;
- lack of good quality and quantity of feed resources;
- socioeconomic constraints; and
- lack of quality-beef marketing.

From those projects, however, we learned that:

- Land preparation and seedbed preparation must be completed before the importation of animals;
- more suitable forage species are needed.
- satisfactory quality and quantity of seed or planting materials must be readily available.
- Basal fertilizer is essential for pasture establishment.
- UMMB supplementation is strongly recommended.

Acknowledgments

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Appendices

Program of the Meeting

(a) Program Overview

Date	Time	Forages for Smallholders Project (FSP)	FAO Regional Working Group on Feed and Grazing Resources in Southeast Asia	FAO Regional Network on Better Use of Locally Available Feed Resources for Sustainable Livestock Production in Southeast Asia
Tuesday 16 January	a.m.	Opening Ceremony and Plenary Session		
	p.m.			
Wednesday 17 January	a.m.	FSP Session	FAO Project Session	Attend either session of the other two projects
	p.m.	Country Presentation	Country Presentation	
Thursday 18 January	a.m.		Field visit–Vientiane Province	
	p.m.		Discussions on Future Activities and Collaboration Closing Ceremony	
Friday 19 January	a.m.	Field visit to Luang Phabang		
	p.m.			
Saturday 20 January	a.m.			
	p.m.			

(b) Program Details

15 January 1996 Arrival of Participants and Registration

16 January 1996

0830-0900 Registration

Opening Ceremony-*Moderator*: Dr. Bounthong Bouahom

0900-0940 Vice Minister of Agriculture, Lao (His Excellency Sitaheng Rasphon)
Director General of the Department of Livestock and Fishers (Dr. Singkham Phonvisay)
First Secretary, Development Cooperation, AusAID (Mr. Robert Jauncy)
Representative, FAO Crop and Grassland Service (Ms. Caterina Batello)

0940-1010 B R E A K

Plenary Session: Regional Projects on Feed Resources - Objectives and Achievements
***Moderator*: Dr. Singkham Phonvisay**

1010-1030 The FAO Regional Working Group on Feed and Grazing Resources in Southeast Asia. (Ms. Caterina Batello)
1030-1050 The AusAID Forages for Smallholders Project (Dr. Bryan Hacker)
1050-1110 The FAO Regional Network on Better Use of Locally Available Feed Resources for Sustainable Livestock Production in Southeast Asia (Dr. Luu Trong Hieu, Dr. Kenji Sato and Dr. Reg Preston)
1110-1130 The International Livestock Research Institute (Dr. C. Devendra)
1130-1150 ACIAR Project 9433- New Leucaenas for Southeast Asian, Pacific and Australian Agriculture (Dr. Max Shelton)
1150-1220 General Discussion
1120-1230 Announcements
1230-1400 L U N C H

Plenary Session: Prospects for Forage Adoption by Smallholders in Southeast Asia
***Moderator*: Dr. Kenji Sato**

1400-1430 Prospects for introducing forages in smallholder farming systems in Asia. (Dr. Peter Horne, Dr. W. Stür, Mr. Phonepaseuth Phengsavanh and Mr. Francisco Gabunada)
1430-1500 Current Status and prospects for tropical forage seed production in Southeast Asia: Experiences and recommendations from Thailand. (Ms. Chaisang Phaikaew)
1500-1515 B R E A K

Plenary Session: Results of Pilot Projects on Sustainable Use of Locally Available Feed Resources
Moderator: **Dr. Bryan Hacker**

1515-1535	Pilot projects in Cambodia
1535-1555	Pilot projects in China
1555-1615	Pilot projects in Laos
1615-1635	Pilot projects in the Philippines
1635-1655	Pilot projects in Vietnam
1655-1715	General Discussion
1730	Depart for Vientiane

17 January 1996

Individual Project Session: (i) Forages for Smallholders Project

0830-0845	Welcome
0845-0930	Indonesia country report (Mrs. M. Tuhulele, Dr. T. Ibrahim and Mr. Ibrahim)
0930-1015	Vietnam country report (Mr. Le Hoa Binh and Mr. Khanh)
1015-1045	B R E A K
1045-1000	Malaysia country report (Mr. Chen Chin Peng)
1100-1145	Lao country report (Mr. Viengsavanh Phimphachanvongsod)
1145-1230	Philippine country report (Dr. P. Faylon and Ms. Elaine Lanting)
1230-1400	L U N C H
1400-1415	Thailand country report (Ms. Chaisang Phaikaew)
1415-1430	China country report (Mr. Liu Guodao)
1430-1730	Discussion Depart for Vientiane

Individual Project Session: (ii) FAO Regional Working Group on Feed and Grazing Resources in Southeast Asia

0830-0900	Adoption of technology for livestock development in Southeast Asia (Dr. A.T. Zainuddin)
0900-0915	Livestock production: policies constraints and future developments in Thailand (Mr. Chirawat Khemsawat)
0915-0930	Crop livestock integration in South Thailand: prospects, constraints and experiences (Dr. Pravit Sophanodora)
0930-0945	Livestock production: policies constraints and future developments in the Philippines (Mr. F. Moog)
0945-1000	Livestock production: policies constraints and future developments in Lao PDR (Dr. Bounthong Bouahom)
1000-1015	B R E A K
1015-1030	Livestock production: policies constraints and future developments in Vietnam (Dr. Le Viet Ly) (a) Farm level seed production of a top performing *G. sepium* in dryland farming areas of Bali (b) Country policy on livestock production (Dr. I.M. Nitis)
1045-1100	Forage development in Vietnam (Mr. Nguyen Ngoc Ha)
1100-1115	Fodder grasses to maximize land productivity for ruminant production (Dr. Ridzwan Halim)
	The performance of hybrid *Leucaena* in acid soils (Mr. Chen Chin Peng)

1130-1145	Evaluation of new *Leucaena* cultivars in the Philippines (Mr. Alex Castillo)
1145-1200	Growth and yield of cassava from crop-pasture rotation. (Mr. Supachai Udchachnon)
1200-1215	Demonstration trial on community-based fodder development in Albay. (Ms. Emily Victorio)
1215-1230	Productivity and sustainability of some tropical grasses under low input management systems (Dr. Wong Choi Chee)
1230-1400	L U N C H
1400-1415	Pasture seed production in Malaysia (Ms. Aminah Abdullah)
1415-1430	Pasture seed production in the Khon Kaen region (Ms. Chureerat Satjipanon)
1430-1730	FAO RWG project business meeting Depart for Vientiane

18 January 1996

Individual Project Session: (i) Forages for Smallholders Project

0830-1230	Review of Results and Discussion of Future Activities L U N C H

Plenary Session: Final Discussion
Moderator: **Dr. Bounthong Bouahom**

Discussion on Future Activities and Collaboration

Closing Ceremony

1700-1730	Closing Ceremony

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