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Forages for Smallholders

PROCEEDINGS OF THE THIRD MEETING OF THE SOUTHEAST ASIAN REGIONAL FORAGE SEEDS PROJECT

Samarinda, Indonesia, 23-28 October 1994

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THIS MEETING WAS HOSTED BY THE PROVINCIAL LIVESTOCK SERVICE, SAMARINDA, EAST KALIMANTAN, INDONESIA

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Section 1: Preface

INTRODUCTORY REMARKS

P.C. Kerridge[1]

On behalf of member organizations of the Southeast Asian Regional Forage Seeds Project, I wish to thank the Governments of Indonesia and of the Province of East Kalimantan, for the funding, time and effort that have gone into organizing and hosting this Regional Meeting.

Member organizations of the Forage Seeds Project include:

from Indonesia	-	DGLS (Directorate General for Livestock Services) and Dinas Peternakan
from Malaysia	-	MARDI (Malaysian Agricultural Research and Development Institute) and the DVS (Department of Veterinary Services)
from Thailand	-	DLD (Department of Livestock Development)
from the Philippines	-	PCARRD (Philippine Council for Agriculture, Forestry and Natural Resources Research and Development)
from Australia	-	CSIRO (Commonwealth Scientific and Industrial Research Organization at Australia), and
from the international community	-	CIAT (International Center for Tropical Agriculture)

We also have participants from the Governments of China, Laos, and Vietnam.

Why a Regional Forage Seeds Project?

In 1989, during a meeting in the Philippines, representatives from the countries in the region decided to request the Government of Australia that AIDAB (Australian International Development Assistance Bureau) fund the establishment of a Southeast Asia

[1]Project Leader, Tropical Forages Program, CIAT, AA 6713, Cali, Colombia.

Regional Forage Research and Development Network (SEAFRAD) which would allow CIAT and CSIRO to work with countries in the region to introduce and evaluate new forages. It was deemed that a regional forage network would promote the rapid flow of forage germplasm and ideas readily through the region and make the most efficient use of the limited resources. The Government of Australia responded to this request and I wish to acknowledge the support of AIDAB on your behalf.

What else is unique about this Forage Seeds Project?

Farmers are being involved at an early stage in the evaluation process and work is being carried out where there is a real need for forages. I am sure you will agree that there is a need in East Kalimantan to increase the productivity of vast areas of low fertility soils dominated by *alang-alang*. We believe that well-adapted forages, in particular, legumes can play a major role in increasing soil fertility as well as - animal production. But the process needs to be one that can be managed using the resources that are available to farmers, and that can be in harmony with a sustainable land use policy.

We acknowledge the support of Ir Erik Nursahramdani, Head of the Provincial Livestock Services of East Kalimantan, for the forage improvement activities in the Province, particularly support of the local staff who are carrying out the work in the field, and who have been given the opportunity to participate in these discussions. These younger colleagues can contribute much through their enthusiasm and ideas.

I would also like to acknowledge the support of all country governments and the country coordinators. The project depends on you to ensure widespread impact. Recently, Mr. Siagian and Mrs. Maimunah organized a national workshop on forage agronomy and seed production with participants from throughout Indonesia attending. Mrs. Lanting of PCARRD organized a similar workshop in the Philippines.

Already in this project, new forages have been identified that are better adapted than those that can be imported commercially into the region. The challenge is to find a way to multiply and move these new varieties to farmers in other areas. On a local scale, much of this can be done effectively by farmers themselves through seed or vegetative propagation. Perhaps we should also try to involve agribusiness and take advantage of opportunities for low cost seed production in particular countries in the region.

Finally, what of the future? It takes time to put a team together and set new processes in action. A solid foundation has been established. people have been trained, better varieties have been identified, and forages are beginning to move out to the real testing ground on the farms. But the momentum needs to be maintained. Thus with the support of Dr. Soehadji and other leaders in the region we have put a proposal to AIDAB to fund a second project entitled "Forages for Smallholders". I understand that this has the support of AIDAB and is presently with the Minister for final approval.

OPENING ADDRESS - GOVERNOR OF EAST KALIMANTAN

H.M. Ardans, SH.[1]

Assalamualaikum Wr. Wb.

The distinguished

Director General of the Directorate General of Livestock Services,

Representative of the Commonwealth Scientific and Industrial Research Organization (CSIRO) Australia,

Representative of the International Center for Tropical Agriculture (CIAT), Colombia,

Chairman of the Provincial Legislative Assembly of East Kalimantan,

Guests and Participants of the Third Meeting of the Southeast Asian Regional Forage Seeds Project.

Ladies and Gentlemen,

Let us extend our praise and gratitude to our almighty God for our being able to gather together here. On behalf of the government and people of East Kalimantan, I am very pleased to welcome the Director General for Livestock and all participants from Southeast Asian countries to East Kalimantan. May God bless all participants, so that their dedication during this meeting will bring in positive results.

The Head of Livestock Services of East Kalimantan has reported that this meeting is attended by decision makers and experts in the field of livestock development from home and abroad. Therefore I believe this Third Meeting of the Southeast Asian Regional Forage Seeds Project will play an important role in provincial, national as well as regional development, especially that relating to livestock and agricultural development.

East Kalimantan Province, with a population of 2,006,933 in 1993, covers an area of 211,440 km^2 (1.5 times that of Java island including Madura). Besides its huge area, Indonesia's second biggest province following Irian Jaya and known as a land of future hopes, East Kalimantan has high economic-valued resources which are advantageous for regional and national development.

[1]Governor of East Kalimantan, Samarinda, East Kalimantan, Indonesia.

These resources provide opportunities for domestic as well as foreign investors. During the previous PJPT I (the first 25 Year Long-Term Development Plan), several domestic and foreign investors became involved in petroleum and natural gas industries, timber industries, fertilizer industries, and coal mining. The development of industries and mining has motivated and sped up the growth of other sectors, such as transportation, trade and services, tourism, and agriculture. We are grateful that with guided and controlled development programs, and with the participation of enterprises and local communities, the economy in East Kalimantan is growing. Within Pelita V (the Fifth Five Year Development Program), the rate of economic growth of East Kalimantan (excluding oil and gas), reached an average of 7.3% per year, exceeding the target of 6.1%. In addition, annual income per capita in this province from non-oil and gas sectors increased to Rp. 2.09 million, which is higher than the target of Rp. 1.5 million. From an economic point of view, East Kalimantan Province has huge natural riches such that it makes a significant contribution to the national economic structure.

Increased incomes for the people of East Kalimantan, especially those living in urban areas, industrial and mining centers, gradually increase the need for higher-quality food like meat, egg and milk. During Pelita V, the consumption of livestock products (meat, egg and milk) increased. According to Widya Karya Pangan dan Gizi (Food and Nutrition Work Study) in 1988/1993, the national per capita livestock product consumption was:

- Meat : 7.6 kg/year
- Egg : 3.5 kg/year
- Milk : 4.5 kg/year

In comparison the per capita consumption of meat, egg and milk in East Kalimantan (1994 data) was:

- Meat : 9.2 kg/year (achieving 121% of the National Standard)
- Egg : 3.0 kg/year (achieving 89% of the National Standard)
- Milk : 4.1 kg/year (achieving 90% of the National Standard)

The increase in meat, egg and milk consumption has a positive impact on the government's efforts to establish better public health condition and improving students' intelligence. Accordingly, parallel to the economic success, efforts for developing human resources should be considered as one of the priority development programs in East Kalimantan.

As it is a time to provide people with good quality meat, an alternative solution has to be found to the current supply of cattle from outside the province which are mostly old and limited in number. So we should encourage private enterprises to develop agribusiness in the animal production sector such as the project for fattening of cattle imported from Australia, managed by PT. Celebes Group Balikpapan. This project will be equipped with post-harvest management processes fulfilling technical and hygienic conditions so that the meat produced will meet the quality standard for safe consumption.

Besides establishing and developing livestock agribusiness managed by private enterprises, cattle fattening by smallholders should be stimulated and extended to boost villagers' income and welfare in line with the poverty alleviation program.

One constraint encountered by smallholders in increasing the population and productivity of their cattle is that feeding the cattle with nutritious forage has yet to become popular. Smallholders still depend on natural grass whose quality is lower than other elite grasses like King grass. As well as disseminating the GEMARAMPAK Program (program of planting King grass for forage), we need to have other productive and nutritious grasses suitable to uplands which can be planted where the cattle can eat the grass directly on a grazing area, or if fenced in, can be cut and carried to the animals.

I am confident that through this meeting, attended by home and foreign experts with abundant knowledge and experience, the problems faced by the smallholders, living in tropical areas like in East Kalimantan, can be solved. I do hope information on species which are most suitable to uplands gained during experiments by the Forage Seeds Project can be transferred during this meeting. Exchanging experience and information is indeed important for smallholders to lift their income, improve their welfare, and alleviate poverty.

From a religious point of view, such awareness is deemed as a respectable work and act of devotion and pious deed. It has an added value.

On this occasion, I would like to ask the Head of Livestock Service of East Kalimantan to use and promote other forage grasses recommended in this meeting. A program for forage promotion and development which meets the smallholders' needs should be created because this community group is expecting assistance from the government.

The distinguished Director General for Livestock, Guests, and participants,

Ladies and Gentlemen,

Bismillahirrahmannirrahim, In the Name of God, I officially open the Third Meeting of the Southeast Asian Regional Forage Seeds Project.

May God bless our measures and efforts.

Wassalamualaikum Wr. Wb.

Section 2: Introduction to Livestock Development in Indonesia

LIVESTOCK DEVELOPMENT IN INDONESIA

D.V.M. Soehadji[1]

Introduction

Indonesia consists of more than 17,000 islands, and has a land area of 1.9 million km^2. It consists of 27 provinces, 269 districts, 3625 subdistricts, and more than 67,000 villages. The human population is about 190 million with 62% of the people living on Java, which is only 7% of the land area of Indonesia. Temperatures range from 23 to 32 °C. Agriculture (forestry, food crops, fisheries, estate crops, and livestock) is the most important industry in the Indonesian economy.

Livestock Development in Indonesia

Stages of livestock development

The history of livestock development can be divided into four stages:

1. Colonial Era. Indonesia was occupied, first by the Dutch, and later by the Japanese until 1945. During this period, livestock development was aimed at fulfilling the demand of the colonialist.
2. Pre long-term development plans. There were two development concepts during this period, namely Kasimo Plan (27 November 1947), and Pembangunan Semesta Berencana Plan (1961-1969).
3. The first 25-Year Development Plan (PJP-I): 1969-1994. PJP-I was divided into five stages of 5-Year Development Plans (FYDP). It lasted from 1969 to 1994.
4. The second 25-Year Development Plan (1994 - 2019). This stage is a continuation of the first Long-Term Development Plan. The present first stage, or the Sixth 5-Year Development Plan, is considered as the beginning of the take-off era.

Re-orientation of livestock development

Entering the second 25-Year Development Plan (PJP-II), the agricultural sector should take into consideration several changes as follows:

- change in the planning and management system, from a centralized to a decentralized system;

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- change in development approach, from a commodity-based approach to a resource-based approach;
- change in development objective, from increasing farmers' income to increasing farmers' prosperity;
- change from subsistence-scale farming to commercial-scale farming;
- change from conventional labor-intensive technology to appropriate technology and mechanization;
- change from primary products to value-added products;
- change in orientation to development region, from western region to eastern region of Indonesia;
- change in input to development, from government dominance, to a greater role of community participation; and
- change in commodity-development orientation, from import substitution to export promotion.

Faced with these changes, livestock development, as part of agricultural development, has progressed tremendously during the first 25-Year Development Plan. Such progress is illustrated by the increasing role of livestock sector in the Indonesian economy. The indicators are:

- an increasing share of the livestock subsector to the Gross Domestic Product (GDP), from 6% in 1969 to 11% in 1993. The share is aimed at 13% in 1998;
- an increase of investment in the livestock industry (US $15 billion);
- an increase in job opportunities (476,100 during REPELITA V (1989 - 1993);
- an increase of unconventional export commodities.

Improvements in the technical aspects of livestock development are illustrated by:

- increasing livestock population, from 11.3 million animal units (AU) in 1969/1970 to 31.9 million AU in 1993/1994;
- increasing meat production, from 309 million tons in 1969/1970 to 1,328 million tons in 1993/1994;
- increasing egg production from 58 million tons in 1969/1970 to 593 million tons in 1993/1994;
- increasing milk production from 20,000 tons in 1969/1970 to 413,000 tons in 1993/1994;
- increasing consumption of animal protein from 1.4 g/capita/day (1969) to 3.5 g/capita/day (1993).

Based on this progress, the livestock subsector is considered as "the new development source", so the concept of livestock husbandry should be reoriented, including the philosophy, the type of farming, development strategies, and development pattern.

The philosophy

The philosophy of livestock husbandry should be re-oriented, from just a "farming process" to livestock husbandry as a "second biological industry", managed and controlled by human beings, and consisting of four aspects:

1. the farmer, the implementor of livestock development, should have increases in income and quality of life;
2. the livestock, the object of livestock development should be increased in number and productivity;
3. the land should be considered as our ecological basis for supporting feed production and animal husbandry;
4. the technology should be developed as a tool to achieve the goal.

The type of farming

To facilitate proper government involvement in livestock development, livestock farming is classified into four types, namely,

1. subsistence farming, meaning 30% or less of farmers' income is generated from livestock;
2. semi-commercial farming, meaning 30% - 70% of farmers' income is generated from livestock;
3. commercial farming, meaning 70% of farmers' income is generated from livestock;
4. livestock industry, meaning 100% of income is generated from livestock.

The role of government is dominant for subsistence and semi-commercial farming, while on the other hand, private input in terms of farm supplies and marketing, is dominant for commercial and industrial farming.

Livestock development strategies

The first and most usual approach to livestock development is the so-called "single factor" or technical approach, such as artificial insemination, vaccination, extension, etc.

The second approach is the so-called "multifactor" or integrated approach, which comprises of technological input package combined with economical input (credit), and sociological input (organization and participation of the farmer).

The last approach is the "agribusiness approach" in which farm supply, farming, processing, and marketing are linked; however, farm supply is managed by private enterprises, farming practices are handled by farmers, processing and marketing is operated by private companies.

The development pattern. Basically, there are three patterns of livestock business, i.e., "service pattern", "credit pattern" (cooperation pattern), and "commercial pattern".

In the "service pattern", the activities are managed with the support of government overseas. In credit pattern, farming activities are managed through the involvement of the private sector in cooperation with smallholders. In the commercial pattern, farming activities are fully supported through private sector investment.

Development of Ruminants

Based on their physiological characteristics, livestock are divided into three groups: ruminants, non-ruminants, and poultry. During the last 25 years (1969-1994), livestock in Indonesia increased from 11.3 million AU to 33.9 million AU. The population structure appears in Table 1.

Table 1. Livestock population structure.

Livestock category	1969	1993
	(%)	(%)
Ruminants	78	44
Non-ruminants	9	7
Poultry	13	53

Table 1 clearly shows the changes in the livestock population structure which occurred between 1969-1993. Ruminant number has decreased, while poultry number increased. This occurred because of changes in land use pattern: agricultural lands are being converted to industrial areas; and the farmers (especially in Java) tend to keep poultry which do not need a large area. The density of Indonesian livestock can be seen in Table 2.

Table 2. Animal density in 1993/1994.

	Ruminants	Horses	Pigs	Poultry
	(AU/km^2)[1]	(AU/km^2)	(AU/km^2)	(AU/km^2)
Sumatra	6.5	<0.1	0.9	5.6
Java	46.5	0.4	0.5	27.4
Kalimantan	0.8	<0.1	0.3	0.9
Sulawesi	12.3	0.9	1.2	4.3
Bali, Nusa Tenggara	21.6	2.2	6.7	5.1
Maluku, Irian Jaya	0.3	<0.1	0.3	0.2

[1]AU = Animal unit

Since there is limited agricultural land in Java, but extensive agricultural land in the outer islands, the government established the policy of agricultural development as follows:

- non-land-based agriculture in Java, with intensive use of available land for livestock farming, such as poultry production;
- land-based agriculture in the outer islands, with extensive use of livestock farming, such as large ruminant production.

Development of Feed Resources

The composition of feed for ruminants, non-ruminants, and poultry is shown in Table 3.

According to an inventory of agricultural by-products conducted by Gajah Mada University in 1982, the composition of feed given to cattle in Java was as follows: natural grasses 56%, other leaves 16%, rice straw 21%, and other by-products 7%. From the same study, it was calculated that the availability of feed in Java, in terms of total digestible nutrients was only 47% of demand, leaving a balance of 53%. To meet the demand for feed, several efforts have been launched. These efforts may be divided into four categories as follows:

1. Intensification, through the programs of planting improved forage species, such as napier, giant napier and legumes;
2. Extensification, through establishment of new grazing lands and forage multiplication stations;

3. Rehabilitation of critical lands;

4. Diversification, by increasing the utilization of agricultural by-products, and by introducing the Three Strata Forage System which is a system to integrate forages into the farming system.

Table 3. Average composition of livestock feed.

	Feed (grasses, leaves and crop residues)	Concentrates
	(%)	(%)
Beef cattle	85	15
Dairy cows	82	18
Buffaloes	74	26
Goats	86	14
Sheep	94	6
Pigs	3	97
Poultry	5	95

The Indonesian government hopes apart from the programs mentioned above, to enhance feed production through collaboration with foreign governments and foreign and local institutions and organizations. One example of collaboration is the Forage Seeds Project in which the Indonesian Government, Centro Internacional de Agricultura Tropical (CIAT), and the Commonwealth Scientific and Industrial Research Organization (CSIRO) work together. So far the collaboration has been successful in finding suitable species for soils with low pH, as we did in Kalimantan. It is hoped that what has been done in Kalimantan can be extended to other areas in Indonesia with similar conditions. The Three Strata Forage System which was developed by Professor Nitis, will be adopted as one of the programs for forage development in Indonesia. It is hoped that through the Forage Seeds Project, compatible species of grasses and legumes, especially shrubs and tree legumes, will be identified and integrated into the Three Strata Forage System.

Conclusion

The Third Meeting of the Southeast Asian Regional Forage Seeds Project is a forum where the policy makers, experts, and practitioners in the forage field, meet and discuss their findings, and try to solve the problems of forage production in connection with the existing farming systems in the Asia-Pacific Region. It is hoped that the participants will find this information on livestock development in Indonesia beneficial and that this meeting will contribute ideas for future collaboration in the region.

LIVESTOCK DEVELOPMENT IN EAST KALIMANTAN, INDONESIA

E. Nursahramdani[1]

Introduction

East Kalimantan has comparative advantages over other provinces in Indonesia because of its huge land area of 221,440 km^2 (1.5 times larger than Java island including Madura), and its small population of 2 million people. Given these conditions, the area offers opportunities to develop the livestock sector and, consequently improve farmers' welfare, supply people with nutritious food, and increase exports.

Generally, less fertile soils (soil classes IV, V, VI) are suitable for use by the livestock industry. In East Kalimantan, 5.8 million hectares of uplands and 8.5 million hectares of *Imperata* grasslands remain uncultivated. The available land will determine what kinds of livestock business can be developed, and whether the animals should be fed with grasses or grains.

This paper will discuss ruminant and non-ruminant livestock production and how the livestock sector implements its field activities in East Kalimantan.

Ruminants

Cattle and Buffaloes

To boost the population of large ruminants (cattle and buffaloes), East Kalimantan Province has imported breeder stock over the last ten years. Such efforts include the following projects:

- ADB II Project : 22687 cattle
  2672 buffaloes
- Presidential Aid : 3044 cattle
  164 buffaloes
- Transmigration : 6134 cattle

[1]Head, Provincial Livestock Services, Jalan Bhayangkara No. 54, Samarinda, East Kalimantan, Indonesia.

All the cattle were distributed to farmers in transmigration locations in all regencies of East Kalimantan under the program of "pola gaduh ternak pemerintah" (raising government cattle for a share). At the end of Pelita-V (the fifth Five-Year Development Program), the cattle population was 74,000 with an annual growth rate of around 12.5% (Table 1). The buffalo population was 21,200 with a growth rate of 6.6%.

Table 1. Livestock population in East Kalimantan, 1989-1993.

	1989	1990	1991	1992	1993
	(head)	(head)	(head)	(head)	(head)
Beef cattle	46,100	55,900	61,700	67,200	74,000
Dairy cows	70	139	141	110	126
Buffaloes	16,600	18,400	19,800	20,800	21,200
Goats	45,900	50,900	51,900	56,900	55,900
Sheep	2630	3070	3480	2900	2900
Pigs	74,900	80,800	82,200	89,500	89,500
Horse	37	49	67	74	86
Village hens	2,012,000	2,632,000	2,813,000	3,022,000	3,214,000
Layer hens	377,600	437,200	336,200	523,400	523,400
Broilers	913,000	1,385,000	1,449,000	1,449,000	1,508,000
Ducks	158,700	177,500	191,600	191,600	219,700

Goats and Sheep

In Pelita-V the goat population in East Kalimantan grew at around 7.5% per year. Goat stocks have been distributed to the transmigration locations all over East Kalimantan through different projects (ADB II, APBN and Transmigration). Up to 1994, the number of goats distributed was as follows:

- ADB Project II : 4000 head
- P4KT APBN : 4369 head
- Transmigration : 1988 head

Goats are considered small ruminants that can give additional income to farmers in a short time. In line with the poverty alleviation program in underdeveloped villages, the Livestock Service has categorized them as recommended livestock.

Sheep raising has potential, but in PJP I (the first 25-Year Development Plan), it played a minor part in East Kalimantan. It is expected that in PJP II, sheep raising will be developed, starting with its introduction in locations where no Bali cattle are raised to protect the cattle from Malignant Catarrnal Fever (MCF) disease.

Cervus Unicolor Brokei

Cervus Unicolor Brokei, a small deer, still lives in the wild in forests in East Kalimantan. It is an indigenous animal which could be domesticated to produce animal protein as well as velvet and leather.

Every year around 5000 deer are estimated shot or trapped by people surrounding the forests. The provincial government or the provincial livestock service has tried breeding deer in Api-api village, Pasir regency. Some worthwhile experiences have been gained from the attempt. More is now understood about the deer's habitat and characteristics. It is very sensitive to environmental changes. To support development, the following outcomes can be expected from deer-breeding:

1. Support natural resource conservation, by preserving the Cervus Unicolor Brokei.
2. Develop practices in husbandry which can become a resource for agribusiness and agritourism.
3. Provide a natural laboratory for the use of future researchers.

Non-Ruminants

Broiler

Broiler chicken is one of the livestock commodities which has increased rapidly in East Kalimantan within the last 10 years. Chicken stock used to be imported from Surabaya or Jakarta; but now there are six farms in East Kalimantan with an annual production capacity of 13 million chicks. Some of the chicken stock production is marketed to the neighboring provinces of South Kalimantan, Central Kalimantan, and Sulawesi.

Nunukan chicken

The native Nunukan chicken has the following characteristics: the feather of the adult female is light brown, while that of the adult male is yellow-red; skin is yellow; the beak, shank, and claw are also yellow; the comb is single type. In some adults the primary wing and tail feathers do not grow or grow imperfectly. The primary feathers that grow perfectly are black. When they are young, the birds are slow-feathering, particularly the males, so that they appear naked until four months of age.

The body weights of adults are around 2.0-2.5 kg for females and 2.5-3.5 kg for males. Maturity is reached at 7.8 months of age. Hens produce around 100-140 eggs per year. The egg weighs 45-50 g. and the egg-shell is brown. Some females brood their eggs; others do not. A day-old chick weighs 35-40 g. A dual-purpose bird, the Nunukan chicken is raised for both eggs and meat.

The chicken can be raised to produce eggs and meat in villages with simple technology and at little cost. Moreover, the hens brood their eggs so chicks can be produced continuously. Females which do not brood or which brood incompletely can be used to produce eggs. Egg production can be increased by separating the chicks from their mother after hatching. However, special care is required for the chicks until three months of age. The chicken have no primary wing and tail feathers so they cannot fly. Farmers do not need to construct high fences to keep the chicken confined. Thus, for small farmers, Nunukan chicken are appropriate because they can be raised using only very simple technology. With advanced technology, these chickens can be used as a genetic resource to produce efficient broilers.

With this potential, the provincial government or the provincial livestock service has developed Nunukan chicken by establishing "Village Breeding Centers" at several locations. Tarakan is the center of pure-line Nunukan chicks.

Mitigation of New Castle Disease

New Castle Disease is a disease of fowl that attacks chickens. Endemic in the province, it is responsible for high mortality rates of village hens. Village hens kept by smallholders as a secondary business are important during a long drought or a failed harvest when they can be sold at relatively good prices. Because of the importance of these hens to the villagers in Pelita-VI, the Provincial Livestock Service of East Kalimantan plans mass vaccination to minimize New Castle Disease.

Integrated Officials Movement

The Integrated Officials Movement (GPT) is being implemented by the Provincial Livestock Service of East Kalimantan to provide services and guidance for farmers. This movement is funded from APBD I (provincial budget), APBD II (budget at district level), and APBN (national budget). During the first year of Pelita-VI (1994/1995), GPT was started in East Kalimantan to implement programs such as artificial insemination, vaccination, extension, and agribusiness for farmers raising cattle, goats, buffaloes, village hens, and ducks.

Improvement and development of other non-ruminants, such as village hens, ducks and pigs, have been achieved through extension work using the so-called Seven-Efforts method implemented by the Directorate General of Livestock Services directly to farmers. In certain villages, the extension program also includes packaged programs for village hens, ducks, and goats as well as for New Castle Disease vaccination of village hens.

Section 3: Forage Seeds Project - Country Progress Reports

FORAGE SEEDS PROJECT IN MALAYSIA: ACTIVITIES, RESULTS AND CONCLUSIONS

C.P. Chen, A. Aminah and G. Khairuddin[1]

Introduction

In Malaysia, ruminant production in the livestock sector has lagged for the past 30-40 years compared to that in the non-ruminant sector. Most of the production is in the hands of smallholders. These are less organized and productive despite heavy assistance and support from development agencies. Nevertheless the increasing demand for ruminant products such as beef, mutton and milk has prompted a new approach to encourage small farmers in ruminant business ventures. Potential small livestock farmers who own land and animals need to change from "animal owners" with 2-3 head to "animal farmers" who make their living through livestock farming. Attention and assistance will be directed to those with sufficient entrepreneurship to achieve this goal.

The contribution of forage resources to total feed requirements in ruminant production has been estimated up to 70-80% in the whole system. In Malaysia, green feed is abundant throughout the year because of the climatic factors conducive to plant growth. Yet animal production is poor, due to either low availability of feed on the farm, or poor feed quality. There is a critical shortage of seed and planting materials of appropriate pasture species. This is a problem commonly faced by countries in Southeast Asia.

The formation of the AIDAB-funded Forage Seeds Project jointly run by CIAT and CSIRO and involving four Southeast Asian countries (viz. Indonesia, Malaysia, Philippines and Thailand), has started to solve the problem. This report highlights project activities that have been carried out, the achievements, and some suggestions to the future implementation of the project in Malaysia.

Species Introduction and Evaluation

Great effort has been channeled in the last 20 years to the introduction and evaluation of forage species by the pasture research team in MARDI, and promising species and genera have been identified (Wong et al., 1982; Wong and Mohd. Najib, 1988). Unfortunately, all those identified genera and species of forages have seed production problems, mostly due to the climatic conditions. Hence, the main aim in the present study was to identify

[1]Livestock Research Division, Malaysian Agricultural Research and Development Institute (MARDI), G.P.O. Box 12301, 50774 Kuala Lumpur, Malaysia.

appropriate seed production methods for promising forage species (Table 1), and to include new species as these become available from current evaluations.

Over 30 accessions of forage species were introduced from CIAT and CSIRO and these were planted at key screening sites at MARDI Research Stations (Table 2). The performance of these accessions has been reported to CIAT/CSIRO project scientists during the assessment period and will not be included here.

The selection of promising forages was based on minimum managerial inputs (i.e., no fertilizer, no weeding, etc.) and species considered for seed production had to have good flowering, seed setting and high plant vigor, to produce plenty of vegetative regrowth. Of course, they must be relatively free from pests and diseases. Only a few introductions passed these criteria and these were selected for seed production studies. They were *Panicum maximum* cv. Vencedor, *Brachiaria ruziziensis*, and *Stylosanthes guianensis* CIAT 184. Several species were short listed for future study viz. *Arachis pintoi* cv. Amarillo, *Stylosanthes guianensis* CIAT 21, *S. guianensis* FM07-2 (CIAT) and *Paspalum atratum* BRA 9610 (CIAT). Other species performing well vegetatively but have not been assessed long enough for their ability to produce seed satisfactorily, are *Brachiaria brizantha* CIAT 26110, *Paspalum atratum* cv. Pantaneira and *Paspalum guenoarum* BRA 3824 (CIAT). The promising species singled out for further study are listed in Table 1.

Table 1. Forage species selected for seed production at Bukit Tangga MARDI Station (May 1990).

A. Grasses

Brachiaria decumbens cv. Basilisk
Brachiaria humidicola cv. Tully
Brachiaria dictyoneura CIAT 6133
Brachiaria brizantha CIAT 6780
Digitaria setivalva (MARDI Digit)
Panicum maximum cv. Vencedor
Panicum maximum CIAT 6299
Setaria sphacelata cv. Splenda

B. Legumes

Arachis pintoi cv. Amarillo
Calliandra calothyrsus
Centrosema macrocarpum
Gliricidia sepium
Stylosanthes guianensis CIAT 184

Seed Production

Initial seed production sites were selected based on climate, infrastructure, accessibility and manpower availability. The agro-ecological zone 1 (Nieuwolt et al., 1982), selected for the seed study, has a mean annual rainfall of 1830 mm (Figure 1), and sandy clay soil of pH 5.5 and 58% aluminium saturation. It experiences a 4 months dry season from January to April. The main objective of the study was to generate sufficient "mother-seed" for distribution to farmers.

Seed production studies of *Panicum maximum* cv. Common and cv. Vencedor, *Brachiaria ruziziensis* (ruzi grass) and *Stylosanthes guianensis* CIAT 184 were successfully conducted.

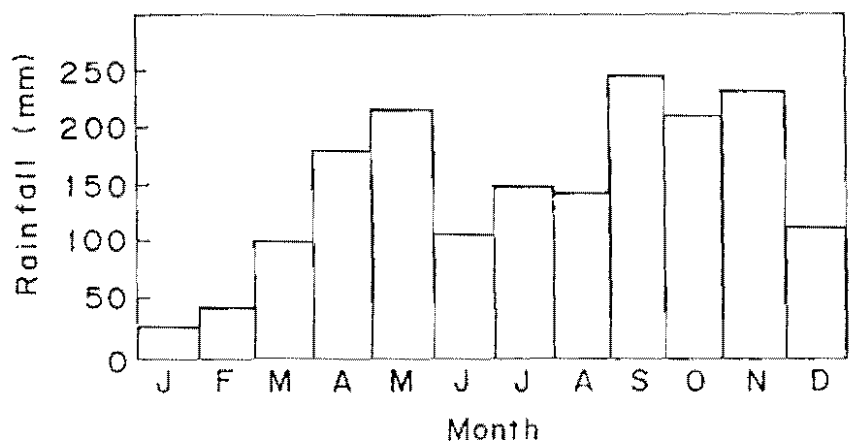

Figure 1. Mean monthly rainfall (1981-1987) at Changlun near Sintok Farm.

Panicum maximum (guinea grass)

Cultivar Vencedor was released by EMBRAPA, Brazil in 1990, and thrives well in soils with pH <5 and also shows better than usual shade and cold tolerance (Chen and Hutton, 1992). Field assessment at Rubber Research Institute Malaysia, Sungai Buloh, showed that it was one of the highest yielding grasses under shade at 55-80% light transmission (Ng, 1990).

Since flowering of guinea grass is independent of day length, managerial approaches such as defoliation, density and fertilizer can be directed to promote seed yield. In an experiment, seed yield of Vencedor guinea grass was affected by both the spacing and nitrogen application. Guinea grass planted in rows 120 cm apart produced higher seed yield (366 kg/ha) than those planted closer at 30 cm (263 kg/ha). Possibly the broader spacing allowed more sunlight penetration. Application of 200 kg/ha nitrogen was optimal for seed production (Table 2).

Vencedor guinea continuously produced panicles from two weeks to nine weeks after cutting back (Figure 2). The highest number of panicle/m^2 was 162 at 8 weeks. At this stage, seed yield had dropped by 57% (Aminah and Khairuddin, 1992). The drastic drop in seed yield showed that even though the panicles were continuously produced, the rate of increase of ripe seeds from new inflorescence could not replace the lost seed from the early-formed inflorescences.

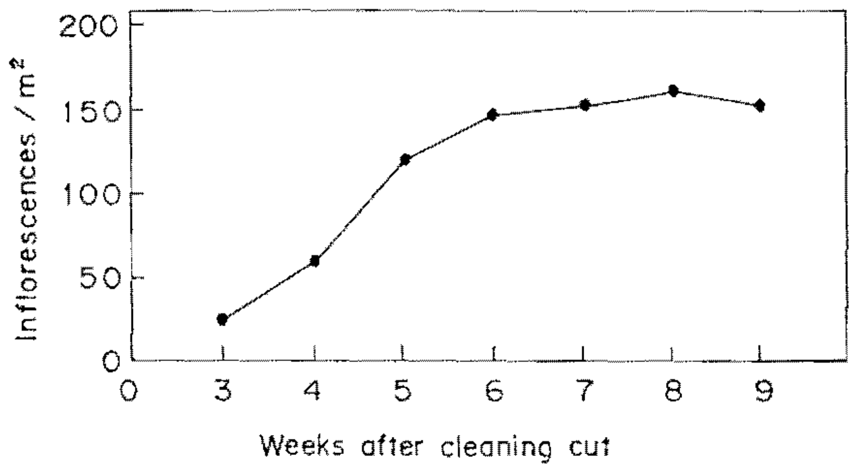

Figure 2. Flowering pattern of *Panicum maximum* cv. Vencedor.

Vencedor guinea grass can be harvested at 6-8 week intervals (Table 3). In the Malaysian context, cutting of seed heads by hand seemed to be the best option. After harvesting, the cut seed heads were sweated for 3-4 days at 40° C. Seed moisture content was 35% after threshing, and 16% after 1 week of air drying. The quality of the seed was high (Table 4).

The amount of seed produced in 1993 was 14 kg of Vencedor guinea and 49 kg of common guinea.

Table 2. The effects of N fertilizer on seed yield of *Panicum maximum* cv. Vencedor.

	Nitrogen rate (kg/ha)				
	0	100	200	300	400
Seed yield (kg/ha)	125	308	345	180	178
1000-seed weight (g)	0.66	0.61	0.88	0.84	0.68
Tiller (no./plant)	29	22	34	24	30
Panicle (no./plant)	12	16	22	21	18
Tiller fertility (%)	38	40	47	57	43

Table 3. Effect of time of harvesting on seed yield (kg/ha) of *Panicum maximum* cv. Vencedor.

Time since cleaning cut	Seed yield
(weeks)	(kg/ha)
6	203
7	119
8	68
9	25

Table 4. Seed quality of *Panicum maximum* cvv. Vencedor and Common.

		Vencedor	Common
Purity (%)[1]		61	52
Germination (%)[1]	- KNO_3	22	26
	- H_2O	6	34
Dormancy		Present	None

[1] QDPI Standards: Purity = 40%; Germination = 25%.

***Brachiaria ruziziensis* (ruzi grass)**

Ruzi grass is normally used as a forage for direct grazing or permanent pastures in the open or grazing under coconuts, and for feeding tethered or stalled ruminants. Ruzi grass is palatable and of excellent quality, with N concentrations ranging from 1.5-2.5% and *in vitro* DM digestibility from 50-70% (4-6 weeks old regrowth). It tolerates moderate shade, and drought fairly well. Even though ruzi grass produces a slightly lower dry matter yield than *Brachiaria decumbens* (signal grass), it has a higher crude protein percentage (11.6% versus 10.6%) (Wong et al., 1982) and produces more seed than signal grass.

Ruzi grass is a quantitative short day plant (Loch, 1980). In northern Malaysia, flowering normally starts between July and September, and seed may be harvested between October and November. The flowering pattern of ruzi grass is shown in Figure 3. From observation it was found that ruzi grass could be harvested about 30-40 days after initial flowering. Harvesting soon after that period produced 630 kg/ha while a delay of about 1 week caused a drop in yield of 81% (117 kg/ha). Furthermore, purity decreased from 82% to 44%.

On average, the purity of the ruzi seed lots was between 74 and 96% while germination in water was 25%, and 70-91% in KNO_3. The amount of seed produced in the last season was 153 kg.

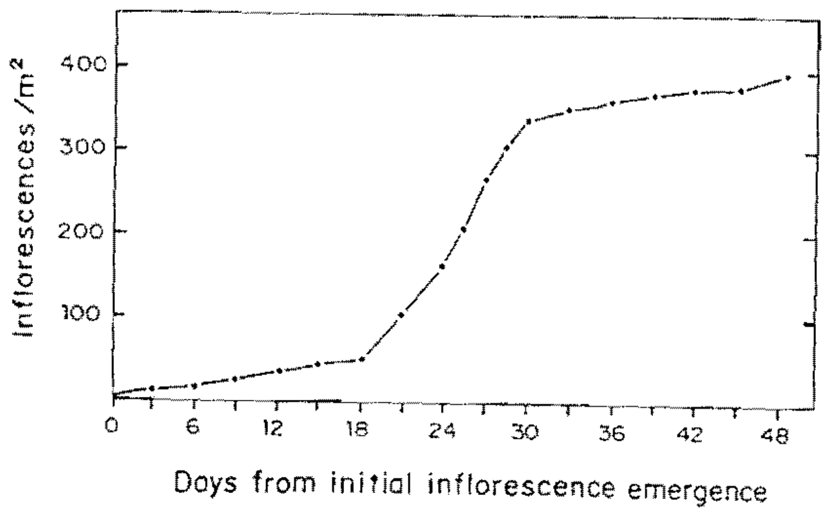

Figure 3. Flowering pattern of *Brachiaria ruziziensis.*

Stylosanthes guianensis CIAT 184 (Stylo 184)

Growing CIAT 184 Stylo in rows facilitated weed control at the early stage of growth. The area became fully covered 3-4 months after planting. Even so, there were some effects of planting densities on seed yield (Table 5), with higher seed yields at higher plant densities. Seed size did not vary greatly (Table 5).

Table 5. Effect of planting density on seed yield and seed characteristics of *Stylosanthes guianensis* CIAT 184.

Row distance[1] (cm)	Seed yield (kg/ha)	Moisture content (%)	1000-seed weight (g)	Purity (%)
30	271	8.7	2.75	88
60	225	6.6	2.80	90
90	242	7.6	2.80	86
120	231	7.8	2.90	90

[1] Planting distance within rows was 50 cm.

Stylo 184 is normally defoliated in August to synchronize flowering in October. Peak flowering occurs in December, and harvesting is carried out in January-April, which are the dry months in the northern and northeastern parts of Peninsular Malaysia.

Flowering of Stylo 184 commenced 7-8 weeks after defoliation. Flowering density peaked 7 weeks after initial flower appearance and then started to decline (Figure 4). It peaked quite sharply where seed shedding was evident there were few flowers, and some ripe seeds protruded from the heads. Harvesting had to be carried out 5 to 6 weeks after peak flowering to minimize seed loss due to shedding. Delay in harvesting the standing pods resulted in a loss due to fallen seed. The average standing pod yield was about 303 kg/ha, which with the average fallen pod yield 63 kg/ha, gave a total pod yield of 366 kg/ha (Table 6).

Purity was 98% and germination in water was 18% with 65% hard seed. The total germination was 83%, assuming that hard seeds were germinable. The amount of seed harvested in the last season was 80 kg.

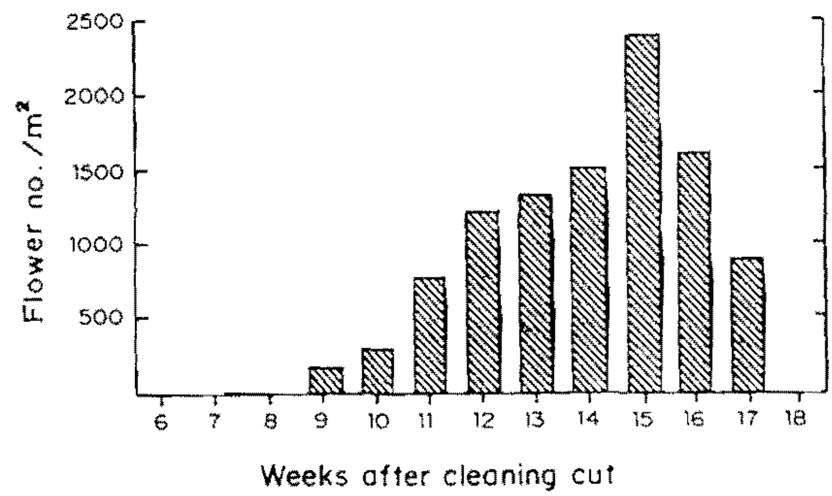

Figure 4. Flowering pattern of *Stylosanthes guianensis* CIAT 184.

Table 6. Effect of time of harvesting on seed yield of *Stylosanthes guianensis* CIAT 184.

Time of harvest (after peak flowering) (weeks)	Standing seed yield (kg/ha)	Fallen seed yield (kg/ha)	Contribution of fallen seed to total seed yield (%)	Total seed yield produced (kg/ha)
3	325	8	2	333
4	288	58	17	346
5	314	71	18	385
6	317	72	18	389
7	272	106	28	378

Future Activities

It is clearly shown that suitable selections of varieties/cultivars from promising species for seed production have been identified under local environments. The absence of a commercial seed production industry in the country is worrisome; nothing will happen with these new forage cultivars unless local seed production by farmers is encouraged and developed. In the future, livestock farmers who have extra land should be assisted to adopt the seed production package. The package has a dual purpose - the crop is used for seed production during the seeding season, but during the remainder of the year, the forage crop can be utilized for feed.

In line with livestock and pasture development, MARDI and the Department of Veterinary Service (DVS) have worked out a joint program for pasture seed production. DVS is the government department responsible for pasture development as well as providing veterinary services. They spend about RM (Malaysian ringgit) 0.3 to 0.5 million per year for importing pasture seed. This amount is not inclusive of those seeds imported as cover crops for plantations by the private sector. Under the present agreement, seeds which have been obtained will be used by the DVS Farm at Sintok, Kedah for large-scale seed production. The seed produced by the Sintok Farm will be distributed in the next wet season to interested livestock farmers who have sufficient land for forage production.

Since the middle of 1993, 17 smallholders have joined the project, and the DVS Farm at Sintok commenced to produce seed (Aminah and Khairuddin, 1994). At present, there are 5 ha of Stylo 184, 1.3 ha of Vencedor guinea, 1.8 ha of common guinea, and 3.3 ha of ruzi grass ready for seed production at Sintok farm. The amount of seed produced so far on the farm is listed in Table 7. Although it is a relatively small amount, its potential for the livestock industry is considerable in that the country will be able to produce its own forage seeds. Seed produced by farmers will be purchased by the Forage Seeds Project and DVS, but the price of seed has yet to be determined.

Further discussions on equipment for seed production will be focused on the facilities for both pre-and postharvest, and storage. Also to be on the agenda are, the anticipated problems for strategies of seed production on suitable species, the amount of seed demand for development, and the expected species of animals for production in various agro-climatic zones.

Table 7. Areas planted and forage seed produced at Sintok Farm (1993/94).

	Area planted	Seed produced	Seed in stock
	(ha)	(kg)	(kg)
Stylosanthes guianensis CIAT 184	4.0	580	80
Brachiaria ruziziensis	3.3	650	87
Panicum maximum (common guinea)	1.8	140	50
Panicum maximum cv. Vencedor	1.3	100	40

Training

The project has been involved not only in developing a seed production package but also in human resource training. Table 8 gives the record of training activities of staff who have been involved in the project.

Table 8. MARDI staff who participated in FSP training or meetings.

	Duration	Place	Activity
Aminah Abdullah	18 February to 30 May 1993	Queensland, Australia	IGC[1] Conference; 1st Regional FSP Meeting; Attachment to CSIRO on forage seed multiplication
Aminah Abdullah	4-8 October 1993	Los Baños, Philippines	2nd Regional FSP Meeting
Chen Chin Peng	18-27 February 1993	Queensland, Australia	IGC Conference; 1st Regional FSP Meeting
Khairuddin Ghazali	17 May to 18 August 1993[2]	Queensland, Australia	Attachment to CSIRO on seed multiplication
Mohd. Yusoff Che	15 September to 15 October 1993	Los Baños, Philippines	Attachment to CIAT on seed multiplication
Ramli Mohd. Noor	15 September to 15 October 1993	Los Baños, Philippines	Attachment to CIAT on seed multiplication
Othman Omar	15 September to 15 October 1993	Los Baños, Philippines	Attachment to CIAT on seed multiplication

[1]IGC = International Grassland Congress; [2] terminated early for medical reasons.

Conclusions

Appropriate varieties and cultivars of promising pasture species have been identified for different agro-climatic zones. These will greatly affect livestock production. Seed can be produced locally despite adverse climatic conditions. The amount of seed harvested per unit area was slightly lower than in some other countries, possibly due to factors such as the edaphic conditions, agronomic practices, fertilizer regimes, and cultivars/varieties utilized. In the future, some of these factors could be altered to increase seed production.

Acknowledgments

The authors would like to thank the FAO Forage Project Regional Working Group of Southeast Asia and the present Forage Seeds Project jointly run by CIAT and CSIRO and funded by AIDAB, for providing on-the-job training opportunities to Ms. Aminah bt. Abdullah and Mr. Khairuddin b. Ghazali and which have served to the present achievements. The strong support from the Director of Livestock Research Division of MARDI, Mr. Ahmad Tajuddin Zainuddin from the Feed Resources Team of Department of Veterinary Services led by Mr. Chin Fook Yuen; and from Dr. Rosli of DVS Kedah have greatly contributed to the success of the project.

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Appendix 1. Legumes introduced into Malaysia (1992-1994) as part of the Forage Seeds Project.

Species	Site planted	Date received
Aeschynomene americana		
cv. Glenn	Bukit Tangga	6/92
cv. Lee	Bukit Tangga	6/92
Arachis pintoi		
CIAT 17434 (cv. Amarillo)	Jeram Pasu, Serdang	9/94
CIAT 18744	Jeram Pasu, Serdang	9/94
CIAT 18747	Jeram Pasu, Serdang	9/94
CIAT 18748	Jeram Pasu, Serdang	9/94
CIAT 18750	Jeram Pasu, Serdang	9/94
(CIAT 17434) cv. Amarillo	Bukit Tangga, Serdang	6/92
Centrosema pubescens		
CIAT 438	Jeram Pasu	8/93
CIAT 15160	Jeram Pasu	9/94
CIAT 15470	Jeram Pasu	8/93
Desmanthus virgatus ex. Philippines	Jeram Pasu	8/93
Desmodium ovalifolium	Sg. Baging	10/93
Desmodium rensonii ex. Philippines	Jeram Pasu	8/93
Macroptilium atropurpureum	Jeram Pasu	8/93
Macroptilium gracile CPI 62158	Bukit Tangga	6/92
Stylosanthes capitata CIAT 10280	Sg. Baging	10/93
Stylosanthes guianensis		
CIAT 21	Jeram Pasu, Serdang	8/93
CIAT 184	Jeram Pasu, Serdang, Bukit	8/93
FM05-1 (CIAT)	Tangga	
FM05-2 (CIAT)	Sg. Baging	10/93
FM05-3 (CIAT)	Jeram Pasu	8/93
FM07-1 (CIAT)	Jeram Pasu	8/93
FM07-2 (CIAT)	Jeram Pasu, Serdang	8/93
SSD-12 (CIAT)	Jeram Pasu	8/93
cv. Graham	Jeram Pasu, Serdang	8/93
	Jeram Pasu, Serdang	8/93
	Bukit Tangga	6/92
Stylosanthes hamata cv. Verano	Bukit Tangga	6/92
Vigna luteola cv. Dalrymple	Bukit Tangga	6/92

Appendix 2. Grasses introduced into Malaysia (1992-1994) as part of the Forages Seeds Project.

Species	Site planted	Date received
Brachiaria brizantha		
CIAT 6780	Sg. Baging	10/93
CIAT 26110	Jeram Pasu	8/93
Brachiaria humidicola CIAT 16886	Jeram Pasu	9/94
Brachiaria ruziziensis ex. Thailand	Bukit Tangga, Serdang	6/92
Digitaria milanjiana cv. Jarra	Bukit Tangga, Jeram Pasu, Serdang, Kuala Linggi	6/92
Echinochloa polystachya cv. Amity	Serdang	6/92
Hymenachne amplexicaulis		6/92
cv. Olive	Serdang, Kuala Linggi	
King grass	Serdang	6/92
Panicum maximum ex. Thailand (Thai Purple guinea)	Bukit Tangga, Serdang	6/92
Paspalum atratum		
BRA 9610 (CIAT)	Jeram Pasu	9/94
cv. Pantaneira	Jeram Pasu	9/94
Paspalum guenoarum		
BRA 3824 (CIAT)	Jeram Pasu	9/94

FORAGE SEEDS PROJECT IN THE PHILIPPINES: ACTIVITIES, RESULTS AND CONCLUSIONS

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Introduction

In the Philippines, about 90% of the ruminant population is in the backyard or smallholder farms. Small farms are considered the backbone of the livestock industry although the commercial sector also makes a valuable contribution to the industry.

The backyard and commercial sectors utilize different natural resources for livestock production. While the former is highly dependent for forage on crop residues/farm by-products, weeds in cultivated fields, marginal lands, roadsides, river banks, etc., the commercial sector makes use of available open grasslands usually dominated by *Imperata* and *Themeda* species. Both sectors utilize pastures under coconuts.

Feeding of concentrate is rarely practiced for economic reasons. Production systems are generally traditional and cash inputs are minimal. Consequently, animal productivity is generally low.

The country's carabao and cattle populations have declined between 1983-1993. The carabao population declined from 2.95 million head in 1983 to 2.56 million head in 1993. Likewise, cattle number decreased from 1.94 million to 1.91 million in 1993. The goat population, however, increased from 1.86 million in 1983 to 2.56 million in 1993. The continuous decline in the cattle and carabao populations can be attributed to the increasing extraction rate due to the high demand for animal protein. Low animal productivity is another reason and is partly due to the erratic supply of good quality feeds throughout the year.

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Domestic meat and milk supply is insufficient. As a consequence, the country has to import beef amounting to about 14,400 t valued at FOB US$ 21 million in 1992; some 50,000 head of cattle were imported. To augment local milk requirement, 1.6 million tons of dairy products worth US$ 271 million were imported in 1993.

The Department of Agriculture's medium-term livestock development program (1993-1998) aims to build up the ruminant population base, increase animal productivity, and lay the groundwork for sustained development. To increase the country's breeding base and to lower extraction rate, massive importation of breeder cattle and feeder stock will be undertaken.

The Philippines' Forage Seeds Project (FSP) which, together with other projects, aims to introduce appropriate forage varieties to smallholder farming systems, is timely. It boosts our present efforts in improving the existing gene pool of forage species available in the Philippines. Moreover, the capability of the Filipino researchers and extension agents working on forages has been upgraded through training and visits to project sites. As a whole, the Forage Seeds Project complements the on-going forage evaluation activities of the national network that assesses species performance and suitability in different agro-climatic and ecological zones of the country.

Screening of Forage Germplasm

This activity aims to determine the adaptation of introduced forage species to eight sites in the country. The soil pH in the sites include very acid, moderately acid and neutral pH soils (Table 1).

Table 1. Environmental characteristics of forage germplasm screening sites in the Philippines.

	Site	Latitude	Altitude (m)	Rainfall (mm/year)	Dry season (months < 60 mm)	Soil Texture	Soil pH (H_2O)
A	ViSCA, Matalom, Leyte	11°N	200	2000	3	clay	4.5
B	MSF, Malaybalay, Bukidnon	8°N	980	2400	2	clay loam	4.5
C	CMU, Musuan, Bukidnon	8°N	302	2000	1	sandy loam	5.5
D	CLSU, Carranglan, Nueva Ecija	16°N	300	1480	5	loam	5.0
E	BUCAF, Guinobatan, Albay	13°N	<50	2020	3	loam	6.5
F	CSSAC, Pili, Camarines Sur	12°N	<50	2260	3	sandy loam	5.5
G	Cavinti, Laguna	15°N	300	4200	0	clay	4.2
H	IRRI, Los Baños, Laguna	15°N	20	1900	4	light clay	5.8

Average annual rainfall in the project sites ranges from 1480 mm to 4200 mm. Topography is slightly rolling to flat, and the surrounding districts are used for crop (upland rice, coconut) and livestock (native pasture) production.

The range of forage species tested at each site varied depending on the needs in the particular area, and the availability of planting material (Tables 2 and 3). However, several species were tested at various sites and cross-site comparisons were possible. The duration of these experiments varied from one to two years according to when the experiment was established. Several of these are still in progress. Cutting management varied but the forages in all experiments were cut back at least once. Emphasis had been placed on legumes since several suitable grasses have been identified previously in the regional performance trials in the Philippine National Pasture Network. Common experimental procedures are summarized as follows:

Land preparation:	1 disc plowing + 1 harrowing
Experimental design:	randomized block
No. of replication:	3-4
Plot size:	18-25 m^2
Row spacing:	1 m apart
Planting materials:	seeds/vegetative
Seeding rate:	4-6 kg/ha
Maintenance activities:	watering, replanting and weeding during establishment as required
Planting time:	onset of wet season
Fertilization:	none
Data collected:	Growth/adaptation/vigor Flowering/seed production potential Pest and disease resistance
Rating scale used:	1 = very good 2 = good 3 = fair 4 = poor 5 = very poor
Species tested	16 grasses (Table 2) 31 legumes (Table 3)
Number of test sites:	8
Location of sites:	see Table 1

The grass species which were rated good to very good across locations were *B. dictyoneura* CIAT 6133, *A. gayanus* CIAT 621, *B. brizantha* CIAT 6780, *B. humidicola* cv. Tully and *Paspalum atratum* BRA 9610 (Table 2). Other species which performed well were *Panicum maximum* cvv. Makueni, Tanzania, Vencedor and CIAT 6299, and *Setaria sphacelata* var. *splendida*.

Table 2. Performance of the introduced grass species in different project sites.

Sites[1]	Growth/Vigor[1]								Flowering/Seed Setting								Resistance to Pests/Disease							
	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
Andropogon gayanus																								
CIAT 621	1	2	1	2	-	-	1	1	1	2	2	2	-	-	3	1	1	2	1	1	-	-	1	1
Brachiaria brizantha																								
CIAT 6780	3	2	1	-	2	1	2	1	1	2	1	-	-	1	3	2	2	2	1	-	1	1	2	1
Brachiaria decumbens																								
cv. Basilisk	-	2	-	2	-	-	-	-	-	2	-	2	-	-	-	-	-	2	-	2	-	-	-	-
Brachiaria dictyoneura																								
CIAT 6133	1	2	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Brachiaria humidicola																								
cv. Tully	1	2	-	2	-	-	-	-	1	3	-	2	-	-	-	-	-	2	-	1	-	-	-	-
CIAT 16886	-	-	-	-	-	-	1	1	-	-	-	-	-	-	2	1	-	-	-	-	-	-	1	1
Panicum maximum																								
cv. Makueni	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-
cv. Tanzania	-	-	1	-	1	-	-	-	-	-	1	-	2	-	-	-	-	-	1	-	1	-	-	-
cv. Vencedor	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-
CIAT 6299	-	-	-	-	-	1	-	1	-	-	-	-	-	1	-	1	-	-	-	-	-	1	-	2
Paspalum atratum																								
BRA 9610	-	-	-	-	3	1	1	1	-	-	-	-	2	1	1	1	-	-	-	-	1	1	1	1
cv. Pantaneira	-	-	-	3	-	-	2	-	-	-	-	2	-	-	1	-	-	-	-	1	-	-	2	-
Paspalum regnellii	-	-	-	-	3	-	3	-	-	-	-	-	5	-	1	-	-	-	-	-	1	-	3	-
Pennisetum purpureum	-	3	-	-	-	-	-	1	-	3	-	-	-	-	-	-	-	2	-	-	-	-	-	1
Setaria sphacelata																								
var. *sericea*	-	-	-	2	-	-	2	-	-	-	-	-	-	-	2	-	-	-	-	1	-	-	3	-
var. *splendida*	-	1	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	-	-	-	-

Sites
A = ViSCA, Matalom, Leyte
B = Malaybalay Stock Farm, Malaybalay, Bukidnon
C = CMU, Musuan, Bukidnon
D = CLSU, Carranglan, Nueva Ecija
E = BUCAF, Guinobatan, Albay
F = CSSAC, Pili, Camarines Sur
G = Cavinti, Laguna
H = IRRI, Los Baños, Laguna

Rating Scale:
1 = Very Good
2 = Good
3 = Fair
4 = Poor
5 = Very Poor

For legumes, *Stylosanthes guianensis* CIAT 184 showed very good adaptation and resistance to pest or diseases (anthracnose) at all sites in the Philippines (Table 3). *Desmodium* spp. also showed good performance across locations with *D. rensonii* (local), *D. heterophyllum* CIAT 349, and *D. ovalifolium* CIAT 350 leading the list. Among *Arachis pintoi* accessions, CIAT 17434 showed good performance at all sites except at the very acid soil site in Matalom, Leyte. *Arachis pintoi* CIAT 18744 also performed well on acid soils and showed good shade tolerance and resistance to pests and diseases. *Arachis pintoi* CIAT 18750 was the best accession at the low fertility, acid soil site (Cavinti). *Aeschynomene histrix* CIAT 9690 had a very good performance in very acid soils (Matalom and Cavinti) as well as in moderately acid soil (Pili).

Table 3. Performance of the introduced legume species in different project sites.

Sites[1]	Growth/Vigor[1]								Flowering/Seed Setting								Resistance to Pests/Disease							
	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
Aeschynomene histrix																								
CIAT 9690	1	4	3	-	-	1	1	-	1	3	5	-	-	1	1	-	1	4	3	-	-	1	1	
Arachis pintoi																								
CIAT 17434	4	-	2	2	2	1	2	2	1	-	1	3	-	1	3	2	1	-	1	1	-	1	2	2
CIAT 18744	-	2	-	-	2	2	2	2	-	1	-	-	3	2	3	2	-	2	-	-	1	1	2	2
CIAT 18748	-	-	-	-	-	2	2	2	-	-	-	-	-	2	3	2	-	-	-	-	-	1	2	2
CIAT 18750	-	-	-	-	-	-	1	2	-	-	-	-	-	-	5	5	-	-	-	-	-	-	1	1
Centrosema acutifolium																								
CIAT 5568	2	-	1	-	-	-	-	-	4	-	5	-	-	-	-	-	2	-	4	-	-	-	-	-
CIAT 5277	5	-	-	2	-	-	2	-	-	-	-	5	-	-	1	2	-	-	-	4	-	-	3	-
Centrosema macrocarpum																								
CIAT 15014	-	2	-	-	2	-	-	1	-	5	-	-	5	-	-	5	-	2	-	-	4	-	-	2
CIAT 5713	2	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	2							
Centrosema pubescens																								
CIAT 15470	-	2	2	-	-	-	-	2	-	3	5	-	-	-	-	2	-	2	3	-	-	-	-	3
CIAT 438	5	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	3
CIAT 442	5	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	3
Desmodium heterophyllum																								
CIAT 349	2	2	-	-	1	1	1	2		3	-	-	-	-	5	5	1	2	-	-	1	1	2	4
Desmodium ovalifolium																								
CIAT 3784	2	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
CIAT 350	2	-	2	-	2	1	2	2	1	-	5	-	3	2	3	3	2	-	2	-	1	1	2	2
CIAT 3788	-	-	-	-	2	-	2	-	-	-	-	-	3	-	3	-	-	-	-	-	1	-	2	-
CIAT 13089	2	2	-	-	2	-	2	2	1	4	-	-	4	-	3	3	2	2	-	-	1	-	2	2
CIAT 13092	-	-	2	-	-	-	2	2	-	-	5	-	-	-	3	3	-	-	2	-	-	-	2	2
CIAT 13129	-	2	-	-	2	-	2	2	-	4	-	-	2	-	3	3	-	2	-	-	1	-	2	2
Desmodium velutinum																								
CIAT 33138	3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
Desmodium rensonii (local)	2	1	-	1	1	-	-	-	1	1	-	1	1	-	-	-	1	1	-	1	1	-	-	-
Leucaena diversifolia (local)	5	2	-	-	-	1	-	-	5	4	-	-	-	4	-	-	3	2	-	-	-	2	-	-
Leucaena pallida																								
(CQ 3439)	5	-	-	-	-	-	-	2	5	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
Macroptilium atropurpureum																								
cv. Siratro (control)	4	3	-	-	-	-	-	-	4	1	-	-	-	-	-	-	5	5	-	-	-	-	-	-

Table 3. Performance of the introduced legume species in different project sites. (continued).

Sites	Growth/Vigor								Flowering/Seed Setting								Resistance to Pests/Disease							
	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
Stylosanthes capitata																								
CIAT 10280	3	4	1	-	-	-	3	-	1	4	4	-	-	-	-	-	2	4	2	-	-	-	3	-
Stylosanthes guianensis																								
CIAT 21	1	2	-	-	-	-	1	1	1	4	-	-	-	-	2	2	2	4	-	-	-	-	2	2
CIAT 184	1	2	1	1	2	1	1	1	1	3	3	1	*	1	1	1	1	2	1	1	1	1	1	1
CIAT SSD-12	3	-	-	-	-	-	3	2	1	-	-	-	-	-	2	2	2	-	-	-	-	-	2	2
CIAT 2542	1	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Stylosanthes macrocephala																								
CIAT 1281	5	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-
Zornia glabra CIAT 7847	3	4	2	-	-	-	2	-	1	3	2	-	-	-	3	-	-	2	3	-	-	-	1	-
Zornia latifolia CIAT 728	4	-	-	-	2	2	-	-	3	-	-	-	2	2	-	-	2	-	-	-	1	1	-	-

* set flowers but no seeds produced

The potential use of the various promising forage species in local farming systems appears in Table 4. Criteria considered are the species innate characteristics such as adaptation, persistence, regrowth capacity, yield, feeding value, etc. vis-a-vis its suitability to specific purposes such as contour hedgerows, cut-and-carry feeding systems, fallow improvement, etc. Not all characteristics were measured at each site and some, such as feeding value, were inferred from the literature or experiences overseas.

For instance, species which have upright growth habit and the ability to form a dense filter strip are considered suitable for contour hedgerows. Hence, *Andropogon gayanus*, *Panicum maximum* cv. Tanzania, *Brachiaria brizantha*, *Desmodium rensonii* and *Leucaena diversifolia* were identified for this purpose. *Stylosanthes guianensis* is semi-erect but it is considered suitable for hedgerows, since the plant remains rooted at the hedgerow line, and even if it spreads, it can easily be cut back. Its spreading characteristic may be advantageous in situations when the area is left fallow since this species can spread and provide cover in the contour strip.

Many of the legume species evaluated have potential for fallow improvement. Aside from their ability to improve soil condition, the species' ability to spread and provide effective ground cover are considered important characteristics.

Table 4. Potential use of promising forages in local farming systems.

Species	Hedgerow	Fallow improvement	Fodder bank	Extensive grazing	Cut & carry	Grazing under coconut	Cover crop
a) Grasses							
Andropogon gayanus	X	-	X	-	X	-	-
Brachiaria brizantha CIAT 6780	X	-	-	X	X	X	-
Brachiaria decumbens	-	-	X	-	-	-	-
Brachiaria dictyoneura	-	-	-	X	-	X	-
Brachiaria humidicola	-	-	-	X	-	X	-
Panicum maximum cvv.	X	-	X	-	X	-	-
Paspalum atratum BRA 9610	X	-	-	-	X	-	-
Pennisetum purpureum	-	-	-	-	X	-	-
Setaria sphacelata							
var. *sericea*	-	-	-	-	X	X	-
var. *splendida*	-	-	-	-	X	-	-
b) Legumes							
Aeschynomene histrix	-	X	-	X	-	-	-
Arachis pintoi	-	X	-	X	-	X	X
Centrosema acutifolium	-	X	-	X	-	-	X
Centrosema pubescens	-	X	X	X	-	-	X
Desmodium heterophyllum	-	X	-	X	-	X	-
Desmodium ovalifolium	X	X	-	X	-	X	X
Desmodium rensonii	X	-	X	-	X	-	-
Leucaena diversifolia	X	-	-	-	X	-	-
Stylosanthes capitata	X	X	-	-	-	-	-
Stylosanthes guianensis							
CIAT 184, 21, 2542	X	X	X	X	X	-	X
CIAT SSD-12	-	X	-	-	-	-	-
Zornia spp.	-	-	-	X	-	-	-

Only two grass species (*A. gayanus* and *P. maximum* cv. Tanzania) and several legume species are considered suitable for use as a fodder bank. The main consideration is the species' ability to produce good bulk of high quality herbage during the dry season.

Brachiaria humidicola, *B. decumbens* and several legume species appear suitable for extensive grazing situations. Selection is based on species growth habit (prostrate), yield, persistence, nutritive value and associative ability.

Criteria in selecting species for cut-and-carry livestock feeding are the species growth habit (upright), good herbage yield and good regrowth capacity. All of the *P. maximum* accessions, *A. gayanus* CIAT 621, *B. brizantha* CIAT 6780, *Pennisetum purpureum*, *Setaria sphacelata*, *D. rensonii*, *L. diversifolia*, *Stylosanthes capitata* CIAT 10280 and *S. guianensis* CIAT 184 are deemed suitable for cut-and-carry feeding system.

Prostrate species such as the herbaceous *Desmodium* spp., *A. pintoi* CIAT 17434 and CIAT 18744, *Centrosema acutifolium* CIAT 5277, and *B. humidicola* cv. Tully and *B. decumbens* cv. Basilisk are considered suitable species for grazing under coconut. Selection of species for use as cover crops is based on growth habit, ability to improve soil condition, ease in establishment and management, persistence, and ability to cover the ground quickly.

Since most of the introduced species have not yet been evaluated on-farm on a wide scale, farmers' opinion on their usefulness has not yet been determined. Hence, the introduction of the most promising species on-farm should be given high priority after the screening activities.

On-Farm and Advanced Evaluation of Promising Germplasm

Only a limited number of species have so far been evaluated on-farm.

The associative ability of the most promising forage species is presently being determined in different FSP project sites. In Bicol (Albay and Sorsogon), on-going evaluations are focusing on the performance of *Brachiaria* species under coconut plantations when planted in combination with *Arachis pintoi* or *D. heterophyllum* and that of *Arachis pintoi* accessions with *B. humidicola* CIAT 16886. The main aim is to determine the best grass-legume combination under coconut. Parameters to be considered are persistence, herbage yield, and botanical composition. In Sorsogon, animal production on *Brachiaria humidicola*/*A. pintoi* pastures is being determined. Likewise, the effect of oversowing legumes into existing *B. decumbens* and *B. humidicola* pastures will be evaluated on smallholder farms.

Feeding trials have been started in Central Mindanao University, Bukidnon using *S. guianensis* CIAT 184 in combination with stargrass for milking animals. The one-month feeding trial showed promising results but due to unavoidable circumstances it was discontinued.

Desmodium rensonii and *Stylosanthes guianensis* CIAT 184 (Stylo 184) were among five legume species evaluated for use as double hedgerow in nine acid-soil (pH 4.2-5.5) upland farms and in one calcareous-soil (pH 8) upland farm in Matalom. Stylo 184 was among the most adaptable entries in terms of growth and persistence on the acid-soil farms. *Desmodium rensonii* thrived well in the calcareous area but was affected by dry periods especially during establishment.

In Matalom, on-farm research is also being conducted to determine the suitability of certain species either for fallow improvement or for use as double hedgerow to the existing grass contour strips. The study on *Stylosanthes guianensis* CIAT 184 as a fallow improvement crop was established in four locations within the acid-soil uplands of Matalom. Initial results show that CIAT 184 can provide adequate ground cover in 4 months with only one weeding required within 2 months after emergence.

On-farm testing of promising forages has commenced in Bicol through BAI and the provincial Department of Agriculture in Albay (in conjunction with the AIDAB-funded Pilot Provincial Agricultural Extension Project - PPAEP). A range of species is being evaluated by farmers for suitability for grazing under coconuts. Initial results will be available in 1995.

Seed Production Activities

This activity aims at increasing seed of promising forage species to ensure availability for multi-locational evaluations and for use in development projects being conducted by both government and non-government organizations. In the Philippines, *Stylosanthes guianensis* CIAT 184 has been identified for increase and distribution for on-farm evaluation. To date, several hectares have been planted with Stylo 184 in the different project sites for seed increase and distribution. This area will greatly increase in 1995 with the participation of the member agencies of the national forage performance evaluation network. Approximately 100 kg of seed was harvested in 1994 and this seed has been distributed throughout Southeast Asia.

In 1993/94, the amount of seed harvested per hectare was lower (below 50 kg/ha) than expected (> 150 kg/ha). Reasons for the low seed yield were the following:

- lack of standard procedure/knowledge in seed production (establishment procedure, management practices, harvesting, etc.)

- occurrence of unusually late typhoons in 1994 causing high wind and heavy rains during peak harvest
- high labor requirement.

Attempts to overcome these constraints have been initiated and these included training in forage agronomy and seed production and better site selection for seed production activities.

Nevertheless, FSP has successfully set the momentum for the development of a local seed industry, particularly for Bicol. Consultations among concerned individuals are in progress to formalize the formation of a Forage Seeds Board in the region. This is a positive attempt for enhancing forage development in particular and livestock production in general. If the local seed industry turns out to be a viable and profitable enterprise, then rural incomes could benefit. It is already well known that a few individuals are making money by seed trading through the "back door" (exporting seed without Government approval and without Phytosanitary Certificate to neighboring countries).

Smallholder seed production of *S. guianensis* CIAT 184 commenced at a pilot scale in Matalom and Bukidnon. The first seed is expected to be harvested in early 1995.

Distribution and Extension of FSP Species

Many of the regional forage screening sites have been visited by farmers, farmer groups, agronomists and students from agricultural colleges. There has been much interest by farmers in forages, and seed and vegetative planting material has been given to farmers by collaborators. For example, more than 200 smallholder farmers have visited the site at Matalom and many requested and were provided with planting material. Unfortunately, only a small fraction of the distributed material has been successfully established by farmers. There are many reasons for this record. Follow-up activities are necessary but these are difficult to do with the many farmers involved.

Larger seed lots and planting material have been distributed to other organizations that are involved in livestock development aimed to distribute and extend promising forage material as widely as possible. These include the AIDAB-funded PPAEP Project in Bicol and Mindanao, Department of Agriculture regional offices, Philippine Land Bank cattle distribution schemes, Bukidnon Forest Inc., Integrated Rainforest Development Project, Earthquake Rehabilitation Project and the Southern Mindanao Agricultural Programme. These projects provided an excellent opportunity to distribute promising forages quickly to many smallholder farmers involved in livestock rearing. For example, the Albay Department of Agriculture established a forage multiplication and demonstration area in a farmer cooperative at Buoyan, near Legaspi City. In Mindanao, PPAEP, working with the local Department of Agriculture, established forage demonstration and multiplication areas; planting material from these areas will be used for on-farm extension.

More than 1000 forage seed lots and vegetative planting material lots have been distributed directly from the FSP project to collaborators in the Philippines, Indonesia, Thailand and Malaysia during the life of the project. Initially, forages were used for regional evaluation but, during the last 6 months, most of the forages was distributed for on-farm work, seed production, and extension activities.

Linkages and Training Undertaken

Linkages

- A more effective linkage has been forged between the national coordinating agency and the FSP scientist. This linkage paves the way for more collaborative undertakings between the national collaborators and the FSP.
- FSP has also initiated the grouping of many institutions (GO & NGO) in Bicol to enhance forage development and livestock production in the region. A major aim of the group is to develop a local forage seed industry.
- Linkage was also made with the local field office of the Land Bank of the Philippines (LBP-Maasin). LBP-Maasin wants to procure seeds and planting materials of forages to be included in their cattle financing program package.
- The linkage between FSP and the member agencies of the national forage evaluation network has been strengthened. The network undertakes performance evaluations of forage species in different agro-climatic areas in the Philippines. With this linkage, the promising species will be evaluated in a wider range of conditions, and introductions and promotional activities could be done on a wider scale.
- As discussed earlier, linkages have also been formed with development projects (i.e. PPAEP, SMAP, ERP, etc.) to ensure dissemination of results emerging from the project.
- Collaboration with the Bukidnon Forest Inc., has led to the use of forage legumes as cover crops in new forest plantings to control erosion and suppress weeds, the development of a smallholder seed production scheme and later to an interest by the foresters to integrate livestock production with forestry projects.

Training

- Mr. Francisco Gabunada, Jr., and other Filipino collaborators undertook short-term on-the-job training working alongside the FSP forage agronomist at Los Baños and Cavinti. Training concentrated on harvesting and processing of forage species such as *Arachis pintoi* and *Stylosanthes guianensis.*
- One-month training on seed production and species evaluation for three Malaysian collaborators was undertaken in September-October 1993 at the International Rice Research Institute, Los Baños, Laguna.
- Three-month training course on tropical pastures for three Filipino collaborators (Prof. Francisco Alvarez, PAC; Mr. Francisco Gabunada, Jr., ViSCA; Mr. Gerardo Ocfemia, BUCAF) in February-April 1994, Queensland, Australia.
- In cooperation with PCARRD, a one-week training course on forage seed production was conducted last September 19-23, 1994 at IRRI, Los Baños, Laguna with 17 participants. Participants were researchers/extension personnel representing the member agencies of the national forage R & D network and FSP collaborators.
- In collaboration with PPAEP, Cagayan de Oro, a short training course on forage agronomy was conducted for personnel involved in livestock development in the region.
- Ms. Elaine L.F. Lanting (PCARRD) attended the XVII International Grassland Congress (Closing Congress), Rockhampton, Queensland, Australia, 19-21 February 1993 and post-congress observation tour to Northern Queensland, 22-26 February 1993 to observe new forage species, commercial utilization of grass-legume species and forage seed production.

FORAGE SEEDS PROJECT IN THAILAND: ACTIVITIES, RESULTS AND CONCLUSIONS

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Two organizations are involved with the Forage Seeds Project in Thailand. The first is the Division of Animal Nutrition, Department of Livestock Development (DLD), with activities mainly in northeast Thailand and more recently in southern Thailand. The second is the Dairy Promotion Organization of Thailand (DPO), with work being conducted at Muak Lek, Saraburi. Reports from the two organizations are reported separately because of the different objectives of their work.

FSP Activities at the Department of Livestock Development

Introduction

The majority of the Thai population, approximately 70 %, are engaged in agriculture. The most important crops are rice, cassava, corn, sugar cane and oil crops. Livestock production is still done on subsistence level. In the last decade the prices of cash crops have declined, while beef and dairy production were not sufficient to meet the demand of consumers. Because of these trends, the government policy is to increase the income of village farmers, by reducing rice and cassava production and increasing animal production, particularly from ruminant animals. The Department of Livestock Development (DLD) has many projects to promote beef and dairy production. The smallholder farmers who belong to the beef cattle or dairy promotion projects are provided with seed and planting material to allow them to establish pastures. Forage seed production in Thailand is increasing year by year. It was 418 tons in 1991, and will increase to 1330 tons in 1994.

The main pasture species are *Brachiaria ruziziensis* (ruzi grass) and *Stylosanthes hamata* cv. Verano (Verano) which were selected during previous evaluation trials. They are promoted as pasture for raising cattle because they are widely adapted to Thailand's environment, and because they establish easily and produce high seed yields.

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The Division of Animal Nutrition, DLD, has continued to evaluate new forage species to find forages of higher production and quality than ruzi and Verano. The major problems in pasture production are the limited areas for grazing, a long dry season and low soil fertility. In some areas, there are additional constraints such as salinity, soil acidity, and waterlogging.

The AIDAB-funded Southeast Asian Regional Forage Seeds Project (FSP) jointly administrated by CIAT and CSIRO, has led to discussions and exchanges of seed knowledge and information and to a pasture development program for the future.

Screening of forage germplasm

Screening experiments were established at Khon Kaen Animal Nutrition Research Center in northeast Thailand and at Narathiwat Animal Nutrition Research Center in southern Thailand. The aim of species evaluation in Khon Kaen was to select species adapted to low fertility, sandy soils and drought conditions (Table 1 and 2). In Narathiwat, the aim was to find species tolerant to acid soils (Table 3).

Of the grass and legume species tested and evaluated in sandy soils at Khon Kaen (pH 6.5), several grasses and legumes have shown good characteristics during the 12 month testing period. These have been recommended for multi-site testing. These include *Brachiaria decumbens* cv. Basilisk, *Brachiaria humidicola* cv. Tully, *Paspalum atratum* BRA 9610, *Stylosanthes guianensis* CIAT 184, *Clitoria ternatea* CIAT 712, *Clitoria ternatea* CIAT 772, *Leucaena leucocephala* K 636, *Leucaena pallida, CQ 3439 and Leucaena diversifolia.*

At Narathiwat, the following grasses and legumes were showing early promise after 3 months on an acid soil: *Andropogon gayanus* CIAT 621, *Brachiaria brizantha* CIAT 16318, *Paspalum atratum* BRA 9610, *Stylosanthes guianensis* CIAT 184, *Stylosanthes guianensis* CIAT 21, *Centrosema pubescens* CIAT 442, and *Desmodium ovalifolium* CIAT 350.

This evaluation needs to be continued to confirm the early results, observe disease and insect damage, and determine seed production ability.

Table 1. Characterization of legumes evaluated at Khon Kaen, northeast Thailand.

Species	Re-growth (months)	Disease and insect damage	Flower-ing	Seed setting	Drought tolerance [1]
Aeschynomene americana cv Lee	12	No	No	No	L
Aeschynomene americana cv Glenn	12	No	Yes	No	L
Calopogonium mucunoides CIAT 17856	12	No	No	No	M
Cassia rotundifolia	12	Yes	Yes	No	L
Centrosema acutifolium CIAT 5277	12	Yes	No	No	L
Centrosema pubescens CIAT 5126	12	Yes	No	No	M
Centrosema pubescens CIAT 15160	12	Yes	No	No	L
Centrosema pubescens CIAT 438	12	Yes	No	No	L
Centrosema pubescens CIAT 442	12	Yes	No	No	L
Clitoria ternatea CIAT 712	12	Yes	Yes	No	L
Clitoria ternatea CIAT 772	12	Yes	Yes	Yes	L
Macroptilium atropurpureum CIAT 55786	12	Yes	No	No	M
Macroptilium atropurpureum CIAT 17856	12	Yes	No	No	M
Medicago sativa cv. Trifecta	12	Yes	Yes	No	L
Medicago sativa cv. Sequel	12	Yes	Yes	No	L
Stylosanthes capitata Multiline	12	No	Yes	No	L
Stylosanthes guianensis CIAT 184	12	No	Yes	No	H
Stylosanthes guianensis CIAT 21	4.5	No	No	No	M
Stylosanthes guianensis SSD 12	4.5	No	Yes	No	M
Stylosanthes guianensis FMO5-2	4.5	No	Yes	No	M
Stylosanthes guianensis FM07-3	4.5	No	Yes	No	M
Stylosanthes scabra cv. Siran	1	No	No	No	M
Terammus uncinatus CIAT 7315	12	No	No	No	M

[1] H = high, M = medium, L = low.

Table 2. Characterization of grasses and tree legumes evaluated at Khon Kaen, northeast Thailand.

Species	Re-growth (months)	Disease and insect damage	Flower-ing	Seed setting	Drought tolerance
a) GRASSES					
Andropogon gayanus CIAT 621	12	No	No	No	H
Brachiaria brizantha CIAT 6780	2	No	No	No	M
Brachiaria decumbens cv. Basilisk	12	No	Yes	Yes	H
Brachiaria humidicola cv. Tully	12	No	Yes	Yes	H
Digitaria milanjiana cv. Jarra	12	No	Yes	Yes	L
Digitaria swynnertonii CPI 59749	12	No	Yes	Yes	L
Hymenachne amplexicaulis cv. Olive	12	No	Yes	Yes	L
Paspalum atratum BRA 9610	7	No	Yes	Yes	M
b) TREE LEGUMES					
Calliandra calothyrsus	2	No	No	No	M
Leucaena diversifolia	12	No	Yes	Yes	M
Leucaena leucocephala K636	2	No	No	No	M
Leucaena pallida CQ 3439	12	No	Yes	Yes	M

[1] H = high, M = medium, L = low.

Table 3. Characterization of forage species evaluated in southern Thailand.

Species	Accession	Plant height at 90 days
		(cm)
Arachis pintoi	CIAT 18748	9
Centrosema pubescens	CIAT 15160	30
Centrosema pubescens	CIAT 15470	26
Centrosema acutifolium	CIAT 5277	35
Centrosema pubescens	CIAT 438	35
Centrosema pubescens	CIAT 442	74
Desmodium ovalifolium	CIAT 350	32
Desmodium ovalifolium	CIAT 13089	18
Desmodium heterophyllum	CIAT 349	9
Leucaena leucocephala	K 636	54
Stylosanthes guianensis	CIAT 184	64
Stylosanthes guianensis	CIAT 21	51
Stylosanthes guianensis	SSD-12	44
Stylosanthes guianensis	FM 05-2	49
Stylosanthes guianensis	FM 07-2	30
Zornia glabra	CIAT 7847	32
Zornia latifolia	CIAT 728	19
Andropogon gayanus	CIAT 621	63
Brachiaria brizantha	CIAT 16318	92
Paspalum atratum	BRA 9610	74

Advanced evaluation of promising forages

Experiment: Evaluation of pasture legumes and grasses for standing dry season feed. The objective of this experiment was to find pasture legumes and grasses capable of providing more standing dry season feed than the currently used species (ruzi grass and Verano stylo).

Ten legumes and grasses were planted by rootstock with 30 cm spacing (sugar cane 50 cm spacing) in sandy soil at Chiang Yuen. Basal fertilizers were applied; these were triple superphosphate (24 kg/ha P), Urea (40 kg/ha N), potassium chloride (40 kg/ha), and gypsum (16 kg/ha S). Plots were established early in the wet season in June 1992. There was no weeding. Species were cut and harvested in September, November, February and May 1993.

Results showed that *Panicum maximum* TD 58 gave the highest dry matter yield (8.0 t/ha) in rainy season (Table 4). *Andropogon gayanus* cv. Kent was the second highest producer with 6.6 t/ha. In dry season, the highest dry matter yield was produced by *Brachiaria decumbens* cv. Basilisk (13.3 t/ha). The second highest dry season yield was obtained from *A. gayanus* (12.0 t/ha). The highest annual yields were produced by *A. gayanus* and *B. decumbens*. *Andropogon gayanus* in particular was seen to be well-suited to low soil fertility and drought conditions. Follow-up research was conducted on the seed production potential of the most promising species.

Table 4. Dry season yield of forages grown in northeast Thailand.

Species	Dry matter yield		
	Rainy season	Dry season	Year (total)
	(t/ha)	(t/ha)	(t/ha)
a) GRASSES			
Andropogon gayanus cv. Kent	6.6	12.0	18.5
Brachiaria decumbens cv. Basilisk	2.6	13.3	15.9
Brachiaria ruziziensis	6.0	6.0	12.0
Eragrostis superba	1.2	4.1	5.3
Hypharrhenia rufa	1.9	3.6	5.4
Panicum maximum TD58	8.0	7.3	15.4
Saccharum officinarum	0.5	-	0.5
b) LEGUMES			
Cajanus cajan	0.7	0.7	1.4
Stylosanthes hamata cv. Verano	3.3	5.6	8.9
Stylosanthes guianensis cv. Graham	0.5	1.2	1.7

Experiment: Seed production of *Brachiaria decumbens* cv. Basilisk (Signal grass). Signal grass was observed to have superior dry season growth compared to ruzi grass which had been widely extended to farmers. Signal grass had not been promoted because of difficulties with seed production.

The experiment aimed to produce satisfactory seed of Signal grass by using different cutting and nitrogen fertilization management. Signal grass was planted with rootstock at 30 cm spacing at Chieng Yuen station in 1992. Three nitrogen and cutting treatments were applied:

Treatment 1: Urea was applied at 75 kg/ha N, half of it at the end of July and August. The grass was not cut.

Treatment 2: The grass was cut at 10 cm above ground at the end of August, and urea was applied at 75 kg/ha N.

Treatment 3: The grass was cut at 10 cm above ground at the end of August, and urea fertilizer was applied at 150 kg/ha N.

Treatments were replicated five times and basal fertilizer was applied at the same rates as in the first experiment. Seed yield was 37 kg/ha in treatment 1 (without cleaning cut) while no seed was produced in treatments 2 and 3 which were cut back at the end of August. It was considered that signal grass produces seed in the wet season and, therefore, has to be cut back at the beginning of the growing period (April and May). Cutting later in the wet season delays crop development leading to unfavorable conditions for flowering.

Experiment: Effect of nitrogen rates on seed yield of *Digitaria milanjiana* cv. Jarra. Plots were planted at Chiang Yuen in September 1993 and left to grow until September 1994 when they were cut at 15 cm above ground and fertilizer was applied at the rates of 0, 50, 100, 150 and 200 kg/ha N.

Application of treatments early in the wet season was originally planned, but this had to be delayed due to the very low and erratic rainfall during that period. A small seed crop was expected by November 1994, and treatments will be applied again in 1995.

Experiment: Effect of cutting height on seed yield of *Andropogon gayanus* cv. Kent. This experiment was planted in September 1993 at Chiang Yuen Station and three cutting height treatments (not cut, cut at 15 cm or 50 cm above ground level) were applied on 8 August 1994. The first seed harvest was expected in late 1994.

Experiment: Effect of nitrogen rates on seed yield of *Andropogon gayanus* cv. Kent. This experiment was established at the Khon Kaen Animal Nutrition Research Center in August 1993. Plots were cut back to 10 cm in June 1994, and nitrogen fertilizer was applied at rates of 0, 100 or 200 kg/ha N.

Growth of *A. gayanus* was excellent after it received rain. The height of the grass, recorded at 90 days after cutting, was 206, 242, and 214 cm at 0, 100, and 200 kg/ha N, respectively. Until September there had been no emergence of inflorescences, but this was expected in October or November with the seed harvest in November or December.

Experiment: Effect of time of cleaning cut on seed yield of *Andropogon gayanus* cv. Kent. This experiment was sown at Khon Kaen in June 1994. Because of the very low and erratic rainfall during the early part of the wet season, this experiment had to be resown later in the wet season. Treatments will be applied in 1995.

Experiment: Effect of time of cleaning cut on seed yield of *Stylosanthes guianensis* CIAT 184. This experiment was sown at Khon Kaen in June 1994. As with the previous experiment, it had to be resown, and treatments will be applied in 1995.

Experiment: Yield and compatibility of different grass-legume mixtures in a sandy soil. This experiment was sown at Khon Kaen during the wet season in 1994. There were nine treatments:

Panicum maximum TD 58 x *Stylosanthes guianensis* cv. Graham
Panicum maximum TD 58 x *Centrosema pubescens*
Panicum maximum TD 58 x *Stylosanthes guianensis* CIAT 184
Brachiaria ruziziensis x *Stylosanthes guianensis* cv. Graham
Brachiaria ruziziensis x *Centrosema pubescens*
Brachiaria ruziziensis x *Stylosanthes guianensis* CIAT 184
Andropogon gayanus x *Stylosanthes guianensis* cv. Graham
Andropogon gayanus x *Centrosema pubescens*
Andropogon gayanus x *Stylosanthes guianensis* CIAT 184

Data will not be available this year (1994) because of a late and erratic start of the wet season. From early observation, CIAT 184 grows faster than the other legumes.

Seed production and extension

Andropogon gayanus cv. Kent seeds were sown into a sandy soil (pH 6.5) on 5 August 1993. Fertilizer was applied at 24 kg/ha P, 40 kg/ha N, 40 kg/ha K and 16 kg/ha S. There was good establishment; inflorescences emerged and were in anthesis at the beginning of November 1993. Seed was harvested at the beginning of December 1993. Seed production was 433 kg/ha with a purity of 27%, 1000-seed weight of 3.14 g, and a germination percentage of 83%. Because of its ability to carry green leaf into the dry season, good regrowth following even light falls of rain, and its ability to produce seed at Khon Kaen, DLD selected *A. gayanus* cv. Kent for promotion to farmers in northeast Thailand. The Department of Livestock Development has purchased 50 kg of cv. Kent seed from Australia, with the aim to produce 2000 kg of seed in Thailand this year. It was sown at Gudung Animal Nutrition Station (50 km from Khon Kaen Animal Nutrition Research Center). Khon Kaen Animal Nutrition Research Center received 15 kg of seed from the FSP; these were sown in August 1994.

In 1993, five farmers (three in Amphur Chiang Yuen, Mahasarakam province, and two in Amphur Muang, Khon Kaen province) were supplied with pasture seed. Each farmer received either *A. gayanus* cv. Kent, *B. humidicola* cv. Tully or *D. milanjiana* cv. Jarra seeds to establish pastures for seed production. Seed will be bought back by the FSP. In Amphur Muang, Khon Kaen, the cv. Kent and cv. Tully were sown on the same farm.

In both Amphurs, *B. humidicola* did not germinate because of seed dormancy, but *A. gayanus* grew well in the first year. In Khon Kaen, 8 kg of *A. gayanus* seed was harvested by the farmer. *Digitaria milanjiana* establishment was poor at Khon Kaen, but fair at Chiang Yuen where a good stand developed in 1994. This year the *A. gayanus* and *D. milanjiana* were ploughed out.

This year 10 new farmers were given *A. gayanus* cv. Kent seed to produce seed. Four farmers have successfully established pastures and will produce seed this year. The other six farmers had to replant in late September so it is unlikely that they will harvest seed this year.

FSP Activities with the Dairy Farm Promotion Organization of Thailand (DPO) at Muak Lek, Saraburi

Introduction

Muak Lek is on the southern edge of the Korat Plateau, with dairy farms developed on gently rolling fertile limestone hills. Agricultural production in the area is diversified and its proximity to Bangkok results in profitable off-farm employment, high land values, and easy access to farm inputs such as machinery and feeds. It is also the site of the first dairy project in Thailand, and the site of the main dairy training, research and development center.

The better, more established farmers around Muak Lek, have 30-40 milking cows averaging 17 liters per day with best cows peaking at nearly 40 liters, on an average 4 ha of land. Because of the high stocking rates, feeding is mostly on purchased prepared concentrate feeds (based on cassava, *leucaena* leaf, rice bran, broken rice, grain legumes, coconut cake and mineral supplements), rice straw and grass hay (ruzi grass). About two thirds of gross income is spent on purchased feed. Cows are fed up to 10 kg of concentrates per day. The standard of animal husbandry is good on these farms and many are mechanized. Pastures were originally sown to para grass, guinea grass, ruzi grass, common centro and Verano, but star grass (*Cynodon plectostachyus*) has invaded and dominates many pastures. Legumes are a minor component of the pastures which are generally fertilized with urea and 15:15:15 ($N:P_2O_5:K_2O$) fertilizer.

Work at DPO has shown that dairy farming is more profitable with increasing pasture grazing and reducing concentrate feeding. DPO wishes to test this concept on a new dairy area at Lampayaklang to the west of Muak Lek. The farm size will be 6.5 ha with, initially, 5 cows. The concept is to produce most feed on farms based on legume pastures and cassava rotations. This farming system has been previously researched and successfully applied to a small dairy farm on infertile soils in northeast Thailand.

The main requirement of the DPO was the replacement of as much concentrate feed as possible with high quality forage, to reduce the cost of milk production. After discussions with the DPO, the FSP was asked to help with the selection of high quality forages which could be used on dairy farms.

Screening of forage germplasm

Forages were screened at two sites, one being farm Anuwatn at Sab Noi Village, Lampayaklang, the other at Nong Hai in Pak Chong District. The soil at Lampayaklang, derived from limestone, is a heavy, black, self-mulching clay with a surface pH of 9.5. This farmer has approximately equal areas of para grass pastures and maize fields which are sown to 3-4 crops per year. The maize is grown for baby corn production and fed green after harvesting the cobs to the dairy cattle. The farmer feeds only about 2 kg of concentrates per day and the cows average 12 liters. The main concern of the farmers in this area is the lack of dry season feed.

The other farm, at Nong Hai in Pak Chong District was on a red loam limestone soil with a surface pH of 6.5.

Two experiments were conducted on these farms. These are described below.

Legume adaptation. The objective was to select high yielding forage legumes for the soils of the Saraburi dairying area of Thailand, with emphasis on the availability of high quality dry season feed.

Thirty-five legume introductions from the Australian Tropical Forages Genetic Resource Center, CSIRO Division of Tropical Crops and Pastures were sown with appropriate rhizobium inoculum in a randomized block design with two replications. The legumes sown were:

Desmodium intortum cv. Greenleaf
D. uncinatum cv. Silverleaf
Aeschynomene americana cv. Glenn, cv. Lee
Arachis pintoi cv. Amarillo
Centrosema acutifolium CPI 94327, CPI 95552
C. grazielae CPI 40058, CPI 92874, CPI 94303
C. pubescens cv. Common
Clitoria ternatea CPI 47187
Desmanthus virgatus CPI 38351, CPI 40071, CPI 55719, CPI 78373 (cv. Marc), CPI 78382, CPI 85178, CPI 92803 (cv. Uman)
Glycine latifolia CQ 3368
Lablab purpureus cv. Highworth, cv. Rongai
Macroptilium atropurpureum cv. Siratro
M. bracteatum CPI 49771
M. gracile CPI 62158 (cv. Maldonado)
M. martii CPI 49780, CPI 55786
Neonotonia wightii cv. Clarence, cv. Cooper, cv. Malawi, cv. Tinaroo
Stylosanthes guianensis cv. Cook, cv. Graham
S. hamata cv. Verano
Vigna luteola cv. Dalrymple

The duration of the experiment was 2 years. Plot size was 4 m^2. Where the legumes were known to be hard-seeded, seed was scarified with sandpaper prior to sowing. Seed was broadcast and lightly raked in, except for the large seeded lines which were dibbled in. The Lampayaklang site was established in a young maize crop and the Pak Chong site in weeds in an area which normally grew maize. No fertilizer was applied at Lampayaklang, while 28 kg P and 35 kg K was applied at Pak Chong. The trial sites were subjected to intermittent grazing.

At Lampayaklang in August 1992 the weeds were extremely vigorous and dominated all the legumes except the most vigorous. Establishment was poor except for *M. martii* CPI 55786, Siratro, Cook and *M. bracteatum*. There was no establishment recorded for the desmodiums, Verano or Amarillo. The outstanding legumes were the two lablab cultivars, which completely swamped the weeds. Next in yield were the two *M. martii* lines, which were far superior to Siratro and *Clitoria ternatea*. This site was crash-grazed by the farmer's cattle on 31 August. The cattle selected the *Desmanthus* lines, while lablab and *M. martii* were not easily selected. There are no further results for this site.

Unusually dry conditions delayed sowing until early August at Pak Chong. By late August, most accessions had fair to good emergence, and only 1 line (Amarillo) did not emerge. Some of the accessions had vigorous early growth, with lablab being outstanding. *Macroptilium martii* and *M. bracteatum* were next in vigor, followed by Siratro. Weeds were not too competitive at this site. During the first wet season, the lablabs were extremely competitive and high yielding. In the second year, October 1993, the two *M. martii* lines were outstanding for yield and spread. They were followed by *Glycine latifolia* which had spread out of its plots, and common centro which was the only other accession maintaining all or most of its plots. For most of the other lines sown, there was at least part of one or more plots present. Included in this category were Cook, Siratro, Lee, Glenn, Verano, *Clitoria ternatea* and some *Desmanthus* lines. The notable absentees were the lablabs, which had not re-established. Most of the lines showed evidence of being well-grazed, except for one tall *Desmanthus* which was only lightly grazed.

Ley farming. The objectives of this trial were to assess the practicality of undersowing a maize crop with legumes and grazing with dairy cattle after the maize is harvested, and to determine the sufficiency of soil nutrients for legume growth.

This experiment was established at both sites, and was designed as a preliminary observation trial potentially leading to ley farming experiments in later years. The experiment was a randomized complete block design with 3 replications of 6 treatments. Treatments were:

1. Control
2. +N (nitrogen applied)
3. Glenn joint-vetch sown at 8 kg/ha
4. Common centro sown at 6 kg/ha
5. Silverleaf desmodium sown at 4 kg/ha
6. Silverleaf desmodium sown at 4 kg/ha + fertilizer application of 30 kg/ha P and 37 kg/ha K

Seed was oversown into a one-month old maize crop sown in 50 cm rows. Plots were prepared by removing every second maize row using a chipping hoe. The maize crops in which the experiment was established was too variable to allow meaningful comparison of the interactions between maize and legume.

This experiment had satisfactory establishment at Pak Chong, but had been ploughed out by the farmer at Lampayaklang. Neither site yielded any useful results and this work was not continued.

Evaluation of other forage species. The DPO was provided with seed of Jarra digit grass (*Digitaria milanjiana* cv. Jarra) to establish an area at the Muak Lek Station for evaluation and for use as a source of planting material for distribution to farmers. A range of other grasses and legumes was provided to Mr Soar Sivichai, during and following training in Australia, for him to evaluate in this environment.

Advanced evaluation

Because of the potential for lablab to provide a large bulk of high quality cattle feed in this environment, lablab seed was provided for sowing on 2 dairy farms in September 1993. The farms were at Sakolkrai Bhavabhutanonthsa (Dairy Colony) on red loam soil and at Huakarok on a black cracking clay soil. At the Dairy Colony, the lablab was drilled into an area of star grass which had been cut short, while at Huakarok it was sown into an area of grass following disking. The performance of the lablab was similar at both sites. The stands were thin, the growth was only fair and there was severe grass competition. It is obvious from these sowings that the grass needs to be more severely controlled, and that the lablab needs to be sown earlier in the wet season.

Because of the performance of the *M. martii* lines in the legume adaptation trial, 0.5 rai of one of the lines was sown on the same farms as above during June 1994. It is too early to comment on their on-farm performance.

After seeing *Arachis glabrata* growing well at Pak Chong Animal Nutrition Research Center, arrangements were made for this species to be planted in wide spaced rows over 0.5 rai in grass pastures, again on the same two farms as above. It is too early for an assessment of performance, as the plantings were only carried out in August of this year.

Seed production and extension

Small areas of both *M. martii* lines were sown at the DPO Station at Muak Lek during the 1993 wet season for seed increase, to provide seed for the on-farm sowings reported above. The areas were irrigated during the 1993/94 dry season. Seed was harvested by hand until the first rains of the wet season in 1994. About 1 kg seed of each line was harvested. Seed collection was difficult because of small pods, shattering of pods and the protracted flowering period.

The FSP trial has shown that two legume species, *Lablab purpureus* (an annual) and *Macroptilium martii*, are adapted to the Saraburi area and could supply a bulk of high quality dry season feed for dairy cattle. These species need further on-farm evaluation before large scale distribution can commence.

Some farmers, particularly those where the new forages were established in 1994, are interested in testing new forages. They want some forage alternatives, and they want forages which will compete with star grass.

Training and Linkages

Three DLD staff from northeast Thailand attended a training course in Australia from 7 May to 15 June 1994. They were Mr. Opas Rudchomphu and Mr. Wichien Susaena from Chaing Yuen Animal Nutrition Station, and Mr. Weerasak Chinosaeng from Khon Kaen Animal Nutrition Research Center.

The training course in forages was also attended by Mr. Soar Sivichai, an extension officer from the DPO at Muak Lek. This has strengthened the linkages between the DLD and the DPO and now there is regular communication between the former trainees of the two organizations.

Miss Chureerat Satjipanon attended the First Regional Meeting of the FSP in Australia, and the International Grassland Congress, 18-27 February 1993, and the Second Regional Meeting of the FSP in the Philippines, 4-8 October 1993.

Conclusions

The efforts of the Forage Seeds Project and the Division of Animal Nutrition, Department of Livestock Development, were successful in initiating and giving new direction to dry season forage research. In the low soil fertility and drought conditions at northeast Thailand, we found that *A. gayanus* cv. Kent was well adapted, *P. atratum* BRA 9610 and *S. guianensis* CIAT 184 were promising, and all could produce viable seed.

Brachiaria decumbens cv. Basilisk and *B. humidicola* also grew very well but did not set viable seed. It is hard to recommend them as farmers prefer oversowing seeds to the more laborious task of vegetative propagation.

In the acid and infertile soil of southern Thailand, *A. gayanus* CIAT 621, *B. brizantha* CIAT 16318, *P. atratum* BRA 9610, *S. guianensis* CIAT 184, and *Centrosema pubescens* CIAT 438 showed early promise. Further investigation under these conditions is warranted. And so, we would like more assistance in pasture research techniques and training on pasture work, from countries which already have well-developed pasture systems.

Research at Muak Lek in conjunction with the FSP has identified two legume species which have the capacity to provide a bulk of high quality dry season feed for dairy cows. When the potential of these species is proven on-farm, they will be extended to the farmers.

FORAGE SEEDS PROJECT IN INDONESIA: ACTIVITIES, RESULTS AND CONCLUSIONS

M. Tuhulele[1], H. Siagian[1], Ir. Ibrahim[2], H. Winarno[3], A. Hariadi[4], Ir Supriyadi[5], and Ir. Sungkono[6]

Introduction

In Indonesia the livestock sector has developed tremendously during the last 25 years. The livestock population has increased from 11.3 million animal units (AU) in 1969 to 33.9 million AU in 1993. The rate of increase has been 6.7% per year. It is projected that by the end of the sixth 5-Year Development Stage (Pelita-VI) in 1999 the animal population will reach 48 million AU. Although the percentage ruminants of the total livestock population has decreased from 78% in 1969 to 44% in 1993, ruminant population increased from 8.8 to 14.9 million AU in the same period. The production of forages and concentrate feeds will need to increase substantially to support the increasing animal population.

Forage Development in Indonesia

The supply of forages fluctuates with rainfall conditions. During the rainy season, forages are abundant, but during the dry season, forage supply is always insufficient, especially in the eastern part of Indonesia, as smallholders rely heavily on naturally occurring grasses. To overcome this situation, several forage programs have been launched. These can be categorized as follows: intensification, grazing land extension, diversification, and rehabilitation.

Through the intensification program, more than 150 million grass cuttings (napier, King grass, setaria) and 11.5 tons of legume seeds (*Leucaena, Sesbania, Desmanthus*, etc.) have been distributed to smallholders in 26 provinces of Indonesia during the last 5 years. The grazing land extension program is aimed at increasing the area of grazing lands, particularly in the eastern islands. The aim of the diversification

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program is to utilize and enhance the quality of available feed resources, such as using treated or untreated agricultural by-products, or to integrate forages into cropping systems. Integration of forage species into cropping systems is promoted through several systems, including alley cropping, companion cropping, hedgerow systems, and the Three Strata Forage System. The rehabilitation program is aimed at improving marginal and degraded land.

Reports on the implementation of the programs reveal that there are still many obstacles and problems in the field which hinder the success of the programs. One of the obstacles is the suitability of the selected forage species to the soil and climatic conditions. Due to the limitation of forage germplasm and the limited budget for research, the species used in the programs are only those available at the Technical Implementation Units (UPT) of the Directorate General of Livestock Services (DGLS) which produce cuttings and seeds. The UPTs are located in nine provinces in Indonesia, and the soil and climatic conditions vary to some extent.

Forage species adapted to the conditions on UPT stations are not always suited to the conditions in the target area. For example, napier grass and King grass, grow well on most UPT stations, but are generally poorly adapted to smallholder conditions in Kalimantan. The need for forage R&D to select adapted, productive forages for each province is very great and urgent.

The FSP in Indonesia

To increase livestock production, especially that of smallholder farmers, the Centro Internacional de Agricultura Tropical (CIAT), Colombia, and the Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia, with a grant from the Australian International Development Assistance Bureau (AIDAB), coordinated FSP activities which were implemented by DGLS and Provincial Livestock Services. The main activity of the project was to identify adapted forages and introduce these to smallholders, to enable them to produce their own forages and forage seeds. The project is for three years and ends in December 1994.

The technical assistance for the project in Indonesia is provided by CSIRO through the Division of Tropical Crops and Pastures. The first CSIRO staff assigned to the Project was Dr. T.A. Gibson, who was later replaced by Mr. A.G. Cameron. The head of the Subdirectorate of Forages, DGLS, is appointed as the Indonesian counterpart. This position was initially filled by Ir H. Siagian, who was later replaced by Mrs. M. Tuhulele.

Activities commenced with the introduction of 30 grass and legume species from CIAT and CSIRO in February 1992. These were grown at sites of the Kalimantan II

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program is to utilize and enhance the quality of available feed resources, such as using treated or untreated agricultural by-products, or to integrate forages into cropping systems. Integration of forage species into cropping systems is promoted through several systems, including alley cropping, companion cropping, hedgerow systems, and the Three Strata Forage System. The rehabilitation program is aimed at improving marginal and degraded land.

Reports on the implementation of the programs reveal that there are still many obstacles and problems in the field which hinder the success of the programs. One of the obstacles is the suitability of the selected forage species to the soil and climatic conditions. Due to the limitation of forage germplasm and the limited budget for research, the species used in the programs are only those available at the Technical Implementation Units (UPT) of the Directorate General of Livestock Services (DGLS) which produce cuttings and seeds. The UPTs are located in nine provinces in Indonesia, and the soil and climatic conditions vary to some extent.

Forage species adapted to the conditions on UPT stations are not always suited to the conditions in the target area. For example, napier grass and King grass, grow well on most UPT stations, but are generally poorly adapted to smallholder conditions in Kalimantan. The need for forage R&D to select adapted, productive forages for each province is very great and urgent.

The FSP in Indonesia

To increase livestock production, especially that of smallholder farmers, the Centro Internacional de Agricultura Tropical (CIAT), Colombia, and the Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia, with a grant from the Australian International Development Assistance Bureau (AIDAB), coordinated FSP activities which were implemented by DGLS and Provincial Livestock Services. The main activity of the project was to identify adapted forages and introduce these to smallholders, to enable them to produce their own forages and forage seeds. The project is for three years and ends in December 1994.

The technical assistance for the project in Indonesia is provided by CSIRO through the Division of Tropical Crops and Pastures. The first CSIRO staff assigned to the Project was Dr. T.A. Gibson, who was later replaced by Mr. A.G. Cameron. The head of the Subdirectorate of Forages, DGLS, is appointed as the Indonesian counterpart. This position was initially filled by Ir H. Siagian, who was later replaced by Mrs. M. Tuhulele.

Activities commenced with the introduction of 30 grass and legume species from CIAT and CSIRO in February 1992. These were grown at sites of the Kalimantan II

Livestock Development Project in East and Central Kalimantan, and at the Animal Breeding and Forage Seeds Multiplication Station (UPT) at Pelaihari in South Kalimantan. In July 1993, the activities were started in Sumbawa, West Nusa Tenggara, at the request of DGLS.

Screening of forage germplasm

Various varieties of grass and legume were tested and evaluated. A list of species sown or planted in Kalimantan and Sumbawa is presented in Appendix 1 and Table 1, and details of sites are presented in Table 2.

The characteristics considered during the evaluation were leaf color, soil cover, plant density, flowering, seed production, plant height, pest/insect problems, disease/fungus damage, leaf drop, nodulation, ability to spread, and dry matter production.

Table 1. Performance of forages evaluated at UPT Serading in Eastern Indonesia.

Species	Cultivar or accession	Growth	Seed harvested
a) grasses			(g/plot)
Andropogon gayanus	cv. Kent	good	10
Brachiaria decumbens	cv. Basilisk	good	5
Brachiaria humidicola	cv. Tully	good	5
Cenchrus ciliaris	cv. Biloela	fair	5
	cv. Gayndah	died	-
Panicum maximum	cv. Riversdale	died	-
Urochloa mosambicensis	cv. Nixon	fair	100
b) legumes			
Arachis pintoi	cv. Amarillo	died	-
Cassia pilosa	CPI 57503	fair	10
Centrosema plumieri	CPI 58568	good	580
Clitoria ternatea	cv. Milgarra,	good	1260
	CPI 50973	good	1410
Desmanthus virgatus	cv. Marc	good	200
Lablab purpureus	cv. Highworth,	good	170
	cv. Rongai	good	400
Macroptilium atropurpureum	cv. Aztec	good	60
Macroptilium bracteatum	CPI 27404	good	130
Macroptilium lathyroides	cv. Murray	good	50
Stylosanthes hamata	cv. Verano	good	20
Vigna trilobata	CPI 13671	good	60

Table 2. Details of species evaluation sites in Indonesia.

Site	Location: latitude & closest town	Soil type	Soil pH	Topography	General description
Kanamit Pankoh III (Klinic)	3°S, Pulang Pisau, Central Kalimantan	organic black loam	4.5	flat	*Imperata* grassland at Klinic
Pangkalan Lada (Klinic)	2.5°S, Pangkalan Bun, Central Kalimantan	podzolic	4.5 - 6.0	flat	*Imperata* grassland at Klinic
Guneung Seteleng (on-farm)	2°S, Balikpapan. East Kalimantan	podzol	4.5 - 5.5	moderate slop terraced	weedy fallow on a farm
Loa Janan (Horticultural Station)	1°S. Samarinda, East Kalimantan	red loam	4.5 - 5.5	gentle slope	*Imperata* grassland at Horticulture Station
Sungai Lantung (on-farm)	0.5°S, Samarinda. East Kalimantan	podzolic	5.5 - 6.0	steep slope	*Imperata* grassland on a farm
Talang Sari (on-farm)	0.5°S, Samarinda, East Kalimantan	eroded podzolic	4.5	steep slope	*Imperata* grassland on a farm
Teluk Dalam (Klinic)	0.5°S, Samarinda, East Kalimantan	black cracking clay	6.0 - 6.5	flat	low-lying grassland, seasonally waterlogged
Waru (Klinic)	2°S, Balikpapan, East Kalimantan	sand	3.5 - 4.0	flat	low-lying grassland, seasonally flooded and waterlogged
Pelai Hari (UPT Station)	4°S, Banjarbaru, South Kalimantan	red-brown clay loam	4.5 - 5.5	gentle slope	*Imperata* grassland
Serading (UPT Station)	9°S, Sumbawa Besar, Nusutenggara Barat	brown cracking clay	6.0 - 7.0	flat	natural grassland

Several grass and legume varieties were well-adapted and these were recommended to be developed further (Tables 3 and 4). The forages which were adapted to several sites in Kalimantan and therefore, the most promising introductions, were the following:

a) Grasses

Andropogon gayanus CIAT 621
Brachiaria brizantha CIAT 6780
Brachiaria decumbens CIAT 606 (cv. Basilisk)
Brachiaria humidicola CIAT 6369

b) Legumes

Centrosema pubescens CIAT 15160
Stylosanthes guianensis CIAT 184

The varieties that showed early promise but which need to be further developed in Sumbawa are:

a) Grasses

Andropogon gayanus cv. Kent and CIAT 621
Brachiaria decumbens cv. Basilisk
Brachiaria humidicola cv. Tully
Urochloa mosambicensis cv. Nixon

b) Legumes

Centrosema plumieri CPI 58568
Lablab purpureus cvv. Highworth and Rongai
Stylosanthes hamata cv. Verano

Table 3. FSP grasses recommended for further development at the evaluation sites in Kalimantan.

Species	East Kalimantan					Central Kalimantan		South Kalimantan
	Sungai Lantung	Talang Sari	Loa Janan	Waru	Gunung Seteleng	Kana-mit	Pangkalan Lada	Pelai Hari
Andropogon gayanus CIAT 621, cv. Kent	-	x	x	x	x	x	x	x
Brachiaria brizantha CIAT 6780	-	x	x	x	x	x	x	x
Brachiaria decumbens cv. Basilisk (= CIAT 606)	-	x	x	x	x	x	x	x
Brachiaria dictyoneura CIAT 6133	-	-	-	-	x	x	x	x
Brachiaria humidicola CIAT 6369, cv. Tully	-	x	x	x	x	x	x	x
Brachiaria ruziziensis ex. Thailand	-	-	-	-	-	-	x	-
Digitaria milanjiana CPI 41192	x	-	x	-	-	x	x	-
Digitaria swynnertonii CPI 59749	x	-	-	x	-	x	x	-
Panicum maximum								
cv. Riversdale	x	-	x	x	-	x	x	-
Thai Purple guinea	-	-	-	-	-	-	x	-
Paspalum atratum BRA 9610 (CIAT)	-	-	-	-	-	-	-	x
Paspalum guenoarum BRA 3824 (CIAT)	-	-	-	-	-	-	-	x

Table 4. FSP legumes recommended for further development at the evaluation sites in Kalimantan.

Species	East Kalimantan					Central Kalimantan		South Kalimantan
	Sungai Lantung	Talang Sari	Loa Janan	Waru	Gunung Seteleng	Kana-mit	Pangkalan Lada	Pelai Hari
Aeschynomene americana cv. Glenn, cv. Lee	x	-	x	-	-	-	x	-
Cajanus cajan CIAT 18700	-	-	-	-	x	-	x	-
Centrosema acutifolium CIAT 5277	-	-	x	-	-	x	x	x
Centrosema macrocarpum CIAT 5452, CIAT 15014	-	x	x	-	-	x	x	x
CIAT 15047	-	-	x	-	-	x	x	x
Centrosema pascuorum cv. Cavalcade	x	-	x	x	-	x	x	-
Centrosema pubescens CIAT 438	-	-	x	-	-	x	x	-
CIAT 15160	-	-	x	-	x	x	x	x
Centrosema schiedeanum cv. Belalto	-	-	x	-	-	-	x	-
Chamaecrista rotundifolia cv. Wynn	-	-	-	x	-	x	x	-
Codariocalyx gyroides CIAT 3001	-	-	x	-	-	-	x	x
Cratylia argentea CIAT 18516	-	-	-	-	-	-	-	x
Desmodium heterophyllum CIAT 349	-	-	-	-	-	-	-	x
local	-	-	-	x	-	-	-	-

Table 4. FSP legumes recommended for further development at the evaluation sites in Kalimantan (continued).

Species	East Kalimantan					Central Kalimantan		South Kalimantan
	Sungai Lantung	Talang Sari	Loa Janan	Waru	Gunung Seteleng	Kana-mit	Pangkalan Lada	Pelai Hari
Desmodium ovalifolium								
CIAT 13089	-	-	-	-	-	-	-	x
Flemingia macrophylla								
CIAT 17403	-	x	x	-	x	x	x	x
local	-	-	-	-	-	-	x	-
Macroptilium gracile								
cv. Maldonado	-	-	x	x	-	x	x	-
Stylosanthes guianensis								
CIAT 184	-	x	x	-	x	x	x	x
cvv. Cook, Graham	x	-	x	-	-	-	x	-
Stylosanthes hamata								
cv. Verano	-	-	-	-	-	-	x	-

Extension of promising germplasm

The distribution to farmers of promising species from the experimental sites in Kalimantan commenced in October 1993. Farmers attended one-day field days (farmers' days) for training in the establishment and management of the new forages. Exactly 56 farmers at Pangkalan Lada, 95 farmers at Kanamit, and 80 farmers in East Kalimantan attended the field days.

Forages were distributed to 234 farmers in East and Central Kalimantan.

The supply of seed and planting materials was insufficient in Indonesia for the initial distribution to farmers in October 1993. For this reason, seeds of *Andropogon gayanus* cv. Kent, and *Arachis pintoi* cv. Amarillo were obtained from Australia while *Stylosanthes guianensis* CIAT 184 seed was obtained from the FSP office in the Philippines. In later field days, farmers were supplied with cuttings, pols (rooted cuttings), and small amounts of seeds harvested from the evaluation plots. The FSP contracted to purchase seed of the new forages produced by the farmers.

Seed Production in Indonesia

Six of the farmers who planted the new forages produced seed. This produce was purchased by the FSP. Common problems encountered by farmers were the long dry season, selection of unfavorable location (seasonally waterlogged, etc.), and the small amount of seed initially supplied to farmers.

The amount of seed of new forages produced by smallholder farmers was 15 kg. Most seed produced was *Andropogon gayanus* cv. Kent, but seeds of other six grasses and 21 legume species were also produced.

Ninety kg of seed from CIAT and CSIRO were distributed to UPT stations for evaluation and multiplication. So far only a total of 25 kg was produced from *Andropogon gayanus* cv. Kent, *Cenchrus ciliaris* cv. Biloela, *Urochloa mosambicensis* cv. Nixon, *Desmanthus virgatus* cv. Marc, *Lablab purpureus* cvv. Highworth and Rongai, and *Stylosanthes guianensis* CIAT 184.

Training of staff

Staff training was conducted on 9 June - 7 July 1993 in Brisbane, Australia, and was attended by Mr Hamonangan Siagian from DGLS, Jakarta, Mr Ibrahim from East Kalimantan, Mr Heri Winarno from Central Kalimantan, and Mr Sungkono from UPT Serading in Sumbawa. The training consisted of laboratory training at CSIRO, and field training and field trips to several commercial farms and research centers. In their laboratory training, the participants were taught seed technology and techniques of field experimentation related to the implementation of the project.

In the opinion of the trainees, the length of the training course was sufficient to start implementation of the project, but it was not sufficient to enable the participants after their return to Indonesia to effectively share this knowledge with colleagues. A longer course including practical training in field experimentation was needed "to train trainers". This limitation was realized only when the participants faced the questions of their colleagues in Indonesia. However, the training was very useful because it helped the trainees to carry out FSP activities in the field.

In Indonesia, DGLS financed and organized a training course in forage agronomy in June 1994. The course was attended by 40 participants, who were UPT station staff and staff responsible for forages from 26 provincial livestock services. The training took place at BPT-HMT Baturraden. Dr. Werner Stür from the Philippines attended and contributed to the training course, which was based on the course given in Australia. The training went well, and most of the participants were very enthusiastic about opportunities to develop forages in their provinces. Participants were supplied with forage seeds for evaluation in their areas.

Forage Development Program for 1995-98

The demand for fodder and forage during 1995-96 is projected at 16.8 million tons of total digestible nutrients. Several programs will be carried out next year as follows:

- Distribution of 40 million forage cuttings to smallholder farmers, and targeting those involved in artificial insemination programs
- Rehabilitation of natural grazing areas and degraded lands.
- Improvement of the quality of agricultural by-products
- Integration of the Three-Strata Forage System into farming systems in 26 provinces.

To support these programs, training of Provincial Staff, preparation of information material (brochures, booklets, leaflets), procurement of seeds, workshops, and other activities are needed.

The FSP can contribute significantly to achieving the goal of the forage development program in Indonesia. Although budget and facilities have been allocated by the Indonesian government for this program, additional inputs will be needed to identify adapted forages, develop seed production and distribution mechanisms, and train personnel in R & D. It is hoped that the FSP will continue the existing activities, and add such activities like selection of adapted tree legume species which can be integrated to the Three-Strata Forage System for upland areas in the drier parts of Indonesia.

Conclusions

After 2 ½ years of research, we identified several species adapted to smallholder conditions. These can be recommended for immediate distribution to farmers. They are *Andropogon gayanus* cv. Kent and CIAT 621, *Brachiaria brizantha* CIAT 6780, *Brachiaria decumbens* cv. Basilisk (CIAT 606), *Brachiaria humidicola* cv. Tully and CIAT 6369, *Centrosema pubescens* CIAT 15160, and *Stylosanthes guianensis* CIAT 184.

Several other forage species were promising at some locations, but these need more evaluation before they can be recommended to farmers. These are the legumes: *Cassia rotundifolia, Flemingia macrophylla, Macroptilium gracile* cv. Maldonado, *Centrosema pascuorum* cv. Cavalcade, and the grasses: *Brachiaria ruziziensis, Digitaria milanjiana, Digitaria swynnertonii, Panicum maximum* cv. Thai Purple guinea, *Paspalum atratum, Paspalum guenoarum.* In addition, some legumes are promising on soils with pH > 5. These are *Arachis glabrata, Arachis pintoi* cv. Amarillo (CIAT 17434), *Cratylia argentea* CIAT 18516, *Centrosema macrocarpum*, and *Desmodium ovalifolium*.

Appendix 1. List of FSP forage species evaluated in Kalimantan, Indonesia.

a) grasses	
Andropogon gayanus	CIAT 621, cv. Kent
Brachiaria brizantha	CIAT 6780
Brachiaria decumbens	cv. Basilisk (= CIAT 606), local
Brachiaria dictyoneura	CIAT 6133
Brachiaria humidicola	CIAT 6369, cv. Tully
Brachiaria ruziziensis	Thai ruzi grass (cv. Kennedy?)
Chloris gayana	cv. Callide
Digitaria milanjiana	CPI 41192
Digitaria swynnertonii	CPI 59749
Euclaena mexicana	local
Panicum maximum	cv. Makueni, cv. Riversdale, TD58 (= Thai purple guinea)
Paspalum atratum	BRA 9610 (CIAT)
Paspalum conjugatum	local
Paspalum guenoarum	BRA 3824 (CIAT)
Paspalum malacophyllum	CPI 27690
Pennisetum purpureum	local napier grass
Pennisetum purpureum x P. typhoides	local King grass
Setaria sphacelata	natural cross based on CPI 15899
b) legumes	
Aeschynomene americana	cv. Glenn, cv. Lee
Arachis glabrata	CPI 93469, CPI 93490
Arachis pintoi	cv. Amarillo (= CIAT 17434)
Cajanus cajan	CIAT 18700
Calliandra calothyrsus	local
Calopogonium mucunoides	local
Centrosema acutifolium	CIAT 5277
Centrosema macrocarpum	CIAT 5452, CIAT 15014, CIAT 15047
Centrosema pascuorum	cv. Cavalcade
Centrosema pubescens	CIAT 438, CIAT 15160, local
Centrosema schiedeanum	cv. Belalto
Chamaecrista rotundifolia	cv. Wynn
Codariocalyx gyroides	CIAT 3001
Cratylia argentea	CIAT 18516
Desmodium heterophyllum	cv. Johnstone (= CIAT 349), local
Desmodium ovalifolium	CIAT 13089
Desmodium velutinum	CIAT 13220
Flemingia macrophylla	CIAT 17403, local
Leucaena diversifolia	local (ex. Bogor)
Macroptilium gracile	cv. Maldonado
Stylosanthes capitata	CIAT 10280
Stylosanthes guianensis	CIAT 184, cv. Cook, cv. Graham, Thai Graham, SSD-12
Stylosanthes hamata	cv. Verano, Thai Verano

Section 4: Forage Seeds Project - Technology Transfer

EXPERIENCES WITH ON-FARM RESEARCH AND EXTENSION OF FSP FORAGES IN EAST KALIMANTAN, INDONESIA

Ir. Ibrahim[1]

Introduction

East Kalimantan province has a land area of 211.440 km^2, or 1.5 times the size of Java island and Madura combined. The population is just over 2 million. Land use in East Kalimantan is dominated by largely unused upland areas and government forest land (Table 1).

The livestock sector in East Kalimantan has a role in maintaining the ecological stability of the land and in developing and increasing the productivity of ruminants towards increased prosperity of farmers.

Starting in February 1992, the Forage Seeds Project jointly administered by CIAT, Colombia and CSIRO Division of Tropical Crops and Pastures, Australia, introduced several forage grasses and legumes, and which were to be monitored for adaptation in East Kalimantan. The project was aimed to select forages adapted to the environment of East Kalimantan, and to extend them to smallholder farmers. This paper reports the experiences during the evaluation and the extension of the new forages to smallholder farmers in East Kalimantan from February 1992 to October 1994.

Table 1. Land use in East Kalimantan.

Land Use	Land Area
	(million ha)
Upland areas	21.0
Paddy rice fields	0.2
Grasslands	0.1
Marshes	0.9
People's forest land	1.1
Government forest land	12.8
Plantations	0.4

[1]Dinas Peternakan, Jl. Bhayangkara 54, Samarinda, East Kalimantan, Indonesia.

Locations

The experiments were carried out at sites which covered the main land types in East Kalimantan. These locations were:

1. Sungai Lantung (Kotamadya Samarinda), strong yellowish brown, clay-loam, pH 4.5-5.0, on rolling land to steep hills.
2. Talang Sari (Kotamadya Samarinda), light yellow, fine sandy-loam over fine sandy clay at 15 cm, surface pH 4.5, sand stone and laterite nearby, 18% slope.
3. Loa Janan (Kabupaten Kutai), red, well-aggregated loam, surface pH 4.5-5.5 (CSIRO site), pH 4.5 (CIAT site), gentle slope, well drained.
4. Waru (Kabupaten Pasir), white sand surface 1 cm, dark sandy loam to 30 cm, surface pH 3.5-4.0, flat, waterlogged.
5. Gunung Steleng (Kabupaten Pasir), podzol, surface pH 4.5-5.5, level terraced beds on about 10° hillside slope.
6. Teluk Dalam, black cracking clay, surface pH 6-6.5, flat, waterlogged.

Three of these sites (3, 4, 6) were on government stations, the other three on farmers' land. One of the government sites, Loa Janan, was managed by a farmer who works on the station; it was also effectively an on-farm site.

The three farms/farmers selected for the on-farm evaluation sites were all "key" farmers who had land and cattle, and who were willing to cooperate in the project.

Thirty-six forages (13 grasses and 23 legumes) were introduced. Details of this evaluation are presented in the country progress report from Indonesia.

Species Adaptation

Persistent grasses and legumes adapted to the screening sites in East Kalimantan were the following:

a) Grasses

Andropogon gayanus CIAT 621
Brachiaria brizantha CIAT 6780
Brachiaria decumbens CIAT 606
Brachiaria humidicola CIAT 6369
Digitaria milanjiana CPI 41192
Digitaria swynnertonii CPI 59749
Panicum maximum cv. Riversdale

Paspalum atratum BRA 9610
Paspalum guenoarum BRA 3824

b) Legumes

Aeschynomene americana cv. Glenn
Arachis pintoi cv. Amarillo
Centrosema acutifolium CIAT 5277
Centrosema macrocarpum CIAT 5452, CIAT 15014, CIAT 15047
Centrosema pubescens CIAT 15160, cv. Belalto
Desmodium heterophyllum CIAT 349
Desmodium ovalifolium CIAT 13089
Flemingia macrophylla CIAT 17403
Macroptilium gracile cv. Maldonado
Stylosanthes guianensis CIAT 184, cv. Cook

Seed Production

The grasses and legumes which produced viable seed at the evaluation sites were *Brachiaria humidicola, Brachiaria brizantha, Brachiaria decumbens, Andropogon gayanus, Aeschynomene americana* cv. Glenn, *Stylosanthes guianensis* CIAT 184, cv. Cook, cv. Graham, *Flemingia macrophylla, Cajanus cajan* and *Macroptilium gracile* cv. Maldonado.

Extension

The farm field day was the extension method used to speed up technology transfer and the diffusion of grasses and legumes to the farmers from the experiment locations.

All the key farmers in an area were invited to the nearest evaluation site for training on the various types of grasses and legumes. There, the farmers were given instruction (both theoretical and practical) on the forages, how to prepare the land, soil acidity, how to establish grasses and legumes with seed, pols or cuttings, how to fertilize, how to harvest the grass and legume seed, and how to determine the quality of grass and legume seed.

After the theoretical and practical training, each of the farmers selected at least one grass and one legume to establish on his farm. The forages were supplied as seed, pols, or cuttings.

Farmer field days

The numbers of farmers who attended training at the various sites are presented:

- Talang Sari
  13 September 1993 - 15
  5 February 1994 - 8
- Sungai Lantun
  16 September 1993 - 12
- Loa Janan
  12 October 1993 - 15
  16 July 1994 - 10
- Gunung Steleng
  10 October 1993 - 20

Eighty farmers have attended field days and received forages to date. These field days were effective; the farmers have successfully grown the new forages on their farms. Nine extension officers also attended a field day at Talang Sari in April 1994.

The forages distributed to farmers as seed, pols, or cuttings were *Andropogon gayanus* cv. Kent, CIAT 621, *Brachiaria decumbens* cv. Basilisk (CIAT 606), *B. brizantha* CIAT 6780, *B. humidicola* cv. Tully, CIAT 6369, *Panicum maximum* cv. Riversdale, cv. Common, *Paspalum guenoarum* BRA 3824, *Paspalum atratum* BRA 9610, *Aeschynomene americana* cv. Glenn, *Stylosanthes guianensis* cv. Cook, CIAT 184, and *Macroptilium gracile* cv. Maldonado. I feel that the ideal number of farmers for this type of field day is 10 to 15.

Factors contributing to successful extension

- Support from Dinas Peternakan, DGLS, and FSP;
- Technical guidance from the FSP team;
- Good field cooperation among farmers, extension staff, and researchers;
- Farmers being motivated to attend the field days and to develop the forages. Some farmers have expanded the areas for the new forages on their farms, while others also intend to do so.

Problems encountered

- Some of the seed supplied from overseas for distribution did not germinate and/or grow when sown on farmers' fields;

- The amount of seed produced at the evaluation sites and on the farms was limited by the small plot size and the limited labor available to harvest the seed;
- Most of the farmers preferred to use the new forages for feeding their animals than for seed production;
- The site at Teluk Dalam was abandoned during the first year after the local person in charge moved the site of the plots from the originally chosen to a poorer, poorly-drained site which was also subjected to uncontrolled grazing during the establishment phase;
- A farmer in one of the sites ploughed out the forages, intending to grow vegetables there in late 1993. This site lost its demonstration value as it had to be replanted;
- No field days were held at the Waru site because there were few farmers with cattle in that area.

For the Future

- Grasses and legumes that will grow well have been selected.
- Farmers' field days to encourage use at the forages will continue. Fifteen more key farmers who can attend training have been identified.
- Motivate farmers who own more than 0.5 ha of land to plant forages.
- Plant areas of forages on Dinas Peternakan stations for source of planting material for farmers.
- Motivate the farmers to produce forage seed.
- Conduct a forage competition in December 1994 in conjunction with the local radio station to promote forages in East Kalimantan.

Conclusions

On-farm evaluation sites have been successful in identifying adapted, persistent forages for East Kalimantan. Field days held at the on-farm evaluation sites were an effective way to quickly transfer forage technology to many smallholder farmers.

EXPERIENCES WITH ON-FARM RESEARCH AND EXTENSION OF FSP FORAGES AT PANGKALAN BUN, CENTRAL KALIMANTAN, INDONESIA

Ir. H. Winarno[1]

Introduction

Breeding, feeding and management are the factors which are important for the success of livestock development with feeding as the most important.

I have been involved in several projects involving the introduction and extension of forages to farmers. These projects were as follows:

- Introduction of new forage varieties from the Regional Breeding and Implementation Center at Serading
- the GEMMARAMPAK programs
- the Kalimantan II Livestock Development Project, and more recently
- the Southeast Asian Regional Forage Seeds Project.

The Forage Seeds Project (FSP) is an AIDAB-funded project jointly executed by CIAT, Colombia and CSIRO Division of Tropical Crops and Pastures, Australia in co-operation with the Government of Indonesia through the Directorate General of Livestock Services. The project aims to identify adapted forages for Central Kalimantan and to extend them to smallholder farmers. This paper reports the activities in the FSP between December 1991 and October 1994.

Location

The FSP introduction and evaluation site at Pangkalan Bun was located at Klinik-08, Pangkalan Lada, 3°S latitude. The area was a flat, well-drained, *Imperata* grassland. The soils was yellow-brown sandy loam overlying red-yellow clay at 30 cm with a surface soil pH 4.5-5.

No introduction sites were established on farms in this area.

[1]Dinas Peternakan, K. Sultan Syahrir 39A, Pangkalan Bun 74111, Central Kalimantan, Indonesia.

Forage Introduction and Evaluation

Forty one forage species were sown or planted between 7 February and 26 October 1992. These consisted of 18 grasses and 23 legumes; five local grasses and one local legume were planted as controls. Details of this evaluation are presented in the Country Progress Report from Indonesia.

A number of forages were well-adapted to the local soil and climate, and some showed promise for extension to farmers (Table 1).

Table 1. Grass and legume accessions adapted to Central Kalimantan.

Grasses	Legumes
Andropogon gayanus CIAT 621	*Arachis pintoi* cv Amarillo
Brachiaria brizantha CIAT 6780	*Centrosema macrocarpum*
Brachiaria decumbens cv Basilisk	*Centrosema pubescens* cv Belalto
Brachiaria dictyoneura CIAT 6133	*Centrosema pubescens* CIAT 15160
Brachiaria humidicola CIAT 6369	*Centrosema pascuorum* cv Cavalcade
Brachiaria ruziziensis ex. Thailand	*Chamaecrista rotundifolia* cv Wynn
Digitaria swynnertonii CPI 59749	*Macroptilium gracile* cv Maldonado
Panicum maximum cv Riversdale,	*Stylosanthes guianensis* CIAT 184
Panicum maximum cv Thai purple	

Seed-increase plots for most of these forages were established at the Klinik in October 1993.

Extension Activities

Extension of forages to farmers was carried out on five occasions. The farmers selected on each occasion were "key" farmers in the area who had cattle, who were available for training, were deemed to have the skills to grow the forages, and were willing to cooperate.

First period

In September and October 1993 forage extension was carried out with nine key farmers. This extension work was done individually on each farmer's property. The forages were planted in communal grazing areas or in farmers' field. In the latter, the forages were either established on monoculture or planted between rows of King grass (in the case of some legumes).

Species used were *Brachiaria humidicola, Brachiaria decumbens, Brachiaria brizantha, Leucaena leucocephala, Stylosanthes guianensis* CIAT 184 (Stylo 184) and *S. guianensis* cv. Cook (Cook stylo) and local *Centrosema pubescens* (Centro).

The grasses were planted as pols (rooted cuttings) from the plots at the Klinik. Not all of these cuttings got established. All nine farmers did not produce seed because they needed the forages for grazing.

In a later extension activity, field days were conducted for farmers. All were brought to a central location for training. The training was both theoretical and practical. The theoretical aspects included forage identification and use, seed technology, planting systems, fertilizer type and use, and general management of forages. The practical aspects included planting pols and cuttings, sowing seed, fertilizing, harvesting seed, and seed storage.

Second period

Twenty farmers attended a field day at Pangkala Lada Klinik on 30 October 1993. Forages available and distributed to the farmers as seed were *Andropogon gayanus* cv. Kent, *Brachiaria humidicola* cv. Tully, *Brachiaria decumbens* cv. Basilisk, *Panicum maximum* (Common guinea), Stylo 184, *Arachis pintoi* cv. Amarillo (Amarillo), and Centro CIAT 15160. All of the seeds, except for the Centro CIAT 15160 which was harvested from the plots at the Klinik, were provided by the FSP from overseas. All forages were established by the farmers in November-December 1993. It was intended that the farmers produce seed of the forages from their area.

Third period

Ten farmers attended a field day at Pangkalan Lada Klinik on 2 March 1994. Forages available as pols or cutting were the grasses *Andropogon gayanus* CIAT 621 (gamba grass), *Brachiaria brizantha, Brachiaria ruziziensis, Brachiaria humidicola, Brachiaria dictyoneura.* Centro CIAT 15160 and Stylo 184 seeds harvested from the plots at the Klinik were also available. These were planted by the farmers in March 1994 in 50 m^2 plots.

Fourth period

Seven farmers attended a field day at Semantaun village on 19 March 1994. Forages available were *Brachiaria humidicola, Brachiaria brizantha, Brachiaria* *decumbens*, Stylo 184, local centro, *Macroptilium grazile* cv. Maldonado (Maldonado), and *Centrosema macrocarpum*. Gamba grass, Stylo 184 and Maldonado were sown from seed harvested at the Klinik. Local Centro was sown from seed produced by the farmers. *Brachiaria* species and *Centrosema macrocarpum* were planted as rooted cuttings from the Klinik. The farmers established the forages in April 1994 in 50 m^2 plots.

Fifth period

Ten farmers attended a field day at BPP Nang Bulik on 11 August 1994. Seeds distributed to the farmers were Gamba grass, *Brachiaria* species, Stylo 184, Centro CIAT 15160, and *Centrosema macrocarpum*.

Outcome of Extension Activities

Fifty-six farmers at Pangkalan Bun, Central Kalimantan received training in forages. Forages were distributed to three more farmers who had heard about them and made inquiries. All grasses had excellent establishment and good growth, except *B. humidicola*, *B. decumbens*, and common guinea from the seed supplied in October 1993. To date, the farmers have produced seed of Kent Gamba grass. Two farmers have harvested a total of 2 kg seed. Maldonado, local Centro, *Centrosema macrocarpum*, Stylo 184, and Amarillo are likewise growing well on the farms.

The farmers were all enthusiastic and responsive during the field days. These field days are ideal in providing training on forages and planting materials to a few farmers. For each field day, 10 farmers for training are enough.

Problems encountered

- The farmers are all smallholders and they want to intensify their livestock management. The farmers prefer tall forages such as King grass and napier grass to meet their needs for cut and carry to stall-fed cattle.
- Despite the high quality of the new forages (*Brachiaria* spp., Guinea grass, Gamba grass, *Centrosema* and *Stylosanthes*), adoption by farmers so far has been limited. However, some farmers has intend to expand the area planted to the new forages in the next wet season.
- Seed yields were low.
- Soil fertility was low.
- Farmers involved in the FSP were practicing mainly mixed cropping with livestock being a secondary component.
- Planting materials must be available at the right time.

- More operational funds would allow more time to be spent with the farmers.
- Some of the seed supplied from overseas did not germinate and/or establish when sown on farmers' fields.

Factors contributing to success

- Support from Dinas Peternakan, DGLS and FSP.
- Technical guidance from FSP.
- Linkages between farmers, administration and researchers.
- Farmers' motivation.
- The farmers have managed the new forages well, with some inspection and advice from Dinas Peternakan staff.

What can be done for improvement

- Interplanting local grasses with new lines of forages from the FSP Project to improve the quality of feed to the animal.
- Combining of food crops with forages into the farming system through of the Three-Strata Forage System to increase land productivity.
- Carrying out more detailed research on seed production at the Klinik.

The Future

- There are 40-50 more key farmers in the Pangkalan Bun area who could attend field days for training in forages.
- We shall encourage the farmers who have received the new forages to share planting material with their neighbors.
- We shall encourage the farmers to expand the area of forages on their farms.

EXPERIENCES WITH ON-FARM RESEARCH AND EXTENSION OF FSP FORAGES IN MALAYSIA

A. Aminah and G. Khairuddin[1]

Introduction

In Malaysia, it has taken almost 30 years for people to recognize the importance of forage resources in ruminant production. Proper utilization of forages in terms of a balanced diet at the farm level has yet to be promoted. This situation may partly explain the lagging ruminant production in the country, as well as the lower profitability and longer break-even time, when compared with other investments in agriculture.

A lot of research information is available on managerial approaches to forages and livestock production. Yet few users seem to be making good use of these information, either because (a) the existing packages are not sufficiently practical for on-farm adoption, or (b) the farmers are not aware of the management and utilization requirements of tropical forages. The increasing demand for beef (or the drop in self-sufficiency level), and the increasing requests for advisory services and planting materials by livestock farmers in recent years, indicate that the problems are with extension rather than with research.

For a project to be successful, the timing, place, and people must be right. The country now has started encouraging livestock farmers to develop a commercial approach. On-farm research and extension is the key to the solution of some of the problems. On-farm trials play an important role in agricultural development. They help improve farmers' practices and thereby increase farm productivity and income. In addition, they provide researchers the chance to test and verify findings in controlled experiments and laboratories.

The present paper discusses our experiences with on-farm trials carried out on farmers' land from October 1993 to September 1994 under the present Forage Seeds Project (FSP).

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Methodology

Selection of farmers

Progressive and keen farmers who had extra land and a minimum of 10 cattle were selected through the assistance and recommendation of the Department of Veterinary Services (DVS). The DVS is responsible for extension services in the development of pastures, as well as the provision of veterinary services. Farmers were chosen from different areas that represented strategic localities such that their farms could be used as demonstration farms to the neighboring farmers. During the visits to the farms, the objectives of the project were spelled out and the problems of farmers, especially those relating to forages, were identified. In general, all farmers had similar problems regarding forages; both on quantitative and qualitative aspects.

Selected farmers received training on the advantages of planting improved forage species, and improved techniques for establishment and management of the pastures in association with animal production.

Discussions were held with the farmers to identify the availability of basic facilities such as labor, land area, and machinery to ensure that the project will run smoothly with minimum inputs from FSP.

Selected farmers were given planting material, fertilizer, financial support for land preparation, and chemicals.

Recommendation of appropriate forage species

Appropriate pasture species were recommended to ensure successful achievement of the targets. Species included those already confirmed locally to produce seed, such as the *Panicum maximum* cultivars Common guinea and Vencedor, *Brachiaria ruziziensis* and *Stylosanthes guianensis* CIAT 184. Factors such as the edaphic and climatic conditions, animal species, and management and feeding system were also considered. For example, a farmer rearing sheep was not offered *Brachiaria decumbens* or *B. ruziziensis* for grazing, since these can cause photosensitization in small ruminants. But *Digitaria setivalva* (MARDI Digit) was offered. For cut-and-carry systems, species like napier and King grass were recommended. If a farm was on a coastal sandy soil, species such as *B. humidicola* and *B. dictyoneura*, were favored for grazing.

Land preparation and forage establishment

When dealing with on-farm trials some trivial things can become a major hindrance to the project. Items like land preparation, a small amount of lime or fertilizer, clearing the site and others deserve close consideration. Land preparation which included ploughing and rotovation was done by outside contractors who were then paid by the project. Farmers were given the forage seeds or vegetative materials, and the farmers themselves planted them with the researchers' or DVS extensions workers' supervision. Weeding was not necessary except in certain cases where noxious weeds like *Mimosa invisa* and *Imperata cylindrica* infested the forage; these were cut occasionally.

Forage and Seed Production

The primary objective of on-farm demonstration under the FSP was to produce seeds or planting materials during the seeding season, and secondarily to provide forages to livestock during the remainder of the year. Three to four months after establishment, impressive growth of introduced forage, compared with those of native species was observed. Despite the initial agreement to produce seed, most farmers preferred to use the forages directly for feeding livestock. This accounts for only a small amount of Vencedor guinea seed was collected this season.

Forage species from FSP were introduced to farmers at the end of October 1993. Initially, only five farmers from Kedah state and two from Kelantan, both in the north of the Malaysian Peninsula, were involved with the project. By the end of September 1994, the farmers had increased to 17. Most of these farmers had earlier experience with improved forage species like napier and *Setaria sphacelata* (setaria) while some had depended solely on native forages. Most of them particularly impressed with the performance of *Stylosanthes guianensis* CIAT 184 (Stylo 184). Tables 1 and 2 present some characteristics of farmers from Kedah and Kelantan involved with the FSP. Their land size ranged from 0.1 ha to 2.8 ha. The recommended species included both grasses and legumes.

Table 1. List of farmers involved with the Forage Seeds Project in Kelantan.

Name of farmer	Livestock reared	Area planted (ha)	Species recommended
1. Mohammed Ismail	sheep, cattle under coconut	3.2	Vencedor guinea, *B. humidicola*, *B. dictyoneura*, Stylo 184
2. Ramli Mamat	sheep under coconut	0.2	*B. humidicola*
3. Ab. Halim	beef cattle, dairy cows	2.8	*P. atratum* BRA 9610, Vencedor guinea, Stylo 184, ruzi grass, dwarf napier, napier, King grass
4. Razali Othman	goat	0.2	King grass
5. Gulam Razul	dairy cows	2.4	Stylo 184, Ruzi grass, Vencedor guinea, Leucaena
6. Ismail Zakaria	beef cattle	2.3	Ruzi grass

Table 2. List of farmers involved in the Forage Seeds Project in Kedah.

Name of farmer	Livestock reared	Area planted (ha)	Species recommended
1. Saad Abdullah	sheep	0.3	Stylo 184, MARDI Digit
2. Rosli Baharom	under pomelo	0.4	Stylo 184
3. Sazali Ahmad	beef cattle	0.6	Stylo 184, Ruzi grass
4. Ahmad Hamid	dairy cows under mango	0.2	Stylo 184, Ruzi grass
5. Husin Abdullah	beef cattle	0.2	Stylo 184, Common guinea, Ruzi grass
6. Wan Hishamuddin Wan Ahmad	dairy cows	0.8	Stylo 184, Ruzi grass, Vencedor guinea
7. Salleh Husin	dairy cows, beef cattle		Stylo 184, Ruzi grass
8. Shamsuddin Ahmad	sheep, goat	0.8	Stylo 184, Ruzi grass, Vencedor guinea
9. Zainol Abdullah	dairy cows	0.3	Stylo 184
10. Che Noroheseni Che Musa	dairy cows	2.5	Stylo 184, Ruzi grass
11. Ahmad Ali	dairy cows, beef cattle	0.1	King grass

Impact of the Project

Success

- The farmers were very impressed with the performance of the introduced species. That the forage species were high yielding, had fast coverage during establishment, and were readily accepted by their stock, persuaded them to adopt. A few farmers requested seed of the new species. Most of them preferred to plant seed rather than vegetative materials because less time was needed for handling.
- The farmers in the project helped spread the news and advantages of the improved forage species to their neighbors. As a consequence, several farmers requested seed, and the number of participating farmers doubled in one year (Table 1). Thirty DVS officials made a special visit in May 1994 to Sintok Farm and MARDI Bukit Tannga Station to observe the forage seed production. It was interesting to observe how much attention that small piece of work received.
- The expansion of the area planted with forages on participating farms was another important phenomenon observed. For example, one farmer started with 0.4 ha which was expanded to 2.4 ha for forage production in one year.
- The farmers were very cooperative to the on-farm trial researchers and extension workers. They managed their pastures well according to the technical advice from researchers.

Failure

- Of the 17 farmers only two responded poorly to the introduced forages. One planted melons, while the other farmer sold off his stock.

Factors contributing to the success of the project

- It was essential that good linkages existed among the researchers, extension workers, and farmers. Subsequent discussions of problems regarding forages and animals enhanced the success of the project.
- Frequent visits by researchers and extension workers to the project sites made the farmers feel that they were being taken care of. The technical advice and some monetary assistance helped to speed up the implementation of the work. The feeling arising from the experience was that the continuity of technical advice tailored to the need and status of development of the farm was most critical to the success of the on-farm projects. The supply of forage species appropriate to the farms, in anticipation of their changing status in development, should be provided.
- The two cases of failure were mainly attributed to the particular circumstances of the farmers themselves.

- To improve technology transfer, organized visits to other progressive farmers either locally or in neighboring countries, would definitely help.
- Pamphlets and brochures on forage in the local language would aid the extension and diffusion of FSP forages.
- Seeds and cuttings of forage species to farmers should be distributed during visits by the researchers and extension workers.
- Workshops, training, seminars, and meetings of researchers, extension workers and farmers to share and exchange knowledge and information and discuss problems in forage production, would help further adoption of improved forages.

Conclusions

Transfer of technology through on-farm research with the full cooperation of researchers, extension workers, and farmers will ensure the success of the project. Workers on forage species for recommendation to farmers have to consider the requirements and preference of the farmers. Continuous technical advice and some financial support will help farmers solve their on-farm problems and make their businesses successful. Without doubt, the objectives of the present on-farm trials have been achieved despite the farmers' preference for forage and not for seed. They all acknowledged the superiority of introduced forages. Through their good response to the innovations, the farmers acknowledged the support provided by the FSP.

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EXPERIENCES WITH ON-FARM RESEARCH AND EXTENSION OF FSP FORAGES IN THE PHILIPPINES

F. Gabunada, Jr. and E. Balbarino[1]

Introduction

On-farm work involving forages from the Southeast Asian Regional Forage Seeds Project (FSP) in the Philippines started just over a year ago. Expectedly, the adoption of these forages by smallholder farmers still leaves much to be desired.

This paper presents experiences with on-farm forage R & D activities of the Farm and Resource Management Institute (FARMI) at the Visayas State College of Agriculture (ViSCA). FARMI is mandated to (a) to strengthen ViSCA's capability in responding to and meeting the technological requirements of resource-limited smallholder farmers; and (b) to enhance linkages between research, technology transfer and to the farmer. Collaboration with FSP has provided FARMI a better chance to achieve these goals.

Description of the Area

The on-farm work on FSP forages was carried out in Matalom, Leyte. Two major fragile upland agroecosystems in the country are represented in this municipality. One is the acid-infertile-soil upland agroecosystem found in elevations less than 200 m above sea level (a.s.l.) with slopes ranging from 5 to 40%. Soil pH ranges from 4.5 to 5.5. Adjacent to this area is the calcareous-soil agroecosystem which represents the second most important fragile upland agroecosystem of the Philippines. It is found in areas of higher elevation (200 to 450 m a.s.l.), steeper slopes, and has alkaline soil with pH ranging from 8 to 10.

Both upland agroecosystems are inhabited and managed by resource-limited, smallholder farmers. Most of them cultivate one to three parcels of land. About two-thirds cultivate a total area of less than one hectare. Only 32% of farmers own all of the land they till. The rest are either share-tenants (38%) or those who both own and have tenanted land parcels. Annual rainfall is about 2000 mm occurring mostly during the typhoon months (June to November). Dry spells commonly occur within this period.

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Like other upland agroecosystems, the environment is classified as complex, diverse, and risk-prone. Farming is mainly for subsistence, with little surplus of the staple food crop and cash crops available for sale. A variety of upland crops (upland rice in the acid soils; corn in calcareous soil; sweet potato, coconut and peanuts in both) and some rainfed lowland rice in valleys are cultivated with minimal external inputs, employing mostly family and exchanged labor. Animals (carabao, cattle, goats, pigs and chickens) are raised for draft (mainly carabao), emergency cash expenses, exchange for farm labor, and food. Ruminants are tethered into native vegetation fallow areas with minimal supplementation. Swine and chickens are fed with mostly crop by-products; scavenging contributes to their nutrient requirements. Low feed quality and quantity are major problems.

In both agroecosystems, poor soil fertility and excessive soil erosion are threatening the food security of the farmer-inhabitants. As an adaptation mechanism, farmers practice the crop-fallow rotation system (Figure 1). This involves either rotation of whole parcels or portions within it for cropping (usually less than 3 years) and fallow to regenerate fertility. Primarily due to erosion and overgrazing, soil fertility has declined allowing only for shorter cropping and subsequently, longer fallow periods. Crop yields and livestock production have, in turn, been decreasing.

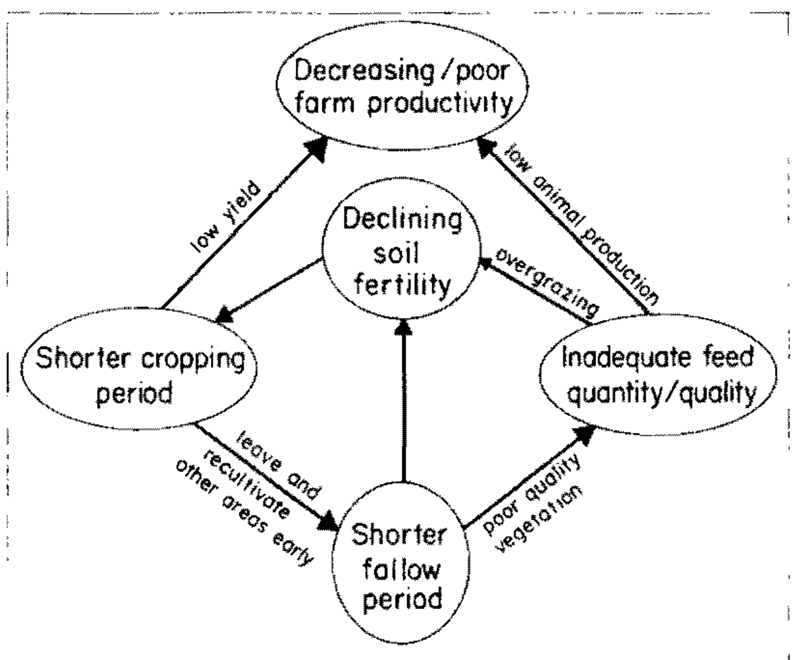

Figure 1. Problem cycle for resource-limited smallholder farmers in the uplands.

On-Farm Work Undertaken

The basic aims of the work with FSP forages were to improve and sustain farm productivity in the two upland agroecosystems. Major consideration was given to the livestock component.

Use of forages as contour hedgerows for erosion control

The problem of declining soil fertility due to erosion has been recognized by the farmers (Balbarino et al, 1992; Peque et al, 1986). An indigenous practice, locally known as "kahon-kahon" (leaving a narrow strip of natural vegetation unploughed), was practiced by some farmers in the area to control erosion. Through interaction with both adopters and non-adopters, the strength and weaknesses of the practice were understood (Baliña and Ly, 1991). Avenues for improving the practice and its attractiveness to farmers were then identified. Farmers interested in trying to improve the practice were taken to visit upland farms on Cebu island where contour hedgerows had been adopted. After returning, they were asked about their plans. The plan involved testing the use of Vetiver (*Vetiveria zizanioides*), Napier grass (*Pennisetum purpureum*), and *Leucaena leucocephala* as contour hedgerows. Farmers living close to each other agreed to form "alayon" (mutual-help groups commonly practiced for crop work) and started contouring their individual farms. Different methods were employed and different species were planted. The practice was promoted through a series of slide shows in nearby communities. A community school also agreed to set up a demonstration area for the practice. Other farmers interested in the practice attended a farmer-to-farmer training carried out by the original "alayon" farmers. The one-day training included a visit to researcher-established demonstration area, and farmer-owned contour farms, as well as farmer-supervised, hands-on session on contour hedgerow establishment. Distribution of planting materials followed when the new "alayon" members were ready and had prepared their fields for planting.

As the practice gained acceptance, farmers and researchers felt the need for further improvement. Vetiver was not palatable to grazing animals. Napier grass affected the main crop. Ways to strengthen the existing hedgerows were needed. The agreed approach was to find adaptable species that can be used either alone or in mixture. Researchers then brought the farmers to FSP evaluation and seed production sites. This activity provided them choices of species to try.

Two types of on-farm experiments were conducted. One was researcher-established (uniform design and planting method) but jointly managed with the farmers. This was conducted on nine acid-soil farms and one calcareous-soil farm. All the species were tested on each farm. The other type involved smaller, farmer- designed and managed experiments using some of the species. Farmers established forages either as sole hedgerow or as double hedgerow to existing grass strips and either as a single species or in mixtures. Thirty farmers were involved.

Through observation and interaction with farmers, adapted species were identified. Information on management and suitability of species for integration into the farming system was collected. For instance, it became clear that the farmers managed the hedgerow species in conjunction with the main crop. This observation highlighted the importance of establishing forages as close as possible to the planting season. Weed competition and unwanted grazing were major constraints to species survival, especially between cropping periods. Accidental weeding by hired farmhands also occurred with species which looked similar to common weeds at the seedling stage. One species which was identified as suitable to acid -soils by many farmers was *Stylosanthes guianensis* CIAT 184 (Stylo 184). The ability of Stylo 184 to serve as hedgerow during the cropping phase (when pruned), and to spread and provide a dense cover during the fallow period were also recognized as favorable traits by the researchers.

Improvement of fallow areas with Stylo 184

The idea of testing Stylo 184 for use as fallow improvement species came from farmers who saw the seed production area. Farmers were attracted by the lush growth and good cover of Stylo 184, and the change in color of the underlying soil into a darker shade which to them indicates improved soil fertility. Farmers also perceived that areas planted with Stylo 184 would be easier to cultivate than an area with densely rooted native vegetation (as in the traditional fallows).

The idea that certain types of vegetation can improve soil fertility is not new to the farmers. A native species in the area (*Mikania* sp.) is considered by some farmers as good for soil fertility regeneration. However, livestock do not eat this species, making it less useful.

Building on these ideas, a researcher-designed experiment was jointly established with interested farmers on four acid soil upland farms in February 1994. Aware of the farmers' circumstances, the researchers designed the activity with minimal material inputs. Farmer participation was encouraged to enable farmers to assess the practice. The experiment compared the effects of planting Stylo 184 on fallow land with the traditional method (native vegetation). Yields and performance of the upland rice crop planted after varying fallow durations (1, 2, and 3 years) as well as growth and performance of goats supplemented with the herbage will be the major basis of comparison. Farmers' comments and the economics of the practice will also be assessed.

Initial results showed that Stylo 184 can provide good ground cover in about 4 months. Weeding once at 2 months after emergence was sufficient to promote a good stand. Stylo 184 was then able to suppress weed growth. Four months after planting, dry matter yield of the herbage was 3.2 t/ha.

Other activities

Because of the increasing demand for seeds both by farmers who have tried or want to try forages, seed production by the farmers themselves was encouraged. One approach was to supply seed to farmers for growing small areas of the forage, and for learning how produce seed. Farmers are integrating these species into their farms and are using them either as hedgerow or as feed reserve for the dry season as well as to producing seed.

In the case of Stylo 184, the project recently started to assist farmers with semi-commercial seed production. The FSP project has agreed to buy seed of Stylo 184 from farmers, and to guarantee a minimum price to help alleviate risk on the part of the farmers.

Some Ideas on Improving Forage Technology Development for Resource-Limited Smallholders in the Uplands

Resource-limited smallholder upland farmers, as referred to in this paper, are practicing resource-poor agriculture. This form of farming occurs in areas which are mainly rainfed, often undulating with problem or fragile soils (Chambers et al, 1989). Some 1.4 billion people or one-fourth of the human race, 1 billion of which are in Asia, depend on this form of agriculture for livelihood (Wolf, 1986). It is typical in many uplands of Southeast Asia.

While working with these farmers in activities involving FSP forages, some important experiences were gained. These can be classified as those pertaining to some essential ingredients, and the actual practices/processes involved in working with them.

Essential ingredients

Considering the totality of the farmers' circumstances. This concern is based on our realization of the complexity and diversity of the environment in these areas. We appreciate the fact that the farming system is a whole unit that is more than the sum of its parts (Reijntjes et al, 1992). This implies the need to know the biophysical and socio-economic situation of the farmers, and to adopt an approach which is holistic, multidisciplinary, iterative, and participatory.

Changing the attitudes of research and development workers. We have recognized that there are limits to the extent that farmers' needs are met by conventional research. Farmers have to be considered as essential parts of the solution and not the problem. This realization called for: (a) starting with the knowledge, problems, analysis and priorities of farmers and farm families; (b) making the farm (not the research station) as the main locus of the action; (c) considering the farmers and farm family members as the main experimenters; and (d) giving farmers a share of the responsibility and a chance to extend their knowledge to other farmers. These imply that the major focus is to enhance their competence, and to assist them in identifying, testing, refining, and extending acceptable practices.

Transformation of the role of R & D workers. Chambers et al. (1989) described the role of R & D workers as convenors of farmers' groups, catalysts and facilitators of farmers' discussions and analysis, searchers for and suppliers of what farmers want and need, consultants for farmers' experiments, and tour operators who arrange for farmers visits for them to learn from each other.

The process and practices applied

The activities done on FSP forages in smallholder uplands of the Philippines involve the process described below:

1. Getting started

- Adequate understanding of the farmers' circumstances (biophysical and socio-economic environment). This objective requires (i) an approach which is holistic, multidisciplinary and farmer-participatory, (ii) experience with Participatory Rural Appraisal (PRA) which allows farmers to adequately describe their areas (maps, households, resources, history, social and institutional structures, farming system), and (iii) learning about the farmers' prioritization of problems and perceived solutions which leads to proper focusing of development efforts, as well as the role of agencies, and of the farmers.
- Understanding of a specific problem. This includes (i) a need to understand the factors affecting the problem and their interactions, (ii) experience with topical PRA's and other farmer-participatory methods, to gain insight into the evolution of the problem (how and when it started), the extent of its effect, who is affected, what are the factors involved, and their interaction, what has been done, what works and why, as well as what needs to be done by whom, how, and the resources needed.

2. Finding things to try

- Starting with farmers' ideas and technologies. Discussions with farmers and with specialists from different disciplines.
- Cross-farm visits and demonstrations to places where the problem had been successfully solved either by farmers or researchers (e.g. FSP plots).
- Follow-up of farmers.

3. Trying out and innovating

- Both researchers and interested farmers.
- Need to capture variability within the whole area.
- Farmers need a basket of choices rather than a standard package.

4. Sharing results

- Through farmer-to-farmer training and facilitating informal discussions with and between farmers.

5. Facilitating spread of a technology

- Never enough research and extension workers to develop and transfer messages to service all farmers.
- Allow farmers to take some responsibility for extension work through partnerships.
- Tapping of other agencies, the public school system, non-government organizations (NGO's), people's organizations (PO's) and indigenous communication systems.

Whether these steps are effective can be determined from the sustained and profitable use of the FSP forages even after the project. Most of the activities have just started and more efforts are still needed for going through the whole process, and learning from it. Promising is the fact that farmers have become aware of the FSP species and have started testing ways of integrating these species on their farms.

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LINKAGES FOR BETTER USE OF RESOURCES, INCREASED EFFICIENCY AND MAXIMUM IMPACT OF FSP FORAGES

W. W. Stür[1]

Linkages are essential in the modern world, and are particularly important in agricultural research and development. Linkages between individuals and organizations lead to cooperation and collaboration.

Cooperation among farmers, researchers, and development and extension workers is needed for many different purposes. Cooperation leads to identification of problems. Once problems have been identified, the opportunity is opened for collaboration in finding solutions to those problems.

Types of Linkages

There are essentially four different types of linkages between professionals and organizations as follows:

- Information exchange among R & D workers
- Collaboration among researchers
- Linking our work with development-oriented projects
- Establishment of research, extension, and development consortium, on specific topics and areas.

In addition, there are linkages to farmers, farmer groups, extension workers, etc., and these are an essential part of the work of R & D workers in agriculture. This paper will concentrate on linkages between workers and organizations involved in agricultural R & D.

Information exchange among R & D workers

Information exchange is one aspect of cooperation, and is an essential part of R & D. It is only through information exchange that people learn who is doing what, and how far people have advanced to solve a particular problem. This knowledge helps to avoid

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duplication of work and stimulates discussion. Information exchange can be encouraged through newsletters, journals, meetings, and workshops, and also by informal contact between individuals.

Newsletters. In Southeast Asia, several attempts have been made to produce a regional forage newsletter. In 1987 the Australian Center for International Agricultural Research (ACIAR) funded the publication of the "Forage Research Newsletter". This was initially published by ACIAR Project 8527 as "The South East Asia/Pacific Forage Research and Development Program" edited by T.R. Evans, Commonwealth Scientific and Industrial Research Organization of Australia (CSIRO). After completion of ACIAR Project 8527 in 1989, the newsletter was published by the Forages Program of ACIAR. It was then called the "ACIAR Forage Newsletter". The first two issues were edited by G.J. Blair, ACIAR, before A.R. Till was employed specifically to edit the newsletter in its present form. In a reorganization of ACIAR's programs, the Forage Program lost its coordinator and the newsletter ceased publication in 1992.

For a newsletter to be effective and sustainable, the R & D workers in the region should have a sense of ownership, and they need to take responsibility for its publication. Problems encountered with regional newsletters to date are that (i) and they depend on outside funding for publication, and (ii) it is difficult to obtain articles and other contributions from R & D workers in the region to keep the newsletter interesting and informative. These are common problems of newsletter editors everywhere.

Effective information exchange between countries depends to some extent on the existence of national Forage R & D networks within countries. National networks can publish their own newsletters in the local language, and with material relevant to the country. These newsletters may have a wide scope, covering a range of aspects of agricultural and livestock interest. A regional newsletter can then use articles from the national networks that are of interest to other countries in the region.

Meetings and workshops. These activities serve a role similar to that of newsletters and journals but have the added advantage of getting people together and fostering information exchange and interaction among participants. Apart from information exchange, meetings and workshops can help to bring people with similar objectives together, to start work collaboratively on problems of mutual interest.

National meetings and workshops are often held within organizations (planning and review meetings) with little outside interaction, but some are held as part of a national network or society, and therefore cut across organizations. An example is the Malaysian Society of Animal Production which has held annual meetings for many years.

Regionally, FAO has sponsored three regional workshops in recent years to encourage interaction among forage scientists in Southeast Asia. Additionally, workshops and conferences have been held on specific topics. In 1992 and 1993, the FSP held regional meetings for forage workers involved in the project. The current meeting is the third and final meeting of this project. These meetings have carried on the important roles of reviewing as well as planning directions and activities of the project.

Collaboration among researchers

Scientists sometimes work collaboratively on problems of common interest. If there are many researchers involved, this characteristic can lead to a research consortium. This type of linkage has several advantages. It concentrates effort, integrates and uses complementary skills (multi-disciplinary). It leads to better use of available resources since overlapping and duplication are avoided. Researchers interact frequently, exchanging ideas and experiences, thus learning from each other.

Research consortia are being encouraged by international research organizations such as CIAT and IRRI. They are highly effective in solving scientific problems and transferring knowledge to research partners. Another organization that is actively sponsoring this type of collaboration is ACIAR.

Linkages with development-oriented projects

Working with development projects provides another type of linkage which can enhance the effectiveness of forage R & D. Development projects can be national livestock promotion programs such as cattle dispersal programs (e.g. Land Bank of the Philippines), or internationally (IFAD, ADB) and bi-laterally funded livestock projects.

Cooperation with development-oriented projects or programs brings about a flow-on of technologies developed by projects such as the FSP (multiplier effect). In the case of the FSP, this effect has led to a wider and more rapid distribution of adapted forages. Cooperation can lead to active collaboration from the feedback from development-project farmers on the performance of forages and on the needs of the farmers. The aims and direction of R & D activities can then be appropriately redefined.

The FSP project depends on cooperation and collaboration with national and international development-oriented projects to achieve wider distribution and promotion of adapted forages.

Research, extension, and development consortium

It is concluded that the three types of linkages described so far, form an essential part of effective R & D projects such as the FSP, particularly if these linkages are based on collaborative partnerships. One further step in linkage is the formation of a research, extension and development consortium on a topic of particular interest to all parties involved. Such a consortium can be based in a specific location but technologies developed and verified in this location can be transferred readily to other regions and countries. In such a consortium, collaboration advantageously occurs not only at the research level, but also combines research, extension and development levels in one project. This feature will ensure clearly defined objectives, feedback from a wide range of farmers, extensive testing of new species at farm level, development of realistic delivery systems (seed production schemes or multiplication of vegetative propagation material), and significantly reduce the time needed to make adapted forages available to smallholder farmers.

One example of a developing consortium is the "Forages and Cattle Under Coconuts" project in the Bicol region in the Philippines. This region has large areas of extensive coconut plantations, and livestock graze naturally occurring vegetation under these plantations. Several organizations had been working independently to promote cattle production under coconuts. The FSP project worked with two of these organizations to develop adapted forages for this system. It recently brought together people from all organizations working in Bicol to discuss activities and future collaboration.

At the meeting, it was decided that the organizations would join forces to develop sustainable forage systems for cattle production under coconuts. The research, extension and development work of the different organizations are now coordinated and several collaborative ventures have been started.

Researchers of the Bicol University College of Agriculture and Forestry (BUCAF) are screening new forage accessions to find better adapted species; the Bureau of Animal Industry is studying animal production using the now available forage species, and conducting on-farm evaluation of new forages; the provincial Department of Agriculture, in conjunction with the AIDAB-funded Pilot Provincial Agricultural Extension Project (PPAEP), is establishing demonstration and multiplication areas on farms in the region.

Conclusion

Linkages are an essential part of projects such as the FSP. Linkages with farmers, which are a natural and essential part of the work of any R & D worker, and linkages between professionals and organizations include information exchange among research, extension and development workers, cooperation and collaboration with development oriented projects, collaboration with other researchers, and the formation of research, extension and development consortia.

Section 5: Review of Forage R&D in Southeast Asia

THE CURRENT STATUS AND FUTURE NEEDS OF FORAGE R&D IN TROPICAL CHINA

Liu Guodao, He Huaxian and Zhang Yixing[1]

The Livestock Industry

Southern China accounts for 10% of the total land area of China (96 million km^2) and 11% of the total population of 1103 million people (Table 1). Tables 1, 2 and 3 show the natural resources and livestock industry in regions of southern China.

Table 1. Natural resources of Southern China.

	Hainan	Guang-dong	Guangxi	Fujian	Yunnan	Southern China	China (total)
Land area (million km^2)	0.03	0.22	0.23	0.12	0.38	0.99	9.60
Human population (million)	6.4	60.3	41.5	28.9	36.4	173.5	1103.6
Agricultural population (%)	79	76	86	83	88	82	79
Agricultural families (million)	1.3	9.9	7.1	5.2	6.5	29.9	193.0
Cultivated land (million ha)	0.4	2.5	2.6	1.2	2.8	9.6	95.7
Cultivated land per capita (ha/person)	0.07	0.04	0.06	0.43	0.77	0.06	0.09
Grassland area (million ha)	0.6	3.3	8.7	0.5	18.9	32.0	408.5
Grassland areas per farm (ha/farm)	0.13	0.07	0.24	0.02	0.59	0.24	0.47

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Feeding Systems

Ruminants (cattle, buffaloes, goats) are raised on state farms and by smallholder farmers; state farms account for only 2-3% of the total livestock population. State farms raise 200-3000 animals on 200-2000 ha of land per farm. The animals are grazed on natural grassland, or occasionally feed on improved pastures (< 1%). Smallholder families raise 2-10 cattle or 1-5 buffalo or 1-3 dairy cows, or 5-20 goats; animals graze along the side of cultivated land.

Like ruminants, pigs are raised either on state farms or on projects of agricultural families. In general, state farms have 1000-10,000 pigs. The animals are fed with compound feed produced by factories. Local agricultural families keep 1-10 animals; they use mixed feed produced on their farm, sometimes supplemented by feed purchased at the local market. The pork is sold on the local market and consumed locally.

Poultry is raised on state farms, on projects of families engaged in specialized poultry feeding and local families. The poultry population is 50,000-1,000,000 on state farms, 1000-50,000 on specialized poultry feeding families, and 5-20 on the local family farms. The state farms and the specialized poultry feeding projects use compound feed produced by factories. These sell their produce in different markets in the country. The local family raisers use feed produced on the farm. They either consume the products themselves, or partly sell these on the local market.

Table 2. Animal population of southern China (million animals).

	Hainan	Guang-dong	Guangxi	Fujian	Yunnan	Southern China	China (total)	Ratio SC/TC[1] (%)
Cattle	3.4	2.5	2.0	3.6	5.0	16.4	82.5	20
Dairying	-	0.02	-	0.02	0.07	0.12	3.14	4
Buffalo	0.8	2.7	4.0	0.5	2.8	10.8	22.2	49
Pig	2.9	21.2	19.0	10.0	21.1	74.3	384.2	19
Goat	0.1	0.1	0.9	0.6	5.1	7.3	97.6	8
Sheep	-	-	-	-	1.2	1.2	109.7	1
Poultry	32	513	151	101	33	830	3193	26

[1] SC/TC = Southern China/Total China.

Table 3. Animal production of southern China ('000 tons).

	Hainan	Guang-dong	Guangxi	Fujian	Yunnan	Southern China	China (total)	Ratio SC/TC[1] (%)
Pork	141	1660	1100	740	820	3640	26,350	14
Beef	13	61	48	10	33	165	1800	9
Mutton	3	4	4	6	17	34	1250	3
Poultry	45	730	210	120	50	1160	4540	25
Egg	14	240	88	170	48	560	10,200	5
Milk	1	58	9	57	92	220	5640	4

[1] SC/TC = Southern China/Total China

Forage R & D in Tropical China

The main tropical part of southern China includes Hainan island and the southern part of Guangdong, Guangxi and Yunnan Provinces. The mean annual temperature range is 20-26°C in these regions. Annual precipitation is in excess of 1500 mm, and soils are generally acid with a range of pH 4.5-5.5.

Subtropical areas are the province of Fujian and the northern parts of Guangdong, Guangxi, and Yunnan provinces. The mean annual temperature range is 18-20°C with an annual precipitation of 1000-2000 mm.

In Tropical China, forage research is carried out by the Chinese Academy of Tropical Agricultural Science (CATAS), Agricultural University of South China, Guangxi Agricultural University, Fujian Agriculture University, Guangdong Academy of Agriculture Science, and the Animal Husbandry Institute of Guangxi. About 100 researchers (total) including 10 senior research fellows and 40 research associates are working in these institutions.

Since 1950 more than 3000 forage accessions have been introduced to tropical China. After preliminary evaluation and regional trials conducted in different ecosystems, many excellent varieties have been selected and released to farmers. These include *Leucaena leucocephala* cv. Reyan I, *Stylosanthes gracilis*, *Pueraria phaseoloides*, *Brachiaria decumbens* cv. Reyan III (CIAT 606), *B. brizantha*, *Digitaria eriantha*, *Panicum maximum*, *Tripsacum laxum* (CATAS), *Macroptilium atropurpureum* cv. Siratro, *Paspalum wettsteinii* cv. Gui Yin No. 1, *Paspalum urvillei* cv. Gui Yin No 2, *Pennisetum purpureum* cv. Huanan (Guangxi), *Melinis minutiflora*, *Stylosanthes guianensis* cv. Graham, and *S. hamata* cv. Verano (Guangdong).

Since 1982, collaboration between CIAT and CATAS has brought about the introduction of many promising accessions to Hainan. Some excellent varieties have been selected from these introductions. These include *Stylosanthes guianensis* cv. Reyan II (CIAT 184), *S. guianensis* CIAT 136, *Arachis pintoi* CIAT 17434, *Brachiaria decumbens* cv. Reyan III (CIAT 606), *Andropogon gayanus* CIAT 621 and King grass. *Stylosanthes guianensis* CIAT 184 has become the most important forage legume in tropical and subtropical China with a total area of 35,000 ha. It is anticipated that *S. guianensis* CIAT 136 will also be grown widely in the future in tropical China.

Varieties which have had significant economic benefit on animal production in tropical China are *Stylosanthes guianensis* Reyan II, *S. guianensis* CIAT 136, *S. guianensis* cv. Graham, *S. hamata* cv. Verano, *Brachiaria decumbens* cv. Reyan III, *Panicum maximum* and King grass.

Tropical Forage Seed Production

Hainan province is the main area for tropical forage seed production in southern China. There, the climatic conditions are suitable for seed production, and seed yields are high (Table 4). In the past 11 years 265 t of forage seed had been produced (Table 5).

Table 4. Mean seed yield of major tropical forage species in China (1982-1992).

	Seed yield		
	low range	high range	mean
	(kg/ha)	(kg/ha)	(kg/ha)
Stylosanthes guianensis cv. Cook	25	230	120
S. guianensis cv. Graham	40	470	250
S. guianensis cv. Reyan II (CIAT 184)	75	520	290
S. guianensis cv. CIAT 136	80	440	210
S. hamata cv. Verano	240	1020	390
S. scabra cv. Seca	110	520	280
Macroptilium atropurpureum cv. Siratro	100	340	240
Paspalum plicatulum	70	860	370
Melinis minutiflora	110	450	250
Setaria sphacelata cv. Kazungula	60	350	170
Brachiaria decumbens cv. Reyan III (CIAT 606)	30	130	80

Table 5. Tropical forage seed production in Hainan (1982-1992).

	Area	Seed production
	(ha)	(ha)
1982	16	2.3
1983	38	6.2
1984	78	21.6
1985	81	18.1
1986	89	19.5
1987	96	19.6
1988	109	23.2
1989	121	34.4
1990	136	57.0
1991	169	37.4
1992	87	26.3

The Use of Tropical Pastures

In Hainan, the main tropical region of southern China, there are 640,000 ha of natural grassland. Cattle and goats graze in these grasslands with minimum management inputs. The productivity of this animal production system is very low. There are about 5000 ha of improved grassland on Hainan Island, yielding 4.5-15 t/ha of DM; this is three to six times higher than the productivity of natural grasslands. The carrying capacity of improved grasslands is double that of natural grasslands. The development of establishment techniques, management of improved grasslands, and selecting suitable grass legume associations, are currently being conducted. Tree legumes are used as living green fence; these replace wire fences in pastures thereby reducing the cost of fencing 10-16 times.

In view of the high population density but limited cultivated land in southern China, tropical forages have to be integrated with other crops. A successful system is the intercropping of forage legumes (*S. guianensis* cv. Reyan II, *S. guianensis* CIAT 136 and *S. guianensis* cv. Graham) with perennial crops such as young rubber trees, coconuts, cashews, and fruit trees.

Forage legumes are also used as leaf meal to supply protein. The main legumes used for meal production are varieties of the genus *Stylosanthes*. These contain 12-16% crude protein, minerals, and vitamins, and are used in feed rations for livestock, poultry, and fish. Our experiments have shown that the use of 10-15% leaf meal of the total diet fed to pigs, and 5% fed to chicken maximizes productivity.

Future Forage R & D Needs in Tropical China

The following programs indicate the current priority research areas in forage research:

National network. To set up a national network to control forage germplasm collection, introduction, evaluation, and cultivar release. The first step is to collect native forage germplasm in tropical and subtropical China, to introduce exotic germplasm from South America, Australia and Southeast Asia, and to set up a national germplasm bank in CATAS's Tropical Pasture Research Center. The second step is to conduct performance and adaptation experiments to evaluate these varieties in the different ecological zones and production systems. The third step is to set up multiplication fields to produce seed of the promising accessions, and to release these to the farmers.

Pasture improvement. There are only 5000 ha of improved grassland on Hainan Island which is 0.8% of the total area of natural grassland in the region. Research will be focused on how to improve these natural grasslands.

Integration of forages with perennial crops. To evaluate tropical legumes for their suitability for intercropping, to screen for shade and acid soil tolerance, and to study the compatibility of forages and perennial crops.

Crop and industrial by-products. Research on the treatment and utilization of by-products of industrial and agricultural crops.

Seed production center. Set up a seed production center on Hainan Island to produce commercial volume of high-quality seed of each recommended forage and pasture crop.

Other research topics. Research on seed production of tropical grasses, drying techniques of forage legume for leaf meal production, multi-purpose use of tropical forage crops, and the ecological and economic benefits of the integration of forages with perennial crops.

CURRENT STATUS AND FUTURE NEEDS OF FORAGE R & D IN LAO PDR

V. Phengvichith[1]

Introduction

The Lao People's Democratic Republic (PDR) is a land-locked country with a total land area of 236,000 km^2. Most of the land is on high terrain and mountainous (about 88%); only a small portion along the Mekong River is a lowland plain. The average annual rainfall ranges from 1500 to 2000 mm. This is sufficient for crop growth during the wet season, but the distinct 6 months dry season prevents intensive cropping (more than 1 crop/year) except for small irrigated areas along the Mekong River in the central and southern part of Lao PDR.

The population is about 4.2 million with an annual growth rate of 2.5%. About 85% of the population is rural, and practices agriculture in various forms of production. Lao PDR can be divided into three main agro-ecosystems based on land form, natural resources, and traditional agricultural practices. These are the lowlands, the plateau area, and the uplands or mountainous area. In the lowlands, farming systems are based on rice production, largely at a subsistence level. Livestock production is a secondary but complementary component of the system. Results of socio-economic surveys conducted across the country by the Department of Livestock and Veterinary Services (DLVS) in 1993 showed that the lowlands are predominantly inhabited by Lao Lum who practice paddy rice cultivation as their main occupation. Farmers own an average 1.9 ha of paddy field per household with an average production of 2.2 t of rice.

In the plateau area, farmers cultivate paddy areas in small valleys with an average of 1.8 ha paddy fields per household. Farmers also practice slash-and-burn shifting cultivation for upland rice, maize, and root crops. They keep cattle, buffalo, pigs, and poultry as a means of saving which can be converted to cash when needed. The upland or mountainous areas are predominantly inhabited by Mong people who practice slash-and-burn shifting cultivation. Mong farmers cultivate about 0.9 ha per household and produce an average yield of 1 t of upland rice. This figure indicates that most farmers produce rice insufficient for their own consumption. Livestock is kept in this area; it is sold when cash is needed to buy rice or to meet other needs of the family.

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Livestock Production

Livestock production in Lao PDR forms part of an integrated crop/livestock production system with livestock providing traction, transport, field fertilizer, and capital accumulation. Livestock frequently generates more than 50% of total household cash income, contributing 22% to the Gross Domestic Product and 15% to export earnings. In 1993, there were approximately 1.0 million cattle, 1.1 million buffaloes, 0.13 million goats, 1.6 million pigs, and 10 million poultry. The livestock industry is primarily smallholder-based.

Ruminants are distributed throughout the country but with varying densities. At present, ruminants are concentrated in the lowland (central and southern part) with stocking rates of less than 2-3 ha of native pasture per animal. These areas are overstocked particularly during the dry season, due to low carrying capacity of the existing native pasture. This situation suggests that there is a need to improve animal nutrition by forage development and better utilization of locally available agricultural by-products. Ruminant density is lower in the plateau and mountainous areas with only 46% of the total population, despite much larger areas of existing native pasture (approximately 6 million ha).

Livestock production is constrained by poor husbandry, poor feed quality, and diseases. Buffalo and cattle are kept in a free range system. In the dry season after harvesting, farmers let their buffaloes and cattle graze freely and look after themselves in the natural grazing land for approximately 6 months (November to April). In some areas, particularly the plateau area, animals are brought back to pens near the farmer's house every night for manure collection. Cattle usually graze for about 10 hours a day.

The major sources of feed for ruminants are natural grasses, agricultural by-products such as rice straw, tree leaves, and bamboo leaves in the forest. Feeding systems vary between the three agro-ecological zones.

In the lowland areas, ruminants are generally managed as follows. During the dry and early wet season animals graze mostly on paddy fields where they eat rice stubble and naturally occurring grass. In the wet season, when rice is being grown, the animals are restricted to native pastures and, to a lesser extent than during the dry season, to forest areas. Supplementary feeding of rice straw is practiced during the wet season for working animals. In some villages, grass is cut and carried to livestock from paddy bunds, irrigated banks, and vegetable gardens. The period of maximum liveweight gain is after the rice harvest when animals are put into the paddy fields. The pattern of high liveweight gain in the wet season followed by weight loss in the dry season is normal for wet or dry monsoon climates. Forage development such as backyard forage and fodder trees could significantly contribute to increasing the forage supply during periods of feed shortage.

The plateau and mountainous areas have a high potential for ruminant grazing with both feed and water resources available. Both the human and animal population density is low compared with lowland areas. Farmers mainly practice shifting cultivation, creating long-term environmental problems such as destruction of forests, soil nutrient run-off, and erosion in watershed areas. This affects not only the sustainability of the upland areas but also threatens the livelihood of people along the Mekong river.

Past and Present Forage R&D

Between 1982 and 1991 tropical forage and pasture research were carried out at the Livestock Service Center at Nam Suang Station by the Lao-Australian Livestock Development Project (LALP). This project carried out pasture demonstration at Nam Suang Station as well pasture grass and legume seed production both on the station and in target villages. Unfortunately, the demand for pasture seed was limited since the concept of planting pasture for animal feed was completely new to farmers. The village seed production program was a contract scheme whereby the project provided inputs of seed and fertilizer, and farmers provided inputs of land and labor. The project purchased the seed produced by farmers. The main species grown for seed were *Stylosanthes* species.

One pasture improvement program was the oversowing of *Stylosanthes* spp. into native grasslands. Seed was oversown without soil disturbance at sowing rate of up to 10 kg/ha. Early heavy grazing and high stocking rates in the first year (due to limited availability of grazing areas during the planting season) resulted in heavy grazing of plants. The surviving plants seldom had a chance to develop or produce seed because of heavy grazing, and the oversown legume (i.e. *Stylosanthes hamata* cv. Verano) generally disappeared within two years of sowing. In a few areas where grazing was controlled, the results were more encouraging.

Another forage improvement program was the planting of *Panicum maximum* cv. Hamil in backyards for cut and carry feed. This program was more successful.

Past forage research and development was focused largely on the lowland areas. Several tropical grasses and legumes were identified as being adapted to this environment. These are *Brachiaria decumbens* (cv. Basilisk), *Brachiaria humidicola* cv. Tully, *Brachiaria ruziziensis*, *Panicum maximum*, *Stylosanthes* spp., and *Leucaena leucocephala*.

At present, several tropical grass and legume species are being tested in the northern provinces of Luang Prabang, Xieng Khouang, Luang Namtha, and others.

Future Forage R&D Needs

Medium-term forage research and development need adaptive on-farm research with emphasis on the integration of grasses, legumes, and fodder trees into different farming systems, and land conservation for sustainable livestock production.

1. Introduction and selection of grasses, legumes and fodder trees for different ecological zones and farming systems
   - lowland area (cut and carry, fodder trees as protein banks, and improvement of both native grazing areas and improved pasture for commercial ranching);
   - plateau area (introduce and select acid and cool tolerant grasses and legumes, fodder trees to improve forage quantity and quality, soil fertility and prevent soil erosion);
   - upland or mountainous areas (fodder trees, forages for smallholders and improvement of fallow land following cropping).
2. Seed multiplication of adapted grasses and legumes for smallholders.
3. Evaluation of selected forage species on government station and on-farm with farmers' participation.
4. Development of forage research and the research capabilities of the staff is important and necessary. The livestock sector is currently constrained by both the number of staff and their skills at the central, provincial, and district level.
5. Better utilization of agriculture by-products such as urea-treated rice straw, and the production of molasses, urea, and mineral blocks.

Prioritization of forage research and development needs

Government policies are directed toward minimizing shifting cultivation farming systems in the plateau and mountainous areas which are no longer sustainable and which create long-term environmental problems. Livestock production may play an important role in confining or reducing shifting cultivation through the introduction of sustainable livestock production systems. However, there are constraints; primary among these are the high incidence of disease and the inadequate feed and protein supply. Forage research and development will lead to improved forage and animal productivity. A strong livestock sector will increase employment opportunities and income levels of smallholders, and so gradually improve their standard of living.

Conclusions

It must be recognized that livestock production in Lao PDR is currently associated primarily with rice production at subsistence level. Farmers raise cattle and buffaloes in free-range systems with low inputs and low productivity. Past research efforts identified several grasses and legumes which are suitable for the rice-growing lowland region. These forage species need to be multiplied and distributed to farmers.

The future selection and introduction of pasture species must concentrate on the plateau and upland or mountainous agro-ecosystems. There is a need to identify adapted forages, and to develop simple technology and extension packages that will be adopted by smallholder farmers.

The development of the research capability of staff at all government levels is required.

CURRENT STATUS AND FUTURE NEEDS OF FORAGE R & D IN VIETNAM

Nguyen Ngoc Ha[1]

Introduction

Vietnam is located along the eastern part of the Indochinese peninsula. The country extends from 8° - 23° N. The land area is 331,000 km^2 with a coast line 3000 km long. The population of Vietnam is over 74 million people. Agricultural land is 6.9 million ha; 47 million people are in the agricultural sector, comprising 9.4 million households. On a per capita basis, agricultural land is only 0.7 ha per household or 0.15 ha per agricultural person.

Agriculture is based mostly on paddy production. Other important crops are maize, sugar cane, potato, sweet potato, cassava, groundnut, and soybean. Perennial crops are rubber, coffee, tea, coconut, and pepper. The land for annual crops is 5.5 million ha of which 4.3 million ha is for paddy rice, and 1.3 million ha for subsidiary crops and short term industrial crops. Improved and cultivated pasture area is only 341,000 ha. However, there are about 2 million ha of waste land which can be used for ruminant grazing (Table 1).

Table 1. Land use in Vietnam in 1992 (million ha).

Arable land	Perennial crops	Perennial pasture	Forest land	Waste land	Other land	Total area
5.5	0.9	0.3	10.0	13.0	3.4	33.1

Vietnam is essentially a tropical country with a humid monsoonal climate. The country can be divided into seven agricultural regions. These are:

1. Northern Mountain and Midlands
2. Red River Delta (Hanoi)
3. Northern Central Coast (Hue)
4. Southern Central Coast

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5. Central Highlands
6. South East (Ho Chi Minh City)
7. Mekong River Delta

The rainy season extends from April to October in northern and southern Vietnam, while a severe dry season lasts from December to March. Annual rainfall in Hanoi and Ho Chi Minh City is approximately 1700 and 1900 mm respectively. In the central part of Vietnam, annual rainfall is higher (>2000 mm at Hue) but is more concentrated with a very wet period in October and November. Rainfall during the remaining months is about 100 mm/month.

Ruminants include buffalo, cattle, and other small ruminants like deer, sheep, and goats. The numbers of buffalo and cattle in 1992 in the different regions are shown in Table 2. About 10,000 deer are concentrated mainly in Nghe An and Ha Tinh provinces (northern central region); about 3000 sheep are restricted almost entirely to Ninh Thuan province (southern central coast); about 312,300 goats are spread throughout the country.

Buffalo and cattle are the main ruminants in Vietnam. They play an important role in agriculture. Their function is to provide draught power, organic manure for agriculture, and meat and milk for human consumption.

Table 2. Buffalo and cattle population ('000 ha) and density (head/km^2) in regions of Vietnam.

	Buffalo		Cattle	
	Population	Density	Population	Density
North Mountain and Midland	1455	14	556	5
Red River Delta	265	21	254	20
North Central Coast	604	12	701	14
South Central Coast	163	4	896	20
Central Highland	61	1	406	7
Northeast South	137	6	201	9
Mekong Delta	203	5	169	4
Total (Vietnam)	2887	9	3202	10

Feeding System

There are two types of management systems for large ruminants in Vietnam. These are the state farms and the private sector. While most of the breeding herds are kept on state farms, 98% of buffalo herds, and 95% of cattle herds belong to the private sector. Ownership patterns vary from 2-3 heads per smallholder in paddy area, to 10-30 head in upland areas. Large herds with hundreds of head are rare.

Ruminants in Vietnam mostly graze on natural pasture combined with a cut-and-carry feeding system. There are sufficient areas available for grazing in the rainy season, but in the dry season grazing becomes more difficult, and cut and carry feeding becomes more important. Usually, animal production is integrated with crop production in Vietnam. We utilize a system called VAC (Garden-Pond-Animal integrated system), which has become popular with farmers in our country.

Existing Forage Resources

There are no extensive natural grasslands in Vietnam. The main diet of ruminants is natural grasses. In the rainy season, ruminants graze along river and canal banks, roadsides, on hills or waste land. In the highlands natural grasses and legumes are plentiful. Instead of grasses, crop residues and agro-industrial by-products are generally used together with sweet potato, cassava leaves and roots, and leguminous fodder during the dry season. Hay and silage are also used for large ruminants on big breeding farms during the dry season. Cultivated grasses and legumes are concentrated on state farms and on households with grazing dairy cattle.

Forage Research and Development

In 1960, an in-depth study and investigation on natural pasture was carried out by the Hanoi University and the National Institute of Animal Husbandry (NIAH). In 1970-1990, the National Institute of Animal Husbandry, together with some stations in the country, studied and evaluated varieties of grasses and legumes. Some of the main grass varieties, their utilization, and productivity are listed in Table 3.

Grass pastures were established and used on some state farms; but it seems that grazing pasture does not fit in with socio-economic condition of Vietnam. Since 1989 studies on *Leucaena leucocephala* and some other leguminous trees have been carried out by NIAH for use as supplementary source of feed for ruminants and poultry. *Pennisetum purpureum* (Napier or Elephant grass) and *Panicum maximum* cv. Hamil (Hamil guinea) have also been grown by smallholders especially for dairy cattle.

Table 3. Grasses and legumes utilized in Vietnam, and their green yield potential.

Species	Utilization	Yield (fresh weight)
		(t/ha)
Pennisetum purpureum	Cut and carry silage	100-200
Panicum maximum	Adapted to sandy soil	80-90
Digitaria phiauta	Used for hay making	60-90
Brachiaria mutica	Adapted to wet areas	50-60
Stylosanthes hamata	Adapted to poor soils	30-40
Leucaena leucocephala	Protein supplement	50-60

Prioritization of Forage Research and Development Needs

In recent years, the number of large ruminants has increased by 3.4% per year, with cattle increasing at a higher rate than buffaloes (Figure 1).

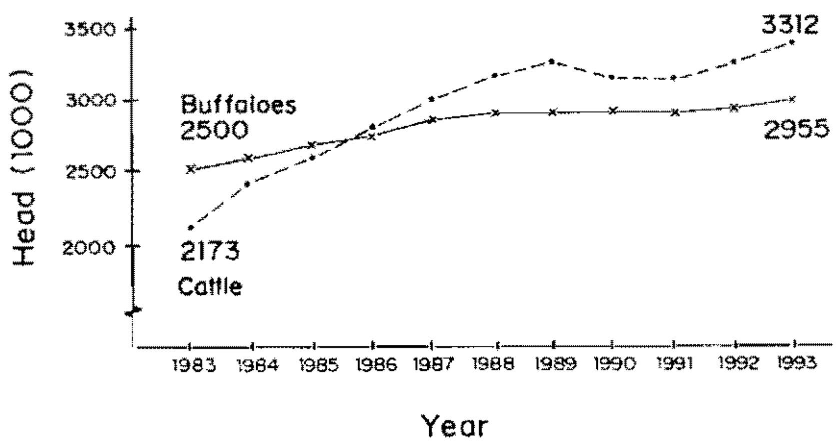

Figure1. Cattle and buffalo population in Vietnam, 1983-1993.

Increases in dairy cow population around Hanoi and Ho Chi Minh City have been particularly significant. One project was planned and implemented for the improvement of cattle in general and of dairy cattle in particular to the year 2000. It is planned that dairy cows will increase in number around Hanoi, Ho Chi Minh City, and Lam Dong province (Central Highlands).

Cattle improvement would be concentrated on the Southern Central Coast and Central Highlands where the largest populations of ruminants are and where there are already some big breeding farms like Duc My (Khanh Hoa province), Long My (Binh Dinh province), and Hatam (Dac Lac province) that can be utilized as nuclear herds for the regions. In 1989-1992, these stations have been involved in a United Nations Development Program (UNDP) project on Beef Development and Research. The climate and land in the Central Highlands are very good for perennial crops as well as developing pastures for ruminants. There are 1.5 million ha of basaltic soil and the human population is sparse.

Generally, natural grass is available, but is insufficient for ruminants even during the rainy season. Rice straw and other crop residues are very important feed resources for animals in the dry season but their quality is poor, and they need to be supplemented with leaves of leguminous trees. In South Vietnam, *Leucaena, Erythrina*, and *Sesbania* are popular. Hay is also an important feed in the dry and winter seasons. Ruzi grass (*Brachiaria ruziziensis*) seems to be good for making hay and green fodder in southern Vietnam. Some other grasses such as Elephant grass, and Hamil guinea grass are also utilized by smallholders for dairy cows.

Highlights of Future Forage R & D Activities

1. Development of seed production of legumes and grasses such as *Leucaena leucocephala, Stylosanthes hamata*, and *Brachiaria ruziziensis*;
2. Establishing forage demonstration and seed production units in the northern, central and southern part of the country and carry out on-farm adaptive research;
3. Training staff and farmers in fodder production, utilization and seed production.

Research stations designated for forage research are Bavi Cattle and Forage Research Center which is representative at northern Vietnam, Duc My farm in central Vietnam, and An Phuoc Farm in Southern Vietnam.

Financial support, documentation, new varieties and seed of fodder shrub trees (*Leucaena, Erythrina*, and *Sesbania*) are needed.

CURRENT STATUS AND FUTURE NEEDS OF FORAGE R & D IN INDONESIA

Soedarmadi, H.[1]

Introduction

In Indonesia, the supply and consumption of animal products, especially meat and milk are increasing. Ruminant livestock is important in fulfilling the requirement for meat and milk. Most of the ruminant livestock in Indonesia is raised by smallholder farmers rather than large commercial operations. Although most of the farmers in Indonesia are concerned primarily with food crop production, livestock plays an important economic and social role. Development of the ruminant livestock industry must go hand in hand with research and development of forage resources. The main objective of forage research and development is to increase forage quantity and quality.

The majority of land in Indonesia can be classified as upland or dry land areas with predominantly podzolic soils (mainly red yellow podzolic), of low soil fertility, and poor physical structure. This soil type occurs widely in Sumatra, Kalimantan, Sulawesi, and Irian Jaya. Upland areas are being utilized for growing food crops, plantation crops and forests, with the remaining land being fallow land, denuded land, and grassland. Only about 3.5% of the upland area is categorized as grassland. The largest grassland areas are found in Nusa Tenggara. Java has only small areas of grassland, but it has the highest human and livestock population density in Indonesia. Consequently, crop residues and agricultural by-products are important feed resources for livestock.

Feeding Systems

There are three feeding systems commonly practiced by farmers. The system used depends on how the farmers raise their livestock.

Cut-and-carry or stall feeding system

Farmers who keep livestock in stalls follow this feeding system. They cut herbage from areas such as fallow land, road sides, river banks, plantations, and forest areas. This feeding system is commonly carried out in areas like Java where farmers practice intensive food cropping.

[1]Faculty of Animal Husbandry, Institute Pertanian Bogor (IPB), Jl. Raya Pajajaran, Bogor 16151, Indonesia.

Grazing system

Farmers who raise ruminants extensively, practice this feeding system. They let their animals graze freely every day. This system is practiced in areas such as eastern Indonesia where grazing land is available. This system is also practiced by farmers who work in their fields or in plantations during the day.

Combination stall feeding and grazing system

Farmers in transmigration areas commonly practice this system. Ruminant livestock are taken to a communal grazing area in the morning and returned to their stall in the afternoon. Usually farmers cut some forage for these animals to feed in the stall before sunset.

Existing Forage Resources

Forage resources in Indonesia can be divided into the following categories:

- native pasture or natural grazing land,
- improved pastures,
- pasture under plantation crops,
- pasture in denuded forest areas, and
- crop residues.

Native pasture or natural grazing land

This resource includes small communal areas, where grazing and cutting of forage for stall feeding has been traditionally carried out by farmers, and large natural savanna grasslands. Natural grassland areas are scattered throughout the country, but are widely distributed only in Nusa Tenggara and South Sulawesi. These areas are dominated by native grass species such as *Chrysopogon asciculatus*, *Ischaemum timorense*, *Bothriochloa glabra*, *Polytrias amaura*, *Heteropogon contortus*, and *Themeda* spp. Natural grasslands in Sumatra, Kalimantan, and Sulawesi are mainly dominated by *Imperata cylindrica*. These grasslands are characterized by low herbage quality and low carrying capacity. The carrying capacity of natural grassland in Indonesia is usually less than one animal unit per hectare, mainly due to low soil fertility.

Improved pastures

Improved pastures are used by commercial dairy and beef cattle farmers as source of forage. High yielding, tall grass species such as King grass, *Pennisetum purpureum*, *Panicum maximum*, *Euchlaena mexicana*, are planted for fodder for stall feeding, and the shorter grass species such as *Brachiaria decumbens, B humidicola, Digitaria eriantha and Paspalum* spp. are used for grazing. Legume species such as *Stylosanthes guianensis, Pueraria phaseoloides*, and *Centrosema pubescens* are sometimes introduced into these pastures. These legume species can also be introduced into native pasture to improve herbage quality.

Pastures under plantation crops

Farmers who live near tree plantations such as coconut, rubber and oil palms, commonly utilize forages growing inside the plantation area. The concept of coconut-beef cattle (cocobeef) farming has been practiced in some parts of Indonesia. Grass species such as *Stenotaphrum secundatum, Paspalum notatum, Axonopus compressus*, and legume species such as *Arachis pintoi, S. guianensis. Pueraria phaseoloides*, and *Centrosema pubescens* are well-adapted to coconut plantation, but their use is not wide spread.

Pastures in denuded forest areas

Denuded forest areas can be utilized as forage resources provided these do not degrade the environment. Natural silvopastoral systems can be found in Sumatra, Kalimantan, and Irian Jaya.

Crop residues

There are many kinds of food crop residues which are an important source of feed.

Past and Present Forage R & D

For several years, several institutions have carried out forage research and development programs. A lot of forage research activities has been done by researchers in research institutes and universities. The research conducted by those institutions include forage breeding, forage crop production and management, forage nutrition and utilization, integrated cropping system, etc.

Forage development has been carried out by the Directorate General of Livestock Services, Department of Transmigration and Resettlement, and the Center of Agriculture Research and Development, in several areas. The Center of Soil Research also has an interest in establishing forages for soil conservation. Forage development programs have been carried out by foreign aid project such as IBRD, IFAD, and ADB.

Future Forage R & D Needs

Future forage research and development will concentrate on how to increase forage production and quality, and on how to produce planting materials (seeds and vegetative propagation material) on a larger scale. Forage breeding, forage management, and forage nutrition and utilization will be a priority in this program. Integrated cropping systems using forages with food crops, plantation crops, and forestry have a chance to be developed.

The Directorate General of Livestock Services carries out several programs on animal production development and these activities include the improvement of feed production and quality.

Ruminant development programs will concentrate on the development of both smallholder and commercial livestock production and many of these programs are targeted on transmigration areas. Cooperation between smallholder farmers and plantation estates is another way to increase livestock production. The best known system of such cooperation is PIR (Peternakan Inti Rakyat) which is practiced in some areas in Indonesia.

To support livestock development programs, forage R & D must be highly coordinated and should concentrate on areas where livestock development programs will be carried out, or in research institutions. At least five major areas of forage research should be encouraged. These are as follows:

- Forage species collection, identification, and genetic resource evaluation, seed production, technology and vegetative propagation,
- forage crop and pasture management,
- forage utilization and animal production,
- integrated cropping systems, and
- fodder conservation.

CURRENT STATUS AND FUTURE NEEDS OF FORAGE R & D IN THAILAND

Kiatsurak Bhokasawat[1]

Introduction

The livestock industry in Thailand is continuing to grow at a rapid pace, particularly the beef and dairy industries. In 1993, milk production was 712 t/day. In 1992, the population of beef and dairy cattle was 7.1 million head, with 2.0 million head in the Central region, 2.5 million in the Northeast, 1.9 million in the North and 0.8 million head in the South. The water buffalo population was 4.7 million head with 0.3, 3.8, 0.5, and 0.1 million head in the Central, Northeast, North and South, respectively.

Beef breeds are being improved by importing quality Brahman cows from both Australia and the United States of America. Approximately 13,000 cows and heifers were imported during 1990-1993. Most beef and dairy farms in Thailand are managed by smallholder farmers, while large farms with 100-2000 dairy cows are the exception.

Feeding Systems

The main factor that limits animal productivity on smallholder farms is the inadequate supply of forages. Smallholders use the following feed resources:

- native herbage plants on communal grazing land, roadsides, paddy bunds, forest areas, and other wasteland,
- fodder trees and shrub legumes planted along fences and in forests,
- agricultural crop residues such as straw, sugar cane tops, corn stover, pineapple waste, cassava leaves, vegetable wastes, and food wastes, and
- sown pastures and backyard pastures.

Because of the limited supply of quality forages, most dairy farmers feed their dairy cows an excess of concentrate feeds, particularly during the dry season. The normal practice is to feed 1 kg of concentrate for every 2-3 kg of milk produced. The

[1]Division of Animal Nutrition, Department of Livestock Development, Phya-Thai Rd., Bangkok 10400, Thailand.

former practice results in very high cost of milk production. Underway is a research which aims to reduce concentrate use by increasing the quality forage in the diet.

Another problem is inadequate mineral supplementation, and the DLD is at present launching a program to promote mineral supplementation. Urea-molasses-mineral blocks are being introduced to farmers; and they are being shown techniques of how to produce these blocks on farms.

Existing Feed Resources

Manidool (1986) reviewed existing feed resources. *Cynodon dactylon, Chloris barbata, Chrysopogon orientalis, Eragrostis* spp., *Panicum repens* and *Themeda triandra* were found in open grazing areas; *Arundinaria pusilla, Brachiaria retans, B. distachya* were found in slightly shaded areas, *Axonopus* spp., *Microstegium ciliatum, Ottochloa nodosus*, and *Paspalum conjugatum* under tree plantations.

Backyard pastures are another important feed resource. These pastures include improved forages such as *Panicum maximum* cv Common and TD 58, *Brachiaria ruziziensis, Pennisetum purpureum*. The important species of tree and shrub legumes are *Leucaena leucocephala, Gliricida sepium, Desmanthus virgatus, Cajanus cajan*, and *Sesbania grandiflora*.

Promising forage species in the mountains in the North are *Desmodium intortum* and *Setaria* spp. In upland areas in the North, *B. ruziziensis, P. purpureum, P. maximum, Centrosema pubescens* and *L. leucocephala* are used, while *B. mutica, Paspalum plicatulum* and *B. humidicola* are recommended for lowland areas.

In plantation areas, *B. decumbens, P. maximum, B. milliformis, C. pubescens* and *Pueraria phaseoloides* are used.

Brachiaria ruziziensis, P. maximum, and *Stylosanthes hamata* are recommended for the Northeast.

Past and Present Forage R & D

There are many organizations working on forage research in Thailand. In the Northeast there is the Department of Animal Science, Khon Kaen University which has special interest in plant selection, soil fertility, seed production, ley farming, and nutritive value of forages.

Kasetsart University, situated in the low plains of the Central region, is doing some research on grass-legume mixtures for dairy farms, using mixture or strip planting.

The Department of Land Development in the Central Region is also doing some research on problem soils, such as mineral and skeleton soil in the South and sandy and saline soils in the Northeast. The promising forage species for such conditions are *Sporobolus virginicus* (coarse and fine leaves) and *Leptochloa fusca* (Kallar grass). There is also emphasis on legume covers and green manure crops such as *C. pubescens* and *Sesbania rostrata*.

The Faculty of Natural Resources at Prince of Songka University in the South takes particular interest in improved forage species for use in plantation crops, in communal and private grazing areas, and in the integration of forages with annual cropping systems.

The Department of Livestock Development (DLD), Ministry of Agriculture and Cooperatives, does both research and development work, and is a center for pasture work in Thailand. The pasture research is concentrated on plant introduction and testing for regional adaptation. DLD has eight research centers situated in various parts of the country. Pasture quality and utilization are also important aspects of the forage research program. Research on pasture seed production, fertilizer use, harvesting techniques and postharvest technology are also carried out. Seed testing laboratories are available in each center. For the past 3 years, DLD has produced an average of 740 t of forage seeds per year; it is projected that this will increase to over 1000 t in 1995. A large part of the forage seed is produced by smallholder farmers, using a contract system with a guaranteed price. Prices are Bhat 55, 80 and 45 for Ruzi, Purple Guinea, and Verano stylo, respectively.

Research cooperation with overseas agencies plays an important role. One example of such cooperation is with JIRCAS of Japan. Some research outputs from cooperative projects are follows:

- 1987 to 1989 - Adaptation of pasture species in coconut and rubber plantations; sorghum and finger millet varieties in paddy fields after rice harvest; pasture legumes in native *Chrysopogon* grassland (1987-1989).
- 1989 to 1992 - Fertilizer supply for pasture species, and pasture productivity on major soils in the South.

Future Forage R & D Needs

- Selection of varieties for adaptation and nutritive values
- Irrigated forage to maximize yield and ensure year-round feed supply in irrigated areas; species to be studied are Para grass, Napier and Purple guinea.
- Fodder conservation. Due to serious shortage of green feed during the dry period (5-6 months in some areas), it is considered necessary to produce conserved fodder for cattle, particularly for dairy cows. The intention is to research and promote silage technology such as bag silo techniques for smallholders using corn or sorghum.
- Pastures under plantation crops. The main interest is in coconut plantations. The plan is to select adapted varieties, conduct grazing trials, and develop appropriate management options. Particular emphasis will be placed on optimum stocking rates and soil fertility issues.
- Fertilizer use. To determine appropriate fertilizer use for major soils series. In some areas, i.e., coastal southern soils, micro nutrient application is an important issue.
- Seed production. To study how to increase seed yields and quality of purple Guinea, Setaria, Creeping Signal and Hedge Lucerne.
- Ley farming systems. To maintain and improve soil fertility of upland areas.
- The most important issues are seed production (low seed quality and low seed yields of some adapted grasses); identification of adapted forages for public grazing land, plantation crops, irrigated areas, and forests; ley farming systems for upland cropping systems such as cassava areas in the Northeast.

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Section 6: Forage Cultivation Development

PROCESS OF SPECIES EVALUATION, CULTIVAR RELEASE, AND ADOPTION OF FORAGES IN TROPICAL AUSTRALIA

J.B. Hacker and A.G. Cameron[1]

Background

Australia has had a long history of research into tropical forages, dating back to the early years of this century. Work expanded in the 1950s, when a Commonwealth Scientific and Industrial Research Organization (CSIRO) group, under the leadership of J. Griffiths Davies, started a program which was strongly focused on developing pasture legumes, but with a continuing interest in pasture grasses. Many of the forage legume and grass cultivars used throughout the world's tropics were developed in Australia. Examples of some of the earlier releases are Siratro, Cunningham *leucaena*, Basilisk signal grass, and Callide rhodes grass.

Development of pasture cultivars in Australia has been directed towards improvement of the subtropical and tropical Australian grazing industries. In the Australian tropics, the main grazing industry is the beef cattle industry, with dairy production being a relatively small industry, located in higher-rainfall subcoastal districts in the south of Queensland, and on the Atherton and Eungella Tablelands in north Queensland. There has been little attempt to provide cultivars for the wool industry, which is largely located in semi-arid regions.

The development of tropical forage cultivars in Australia has been almost totally through government agencies, primarily by CSIRO and the Queensland Department of Primary Industries, and to a lesser extent by the Northern Territory Department of Primary Industry and Fisheries, the New South Wales Department of Agriculture and the University of Queensland. There are now increasing trends towards cultivar development being funded in part by agricultural industries, either through rural industry funds, or through seed merchants. The exceptions are forage sorghum and forage pearl millet, which are mostly bred by commercial companies, which exclusively market F_1 hybrids, which give them exclusivity on their products, as they hold the parental lines.

To appreciate the direction of research on cultivar development in Australia, it is necessary to understand something of the soils and climate of the region, and the requirements of the grazing industries.

[1]Australian Tropical Forages Genetic Resource Centre, CSIRO Division of Tropical Crops and Pastures, 306 Carmody Rd, St Lucia, Queensland 4067, Australia.

Target Environments

Subtropical and tropical Australia extends from 11°S to 28°S. A large proportion of the region is desert to semi-desert and is inappropriate for grazing or carries native rangelands which can only support low stocking rates. Areas which have potential for improvement with sown forages are limited to those with annual rainfall exceeding 500 mm, to the east and north of the continent. Only very limited areas have annual rainfall above 1500 mm. Annual rainfall is extremely variable, except in the far north, years with less than half the mean annual rainfall being a frequent occurrence. In the north, rainfall is more reliable and is restricted to a three to five month summer wet season, whereas in the south, about one third of the rainfall may fall in winter. This winter rainfall allows the use of some temperate forages, including forage oats, lucerne, medics and clovers.

Summer temperatures are hot to very hot, with mean daily maxima in the range 30°C to 38°C. Light frosts occur over much of the subtropics, and also at higher altitudes in the northern tropics. The occurrence of winter frosts limits the use of some species and accessions which flower in short days.

Soils are generally infertile, with low phosphorus (P), nitrogen (N) and sulfur status. The low P status has led to a strong emphasis on the genus *Stylosanthes*, noted for its tolerance of low P soils. Cropping is restricted to areas of heavier, more fertile soils, but rundown in fertility has led to a requirement for a pasture phase and a legume adapted to these heavier soils. Research has led to the recent release of three cultivars of *Desmanthus*, which are adapted to these soils. Lighter soils are generally slightly acid (pH 5.0 to 6.0), and there are no extensive areas of highly acid soils.

Pasture Systems

In the early stages of pasture development in tropical Australia, the concept was total replacement of the existing vegetation with a sown grass-legume pasture and this continues in the higher rainfall areas. For the lower-rainfall, more extensive, beef-producing areas, this practice has now largely been replaced by that of legume-augmented native pastures, where the legume is sown into native rangeland. Partly as a result of this philosophy, and partly because of an adequate suite of grass cultivars for most situations, selection of new forages focuses strongly on legumes.

The Genetic Resource

Largely because many of the native grasses and legumes in Australia will not tolerate heavy grazing, pasture scientists have concentrated on introduction and development of exotic germplasm. This has led to the assembling of one of the world's largest collections of tropical forage germplasm, which is held by the Australian Tropical Forages Genetic Resource Centre (ATFGRC), at Brisbane. The focus has been on legumes, although many grass accessions are also maintained in the collections (Table 1). The legumes are predominantly of South and Central American origin, whereas the grasses are largely from Africa. Southeast Asia is a source for certain legume genera, particularly *Desmodium* and *Pueraria*.

Table 1. The main legume and grass genera in the ATFGRC collection.

Genus	No. of species	No. of accessions	Genus	No. of species	No. of accessions
a) Legumes			**b) Grasses**		
Stylosanthes	33	2475	*Panicum*	58	869
Vigna	47	2103	*Cenchrus*	10	591
Desmodium	80	1541	*Digitaria*	45	591
Centrosema	25	1235	*Paspalum*	50	501
Zornia	25	1122	*Setaria*	34	389
Macroptilium	14	708	*Urochloa*	6	403
Leucaena	12	683	*Bothriochloa*	11	237
Glycine	16	525	*Chloris*	22	195
Indigofera	77	489	*Brachiaria*	22	198
Aeschynomene	29	470	*Anthephora*	8	164
Rhynchosia	40	373	*Sorghum*	14	155
Crotalaria	68	360	*Eragrostis*	16	142
Alysicarpus	10	341	*Dichanthium*	4	139
Desmanthus	9	341	*Andropogon*	19	110
Total (all species)		17,301[1]	Total (all species)		5,614[2]

[1] including 1,740 grain legumes.
[2] including 80 grain sorghums.

There is a continuing effort to expand the collection, but this is strongly focused by species, region or potential utilization. Recent expeditions have been made to Brazil (*Stylosanthes* sp. aff. *S. scabra*), Paraguay (a country poorly represented in the collection, and a homoclime of Central Queensland) and South Africa (grasses for heavy grazing).

As well as seed, the ATFGRC also holds a major RNB (root nodule bacteria) collection. A crucial step in the release of new legume cultivars is that they nodulate freely with native RNB, or an adapted RNB be identified and supplied for coating on the seed sown by farmers.

The identification of new forage accessions into Australia generally requires several steps before they can be made available for testing. Invariably, only a small amount of seed is received. Many genera and species must be grown through one generation of quarantine. The Quarantine glasshouse is enclosed so as to prevent the escape of any insect or disease introduced with the seed, and plants are inspected by a pathologist and any diseased plants destroyed. As space is limited, only a small quantity of seed can be harvested from these plants and made available for further work. A seed increase phase is therefore necessary, before there is enough seed available for field sowings.

At this stage, if there are many lines of a particular genus or species, a characterization study is carried out. Morphological (M) and agronomic (A) characters are measured and many lines are grouped into more-or-less discrete groups (M-A groups). Different groups frequently come from different geographic regions, or from different soil types, suggesting that accessions within groups are likely to be quite similar in adaptation, whereas those in different groups differ in adaptation. A current activity is a characterization study of *Zornia*, a legume genus which we, at this stage, know little about, but which could have promise for infertile soils.

Cultivar Development

Selection from naturally occurring morphotypes

The way in which elite accessions are selected for testing varies, but a generalized system would be as follows:

- A situation is identified where a new pasture plant is needed by the farmers - for example, a perennial legume adapted to heavy soils, or a grass tolerant of heavy grazing and intermittent severe droughts;
- Accessions, species or M-A groups which could provide potential new cultivars to fit the need are identified. Selection is based on previous knowledge, literature, or passport data (information from the site where the accession was collected);
- Accessions are grown in rows 4-5 m long or small plots of 10-20 m^2, in introduction trials, over a range of environments, and are monitored for establishment, growth, persistence, seed production, and spread. During this phase, they are generally grazed intermittently. A relatively recent development of

this phase in Australia is to combine the resources of two or more organizations, so as to provide a broader assessment of the environmental adaptation of the accessions being tested. This program is referred to as the COPE (Coordinated Plant Evaluation);

- The more promising accessions are grown in larger plots, usually under periodic common grazing and for 3 years or more. There is usually only one measurement of yield, taken towards the end of the growing season, although occasionally yield is measured just before each grazing. Especially with legumes, plant density is measured annually. An alternative approach, used by some scientists, is to carry out a series of cutting trials and select the highest yielding lines for further evaluation. This approach is particularly appropriate for selecting forages for cut-and-carry systems;
- After (or instead of) the cutting trials, the performance of the best few accessions may be evaluated in several separately fenced plots under different grazing pressures. If these plots are large enough, it is possible to measure animal production. Animal production data are not required for release and such trials are not usually carried out where there are other cultivars of the same species already available, and that are known to be beneficial for animal production.
- The later phases of this evaluation process are often carried out on farms, rather than on research stations.

Plant breeding

Breeding is a long-term process, generally taking 10-15 years before a new cultivar is on the farm. Plant breeding programs are only initiated where it appears that the goal cannot be achieved through introduction and selection. In Australia, plant breeding is now limited to a few legumes (shrubby stylo, lablab and lucerne) and rhodes grass. With shrubby stylo and lucerne, the goal is disease resistance, and with lablab, it is the combining of some perenniality with high forage yield. When a potential new cultivar has been produced in a breeding program, many of the stages carried out for selecting cultivars from accessions may not be necessary, as performance may have been adequately evaluated and selected, during the breeding program.

Cultivar Release

In Queensland, when it seems that an elite accession might be good enough to release, it is submitted to the Queensland Herbage Plant Liaison Committee for approval. This committee comprises members from the State Department of Primary Industries, CSIRO, the Seeds Industry (growers and merchants), and a representative from the state Department of Environment and Heritage, whose presence is to safeguard against the possible release of potential weed species. Similar committees exist in other states. The QHPLC will only approve the release of the accession or cultivar if it has merit as a new pasture plant. A decision may be postponed until more information, particularly on response to grazing, is obtained.

In the past, all releases were "public cultivars", and a Seed Increase Committee was then appointed to negotiate for production of sufficient seed to distribute to several seed merchants for further multiplication and marketing. The release procedure has now changed, and an arrangement is usually made with a company to market the new cultivar, although there are still some public cultivars on the market. Royalties paid by the company to the organization help support continued plant selection and breeding. Ownership of the cultivar, legally possible through Plant Breeders' Rights, is generally leased to the marketing company.

Recent releases

Table 2 provides a listing of 24 recently released Australian cultivars. Most of these come from selections from wild populations collected overseas, although Siran shrubby stylo and Aztec atro are bred cultivars.

Table 2. Tropical and subtropical forages released in Australia, 1989-94.

	Common name	Cultivar	Comments
a) Legumes			
Aeschynomene americana	american jointvetch	Lee	some perennation
Clitoria ternatea	butterfly pea	Milgarra	clay soils
Desmanthus virgatus	desmanthus	Marc	clay soils, early flowering
Desmanthus virgatus	desmanthus	Bayamo	clay soils, mid-flowering
Desmanthus virgatus	desmanthus	Uman	clay soils, late flowering
Leucaena leucocephala	leucaena	K636	high yield
Macroptilium atropurpureum	atro	Aztec	rust resistant
Macroptilium gracile	llanos macro	Maldonado	monsoonal tropics
Sesbania sesban	sesbania	Mount Cotton	shrub
Stylosanthes scabra	shrubby stylo	Siran	anthracnose resistance

Table 2. Tropical and subtropical forages released in Australia, 1989-94. (continued)

	Common name	Cultivar	Comments
b) Grasses			
Bothriochloa bladhii	forest bluegrass	Swann	high yield
Bothriochloa pertusa	indian bluegrass	Dawson	heavy grazing
Bothriochloa pertusa	indian bluegrass	Medway	heavy grazing
Cenchrus ciliaris	buffel grass	Bella	spring growth
Cenchrus ciliaris	buffel grass	Viva	spring growth
Chloris gayana	rhodes grass	Finecut	hay
Chloris gayana	rhodes grass	Nemkat	nematode resistance
Chloris gayana	rhodes grass	Topcut	hay
Dichanthium aristatum	angleton grass	Floren	clay soils
Digitaria eriantha	digit grass	Apollo	spring growth, seed production
Digitaria milanjiana	finger grass	Jarra	rapid spread, yield
Echinochloa frumentacea	jap millet	Indus	soil stabilization
Panicum laxum		Shadegro	shaded lawns
Vetiveria zizanioides	vetiver	Monto	erosion control

Plant Variety Rights (PVR)

Plant Variety Rights are available through national legislation, and are strictly controlled. PVR are awarded providing a cultivar is uniform, stable and distinct from other cultivars of the same species. Once awarded, PVR gives ownership of the cultivar to the person or organization that has negotiated PVR. There are arrangements between countries which are members of UPOV (Union International pour la Protection des Obtentions Végétales) and have a PVR system, which offer protection of ownership. However, countries which are not members of UPOV are potentially denied access to cultivars with PVR status. UPOV encourages national membership, and in the last few years seminars encouraging participation in the east Asian region have been held in Tokyo, Seoul, and Beijing.

Cultivar Adoption

Methodology for promotion of new cultivars is changing. In the past, it was left to the seeds industries and extension workers to promote the new cultivars. Now, the releasing organization makes use of the media at the time of release - rural newspapers, rural radio programs, agricultural journals. Television is rarely interested in promoting new forages. Opportunities are taken to hold field days where successful pastures of new cultivars are exhibited. There are increasing tendencies for the organizations releasing new cultivars to be involved in promotion activities, interacting with extension officers, producing leaflets and providing and manning exhibits at agricultural shows. Companies which have the PVR rights to the new cultivar actively promote it.

Rate of adoption of new cultivars is variable. If the farming community sees a need for a new cultivar, and if there are good seasons after the cultivar is released, adoption is likely to be quite rapid. Sowing seed over large areas is expensive, and failures can be costly. Ultimately, the success of the new cultivar depends on farmers seeing it as filling a role in their farming system. For this to happen, they must be able to obtain sufficient seed to sow on their properties. It is critical to have an adequate amount of seed or vegetative planting material available when a cultivar is released.

When a cultivar proves itself on a farm, the farmer's neighbors get to hear about it, and the word spreads. The word also spreads if the cultivar does not grow well!

Conclusions

The development of tropical forage cultivars is continuing in Australia. However, reduced funding for agricultural research is likely to result in fewer releases in the future. Adequate cultivars are available for most situations, but the threat of plant diseases necessitates continued research effort on priority genera.

The development of a new cultivar is often a lengthy process. Farmers should be involved as early as possible in the development of a new pasture cultivar. The success of the release will depend on the farmers being familiar with the new forage and wanting to grow it.

THE RELEASE PROCESS AND THE ADOPTION OF NEW FORAGE CULTIVARS IN TROPICAL AMERICA AND ITS RELEVANCE TO SOUTHEAST ASIA

P.C. Kerridge[1]

Introduction

Well managed grasses, legumes and shrubs play an important role in increasing animal productivity and in soil improvement in most tropical ecosystems. We look for new cultivars of forages that will have some advantage over existing ones. This may be better adaptation to soil and climate, higher disease and pest resistance, higher palatability and nutritive value with respect to their use for animal production, or usefulness in prevention of erosion, weed control and improving soil fertility with respect to improved land management. Once new species or accessions of species have been identified, there is a need to release these for wider use.

The release process refers to the transfer of species from the agricultural research community to the farming community, that is, making them more readily available to farmers. However, while there are usually well established release processes for food crops such as rice in most countries, the mechanism for release of new forage cultivars is neither clear nor well defined. Even where there is a release process defined by research organizations, it is not always followed by the commercial sector.

Hence the release process may be formal (official) or informal (non-official). Either way it involves a series of events, which include identification of a new cultivar (usually by researchers), increase of basic seed or planting material, making the new information about the cultivar widely known, and then handing the material over to the commercial sector. The process may be driven by the researchers and official agricultural officers, who perceive that they have something useful to offer to farmers, or it may be driven by the farmers and the commercial seed industry, who recognize a need for the new cultivar. Obviously, a high adoption rate will depend on there being a demand for the new cultivar.

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Components in the Release Process

This has been summarized by J. E. Ferguson, who worked for many years in CIAT developing seed systems to facilitate the release of new cultivars (Ferguson, 1985; Ferguson, 1994; Ferguson and Sauma, 1994). The reader is encouraged to seek out these articles for a fuller discussion of the subject. He lists the following interacting components in the release process:

- Status as a cultivar. The new cultivar must have a clear role in terms of its potential for farmers. However, the release process *per se* cannot guarantee adoption. If there is poor adoption, or worse, failure to live up to expectations, then those responsible for the release will lose credibility in the farming community and it will be more difficult to promote other cultivars in the future.
- The release authority. There should be a recognized release authority in each country. The national agency responsible for identifying new forage cultivars will usually take the initiative in setting up a committee or group which makes the decisions on release. It is important that it includes all those involved in the adoption process - extension personnel, seed industry, farmer organizations, educational bodies and even credit organizations. This group should not only make decisions about release but supervise the process of seed increase and distribution.
- Multiplication of basic seed or planting material. This material is used for distribution to the private sector which will multiply the seed for sale and general distribution and this represents the last step in the release process. It is also important that basic seed or vegetative material is maintained by the release authority or some other organization for reasons of security and for later distribution.
- Certification and quality control. Seed certification is a quality control system that operates well in many developed countries but poorly in developing countries. In practice, in developing countries, once a cultivar is released there is a limited chance of controlling the purity of the cultivar. However, there is a real need to be able to distinguish new cultivars from other cultivars of the same species as the commercial sector may substitute one cultivar for another where supplies are short. There are also non-technical factors that affect the release process. These include greed, prestige and commercial rivalry which may result in the release of cultivars of little value or release before there is adequate seed or planting material.

Releases in South America

The role of CIAT has been to identify potential new cultivars. National organizations carry out the final evaluation and release the material to the private sector. Table 1 shows releases of legumes and Table 2 releases of grasses in South America by different countries.

Table 1. Recent cultivars of legumes released in tropical Latin America.

Scientific name	Cultivar name	Process of liberation		Present
		Country	Duration[1]	Position[2]
Arachis pintoi CIAT 17434	Maní Forrajero Perenne	Colombia	1992-93	I
	Pico bonito	Honduras	1993	I
Centrosema acutifolium CIAT 5277	Vichada	Colombia	1987-91	S
C. pubescens CIAT 438	El Porvenir	Honduras	1990	S
	Villanueva	Cuba	1993	-
Clitoria ternatea CIAT 20692	Tehuana	Mexico	1988-90	S
	Clitoria	Honduras	1990	
Desmodium ovalifolium CIAT 350	Itabela	Brazil	1989-91	S
Leucaena leucocephala CIAT 21888	Romelia	Colombia	1991	I
Pueraria phaseoloides CIAT 9900	Jarocha	Mexico	1989	S
Stylosanthes capitata CIAT 10280 (comprising 5 accessions)	Capica	Colombia	1982-86	S
S. guianensis var. vulgaris CIAT 184	Pucallpa	Peru	1985-88	I
S. guianensis var. vulgaris CIAT 2950	Mineirao	Brazil	1993	

[1] Time between release of cultivar and availability of commercial seed.
[2] Refers to future prospects for the cultivar: I = Increasing; S = Stable.

Table 2. Recent cultivars of grasses released in tropical Latin America.

Scientific name	Cultivar name	Process of liberation		Present
		Country	Duration[1]	Position[2]
Andropogon gayanus CIAT 621	Carimagua 1	Colombia	1980-83	L
	Planaltina	Brazil	1980	S
	San Martin	Peru	1982-84	L
	Sabanero	Venezuela	1983-85	S
	Veranero	Costa Rica	1989	S
	Llanero	Mexico	1987-88	S
	Veranero	Panama	1983-85	L
	Andropogon	Cuba	1988	S
	Otoreño	Honduras	1989	S
	Gamba	Nicaragua	1989	L
	ICTA-Real	Guatemala	1992	S
Brachiaria brizantha CIAT 6780	Marandu	Brazil	1984	L
	Brizantha	Cuba	1987	S
	Gigante	Venezuela	1989	S
	Insurgente	Mexico	1989	I
	Diamantes 1	Costa Rica	1991	I
B. brizantha CIAT 26646	La Libertad	Colombia	1987-93	S
B. decumbens CIAT 606	Braquiaria	Cuba	1987	S
	Chontalpo	Mexico	1989	I
	Senal	Panama	1989	S
	Pasto Peludo	Costa Rica	1991	S
B. dictyoneura CIAT 6133	Llanero	Colombia	1987	I
	Gualaca	Panama	1992	I
	Ganadero	Venezuela	1993	I
B. humidicola CIAT 679	INIAP-Napo	Ecuador	1985	S
	Aguja	Venezuela	1989	S
	Humidicola	Panama	1989	S
	Chetumal	Mexico	1990	S
	Humidicola	Colombia	1992	S
Panicum maximum CIAT 26900	Vencedor	Brazil	1990	S
P. maximum CIAT 16031	Tanzania 1	Brazil	1990	S

[1] Time between release of cultivar and availability of commercial seed.

[2] Refers to future prospects for the cultivar: I = Increasing; S = Stable; L = Poor

* "Ghost cultivar", not real, due to an incomplete process of liberation (basic seed not available)

Several observations can be made from these tables:

- Where a single accession has been released in several countries, the time to release has varied considerably, even though most would have received the material from CIAT at the same time.
- In some cases sufficient basic seed was not available for distribution to the private sector. Shortage of seed has been a major limitation in the adoption of new cultivars.
- In some countries, an official release was not made until the cultivar was being used widely in the commercial sector.
- The same accessions received different common names in different countries. A specific name in a country gives some prestige to the release authority in that country. However, it does lead to confusion as seed may be produced in another country. Often confusing nomenclature has been used. For example, the use of the species name for the common name.
- The commercial relevance of a cultivar may change with time. A species may go from a position of increasing prospects (I) to one of stability (S) through to poor prospects (L). This may be because the species is not really well adapted in the farming systems of a particular country or a stable commercial seed industry has not developed.

Lessons from the Release Process in South America

The factors that favor successful release of new cultivars have been:

- Real demand. Farmers see the advantage of the cultivar in their farming system. An example would be with *B. dictyoneura* which grows better on poorer soils and is less susceptible to disease than *B. decumbens* and has a higher feed value than *B. humidicola*.
- Commercial seed available. This is as equally important as demand because there cannot be a demonstration of demand where there is no seed or planting material available.
- Suitable seed technology available. The commercial sector is more reluctant to produce seed of a new cultivar where there are problems in its production e.g., low seed yield, shattering of seed, high dormancy in the seed.
- Previous knowledge of the species being released. It has been much easier to achieve widespread adoption of new cultivars of *Brachiaria* than legumes because farmers have had previous experience of and appreciate the value of *B. decumbens*.

Factors that have limited successful release have been:

- Lack of an appropriate release authority. While there are established release processes for new crop cultivars these often do not exist for forage cultivars. Further, one government sector, (e.g. a livestock department) may have carried out a release without involving other institutions which could assist in the process and contribute towards successful promotion.

- Poor coordination in the release process. There need to be concurrent activities in the final evaluation, seed increase and distribution process.
- Lack of basic seed technology. In some cases, the commercial sector is not capable to produce seed due to technical limitations.
- Lack of a national seed industry. In practice, most of the seed production in South America is concentrated in Brazil, with seed merchants in other countries merely acting as brokers. This is in part because climatic conditions are more suitable for seed production in Brazil than in many other humid tropical countries. It does mean that the varieties used tend to be those produced by the Brazilian seed industry. However, there are examples of successful seed production in the other countries for legumes and some grasses.
- Poor promotion. Promotion and education are likely to be very important where the species is new to farmers. An example would be slow adoption of a legume cultivar where farmers previously were familiar only with grasses.

Lessons for Southeast Asia

Firstly, there needs to be confidence that new cultivars have a role in the farming system. This implies that there should be evidence that farmers accept the new technology and are willing to invest in it. This can be accomplished by farmers participating in the research and development process.

Secondly, there needs to be a seed multiplication or vegetative propagation system that is appropriate for the country and farming system. For some cultivars, it may be more efficient to produce seed in areas distant from the point of use or even in other countries. The market economy should be allowed to operate freely within Southeast Asia. However, individual countries need to make sure that standards of germination and quality are maintained. One word of caution is that disease is spread much more readily where vegetative material is used rather than seed.

Thirdly, unless a regional seed industry is developed, there will continue to be a reliance on materials that are commercially available from other regions which are not necessarily optimal for Southeast Asia.

Fourthly, each country should plan for release of new cultivars with a formal system of release.

Conclusions

A formal release process will ensure that accessions and species with the greatest potential are available to farmers in the region. It can also be used to promote and hasten the rate of adoption. Recognition of the organization which developed the cultivar will give the organization credibility with farmers and those who financially support it.

The release process will proceed more rapidly through a region where there is an active network (e.g. RIEPT - South America, SEAFRAD - Southeast Asia). It will also proceed more smoothly where all participants are in accord with the process. Finally, an effective formal release process will ensure adequate supplies of seed or vegetative propagation material are available.

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Section 7: Conclusions and Recommendations

CONCLUSIONS AND RECOMMENDATIONS

The Third Regional Meeting of the Southeast Asian Regional Forage Seeds Project reached the following conclusions:

1. It strongly supports the recommendation of the regional meeting of government representatives from Southeast Asia held at Los Baños, Laguna, Philippines in 1989, that a Southeast Asian Forage Research and Development network (SEAFRAD) be established.

   This regional network should pursue the following initiatives:

   - Facilitate and encourage the development of, and operate through, national networks that are open to all forage research, development and extension workers in each country.
   - Form linkages with other regional groups concerned with feed resources for livestock.
   - Publish a newsletter twice a year and which will be distributed through national representatives.
   - Organize regional meetings of forage research, development, and extension workers.
   - Supply and exchange forage germplasm.
   - Facilitate opportunities for forage research, development, and extension workers to visit and train in other countries within Southeast Asia.
   - This network will be coordinated by a Secretariat, which will rotate among countries.

2. The meeting concludes there are several forage cultivars introduced through the Forage Seeds Project that have shown sufficient potential to warrant release within Southeast Asia. These include the grasses *Andropogon gayanus* (CIAT 621), *Brachiaria decumbens* (cv. Basilisk), *Brachiaria brizantha* (cv. Marandu), *Brachiaria humidicola* (cv. Tully, CIAT 6369, CIAT 6133), and legumes *Centrosema pubescens* (CIAT 15160) and *Stylosanthes guianensis* (CIAT 184).
3. The meeting recommends that each country establishes a mechanism for release of new forage cultivars.
4. The meeting recommends that future R & D should be carried out on the following:
   - Forage tree legumes for smallfarm systems
   - Forage seed production, quality, and storage
   - Indigenous forage resources.

5. The meeting recommends that training courses continue to be held on forage agronomy and seed production and technology.

6. The meeting acknowledges the importance of East Kalimantan as an area with potential for forage and livestock development in association with forestry and agricultural development. Another with potential is forage development in association with mining land.

7. The meeting recognizes the need for a regional code or standard with respect to seed quality and seed health.

8. The meeting recommends that the next meeting be held in Lao PDR in February 1996.

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