Inception Workshop

'RETA 6067: Improving Livelihoods of Upland Farmers Using Participatory Approaches to Develop More Efficient Livestock Systems'

Short title: 'Livelihood and Livestock Systems Project' – LLSP

Hainan, China, 26-31 Jan. 2003

Edited by Jindra Samson

CIAT FSP ADB

The Livelihood and Livestock Systems Project

The Livelihood and Livestock Systems Project (LLSP) is a partnership of the governments of Cambodia, Indonesia, Lao PDR, Philippines, P.R. China, Thailand and Vietnam. The LLSP is funded by the Asian Development Bank (ADB) from Jan. 2003 to Dec. 2005 and is coordinated by Centro Internacional de Agricultura Tropical (CIAT).

The purpose of the LLSP is to

1. Improve the sustainable livelihood of small farmers in the uplands through intensification of crop-livestock systems, using farmer participatory approaches to improve and deliver forage and feed technologies; and
2. Improve delivery mechanisms in participating DMCs for the dissemination of these technologies.

The national implementing agencies in partner countries are:

Cambodia	National Animal Health and Production Investigation Centre, Department of Animal Health and Production, Phnom Penh.
P.R. China	Chinese Academy of Tropical Agricultural Science (CATAS), Danzhou, Hainan.
Indonesia	Livestock Services of East Kalimantan, Samarinda, East Kalimantan, and Directorate General of Livestock Services, Ministry of Agriculture, Jakarta.
Lao PDR	National Agriculture and Forestry Research Institute (NAFRI), Vientiane.
Philippines	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Los Baños, Laguna.
Thailand	Department of Livestock Development, Ministry of Agriculture and Cooperatives, Bangkok.
Vietnam	National Institute of Animal Husbandry (NIAH), Ministry of Agriculture and Rural Development (MARD), Hanoi.

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Workshop Summary

by Ralph Roothaert

An inception meeting was held in Hainan, PR China, for the project 'Improving livelihoods of upland farmers using participatory approaches to develop more efficient livestock systems'. The project is funded by the Asian Development Bank (ADB), and convened by the Centro Internacional de Agricultura Tropical (CIAT). The Technical Assistance Agreement was signed in January 2003, referred to as RETA No. 6067. The project is based on the results of the previous CIAT-ADB project 'Developing sustainable forage technologies for resource poor upland farmers in Asia', in short 'Forage for Smallholders Project (FSP-II)' which is ending in June 2003. The new project builds on previous experiences in the Philippines, Indonesia, Vietnam, China (Hainan), Thailand and Lao PDR. A new country, Cambodia, will join, and a reduced program is envisaged in Thailand and Lao PDR. The project will expand research activities to incorporate integrated feed systems using indigenous forages and crop residues. It will also expand to more farmers in the participating countries and further develop participatory monitoring and evaluation systems to enable community learning and provide feedback. Capacity building will stretch beyond field level to institutional heads to bring about institutionalization of approaches and technologies. Research will aim to address constraints to increased livestock production beyond the forage and feed components, such as increased commercial orientation. Synergies will be established through existing networks and new collaboration with development projects.

The inception meeting provided an opportunity for each country of the FSP-II to show what has been achieved in the last three years, the lessons learned, and the research needs for the new project. Objectives of the new project were presented, related questions were clarifications were discussed, and countries indicated the priorities they would allocate to each objective. Participants grouped by country were given more than a day to develop and fine-tune country research objectives, strategies and workplans. Summaries of the strategies were presented towards the end of the workshop, but detailed workplans would be completed during the first quarter of the project. The ADB senior agricultural specialist provided guidelines for improving indicators that were

mentioned in the TA framework. A lot of consideration during the working group sessions went into making the indicators more realistic and closer to the project purpose and objectives.

The management structure will be different from FSP-II. The previous network coordinator, Dr. Ralph Roothaert, is leaving to take up a new position in Africa. The new project management will consist of a team of a senior international scientist, Dr. Werner Stür, and two regional scientists, Mr. Francisco Gabunada and Mr. Phonepaseuth Phengsavanh. Dr. Rod Lefroy will remain the Regional Coordinator of CIAT in Asia, and Ms. Pratima Dayal will be the ADB project officer. In each country a national coordinator was identified, the names of which are mentioned in Table A2.3 of the project proposal. Letters of commitment, otherwise called Letter of Understanding (LoU), will be composed in collaboration with the management team and the implementing institutions in each country.

It was agreed that the planning workshops would continue to be held on an annual basis, each time in a different country to enable delegates to directly learn from regional experiences during the field day. The newsletter of the 'Southeast Asia Feed Resources Research and Development Network' (SEAFRAD) will continue to be produced by country editors on a rotational basis, although the timing will be more flexible. The next two issues will be edited and produced by Mr. Yi Kexian, China. A new name was accepted for the relatively long project title 'Improving livelihoods of upland farmers using participatory approaches to develop more efficient livestock systems', which became 'Livelihoods and Livestock Systems Project' (LLSP). It was accompanied by a new logo, reflecting gender focus, feed resources and livestock systems.

Contents

Section 1:

Preface

Welcome Address

by Chen Qiubo, Vice president of Chinese Academy of Tropical Agricultural Sciences

Good Morning, Ladies and Gentlemen,

It's my great honor to be here this morning. First of all, I would like, on behalf of the Chinese Academy of Tropical Agriculture and the South China University of Tropical Agriculture, to extend our warm welcome to all participants from Cambodia, Indonesia, Laos, Philippines, Vietnam and China to this LLSP Inception Meeting, particularly to ADB officer, Mrs. Pratima Dayal, CIAT officers Dr Roothaert and Dr Lefroy, and also ILRI scientist Dr. Gray. As the local host, we assure you that we will try our best to provide all possible and necessary services to make the meeting a greet success.

My academy has been cooperating with CIAT since the early 1980s. We both get benefits from our cooperation in all aspects. One of the projects that we have been collaborated is the Forage for Small Holders Project (FSP). We were rewarded with great achievements. Our scientists who joined the projects have enjoyed working with project team members from other countries and CIAT officers and working closely and directly with the local farmers. Now the second phase of the project has a new name, LLSP, stands for Improving Livelihoods of Upland Farmers Using Participatory Approaches to Develop More Efficient Livestock Systems. The abbreviation is so delicate and sweet that we should bestow the inventor a prize for his or her contribution. It is with this opportunity, I would like to express our gratitude to ADB, for its continuous support to this and for all other projects leading to sustainable rural and agricultural development. We can assure ADB that we will work as hard as we can to ensure that the project will be successful and achieves the targets set for the project. I am sure that all team members will agree me in this statement.

We are now here facing the campus of the Chinese Academy of Tropical Agricultural Sciences and the South China University of Tropical Agriculture, which form a unity of research academy and education university in the domain of tropical agriculture. CATAS owes its origin to the South China Research Institute of Tropical Crops founded in 1954 in Guangzhou, Guangdong

Province and moved in 1958 from Guangzhou to the present location, Baodao Xincun, Danzhou, Hainan Province. Eight years later it was renamed as South China Academy of Tropical Crops and 20 years later it was renamed again as the Chinese Academy of Tropical Agricultural Sciences (CATAS). With the recognition of the need to extend knowledge and technology in tropical crops. the South China College of Tropical Crops was then established in 1958 in the same location with the institute. The College was conferred university status in 1996 with its service field extending from tropical crops to tropical agriculture as in the case of CATAS.

CATAS/SCUTA were established to initiate and sustain research and education in tropical crops to respond to the national demand for tropical commodities. CATAS/SCUTA are proud of their two beautiful campuses with various tropical attractions and charms. CATAS/SCUTA at Danzhou have a campus of 167 ha and CATAS/SCUTA at Haikou have a somewhat smaller campus of 33 ha. As the largest landlord among agricultural universities in China, CATAS/SCUTA unity has access to more than 40,000 ha for experimental and trial uses. Trial fields under various crops surround our campus here. The Tropical Pasture Program involved in this project has its trial fields very close to this hotel. You are scheduled to visit the field during the meeting.

CATAS endeavors researches in the development of tropical agriculture and enjoys good domestic and international reputation. It has 10 research institutes and one analytical testing center located at the headquarters in Danzhou, some others in Wenchang City and Wanning City in Hainan Province, and Zhangjiang in Guangdong Province. In addition, CATAS also owns a national key laboratory, two ministerial key laboratories, and four ministerial key monitoring and testing centers for quality control of agro-products. The tropical pasture program is only a small unit in the Research Institute of Tropical Pasture and Field Crops, but they have made big progress in their research, and I am very proud of them.

SCUTA consists of 9 colleges including College of Agronomy, College of Engineering and Technology, College of Economics and Trade, College of Horticulture, College of Plant Protection, College of Liberal Arts and Laws, College of Fundamental Sciences, College of Adult Education and Vocational College. SCUTA offers 21 bachelor programs and 20 junior college programs, 15

master programs and six doctoral programs. SCUTA, now has an enrolment of some 8000 students at Danzhou and Haikou campuses.

As you may know, one week from now will be the traditional Chinese New Year - the Spring Festival. This Inception Meeting partly coincides with that great event. We now can usher in the new phase of this project and the traditional Chinese New Year that signifies a very good beginning of both our new year and this project double blessing as we Chinese call it. The schedule for the Inception Meeting is so tight that all participants will be very busy during this week. I wish all participants to enjoy your stay with us in Hainan, and good health during and after the meeting. May the Inception Meeting be a great success.

Introduction

by Ralph Roothaert

Objectives of the meeting

Review achievements FSP phase II

- Country presentations

Strategies for next phase

- Objectives
- Partners
- Sites
- Activities

Field trip

- CATAS experimental farm
- On-farm in two counties, Baisha and Danzhou

Development of workplans and indicators

- Monitoring and evaluation
- Indicators
- Activities
- Budgets
- Workplan for 2003

Management

- Multi-person coordination
- Links with ILRI – communication and networks
- Reporting
- Short name 'Livelihood and Livestock Systems Project'
- New logo
- Network newsletters, web site, etc.

Summary of achievements in 20021) Experiments

Table 1. Summary of experiments and reports 2002

Country	Target/ achieved	No. of farmers carrying out experiments	No. of SEAFRAD articles contributed
China	T	30	4
	A	30	4
Indonesia	T	17	3
	A	31	0
Philippines	T	41	8
	A	30	6
Thailand	T	3	1
	A	3	1
Vietnam	T	55	2
	A	45	1
Total target		146	18
Total achieved		139	12
% Achieved		95	67

2) Dissemination

Table 2. Summary of dissemination achievements of FSP in 2002

Country	Target/ achieved	No. of PDs conducted	No. of farmers partic. in PDs	No. of new groups	No. of cross visits organized	No. of farmers partic. in cross visits	No. of new farmers planting forages	No. of total farmers planting forages in 2002
China	T	7	105	7	15	75	100	173
	A	7	109	8	14	81	97	176
Indonesia	T	24	430	36	23	389	478	879
	A	9	269	14	29	278	183	929
Philippines	T	30	340	23	29	640	383	595
	A	33	355	27	60	674	436	1663
Thailand	T	8	120	8	18	175	295	449
	A	1	15	1	3	100	195	276
Vietnam	T	52	1330	0	40	650	550	1656
	A	51	1400	2	35	700	660	1737
Total target		121	2325	74	125	1929	1806	3752
Total achieved		101	2148	52	141	1833	1571	4781
% Achieved		83	92	70	113	95	87	127

3) Multiplication systems

Table 3. Summary of multiplication achievements 2002

Country	Target/ achieved	New groups prod. planting material			New groups producing planting material			No. of new on-farm tree seedling nurseries
		Vegetative	Seeds	Vegetative + seeds	Vegetative	Seeds	Vegetative + seeds	
China	T	5	0	0	45	20	0	10
	A	5	0	0	45	20	0	12
Indonesia	T	25	3	8	202	5	15	11
	A	11	28	0	0	0	0	3
Philippines	T	12	54	14	2	2	7	19
	A	31	511	157	156	21	16	13
Thailand	T	0	0	0	0	0	0	0
	A	0	0	21	0	0	0	0
Vietnam	T	0	0	0	11	13	5	2
	A	5	65	40	3	3	10	1
Total target		42	57	22	260	40	27	42
Total achieved		52	604	218	204	44	26	29
% Achieved		124	1060	991	78	110	96	69

4) Capacity building

Table 4. Summary of capacity building 2002

Country	Target/ achieved	No. of farmer training courses or field days conducted	No. of farmers participated in training courses or field days	No of technicians' training courses	No. of technicians attended training course
China	T	5	130	1	10
	A	7	146	2	8
Indonesia	T	3	425	21	38
	A	6	126	4	18
Philippines	T	39	970	20	47
	A	22	947	9	62
Thailand	T	4	100	1	5
	A	2	100	1	5
Vietnam	T	30	650	1	20
	A	57	1632	2	35
Total target		81	2275	44	120
Total achieved		94	2951	18	128
% Achieved		116	130	41	107

Scaling out in numbers

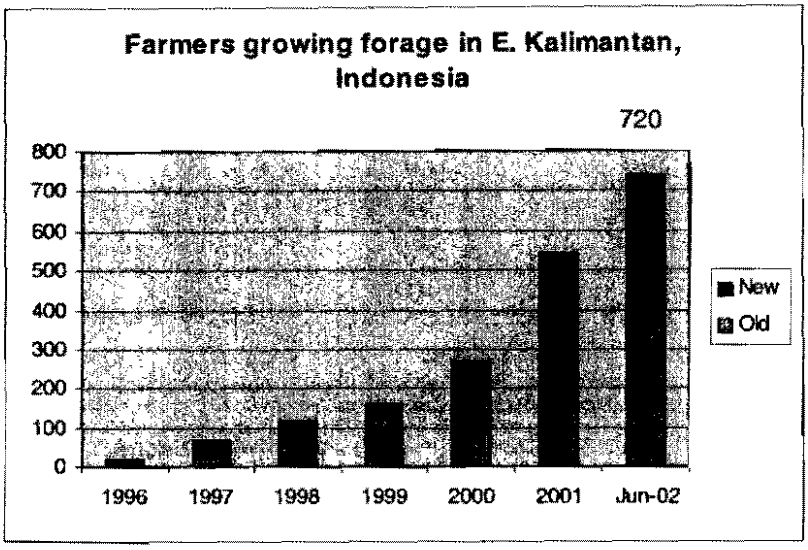

Figure 1. Farmers growing forage in Indonesia

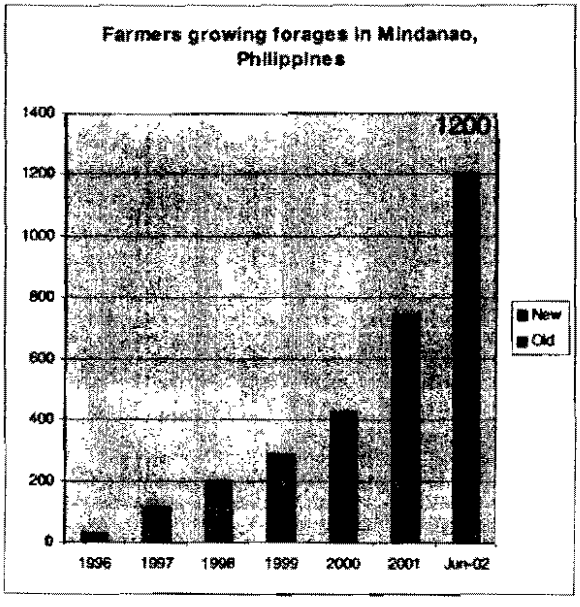

Figure 2. Farmers growing forage in the Philippines

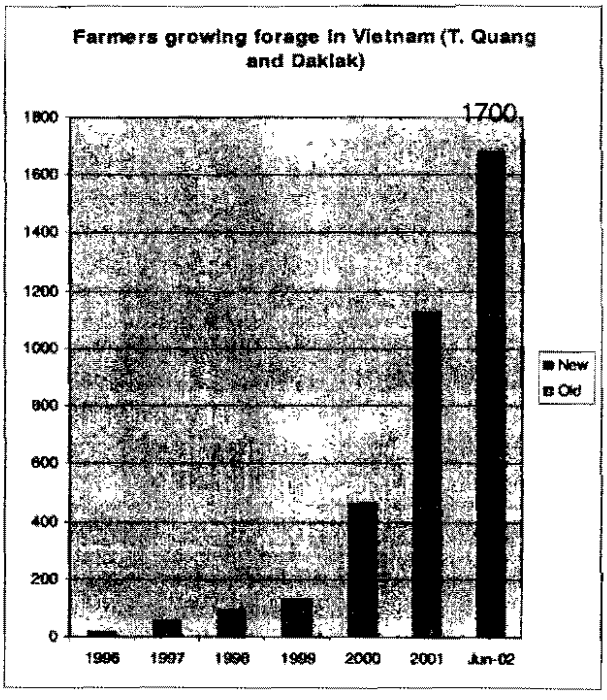

Figure 3. Farmers growing forage in Vietnam

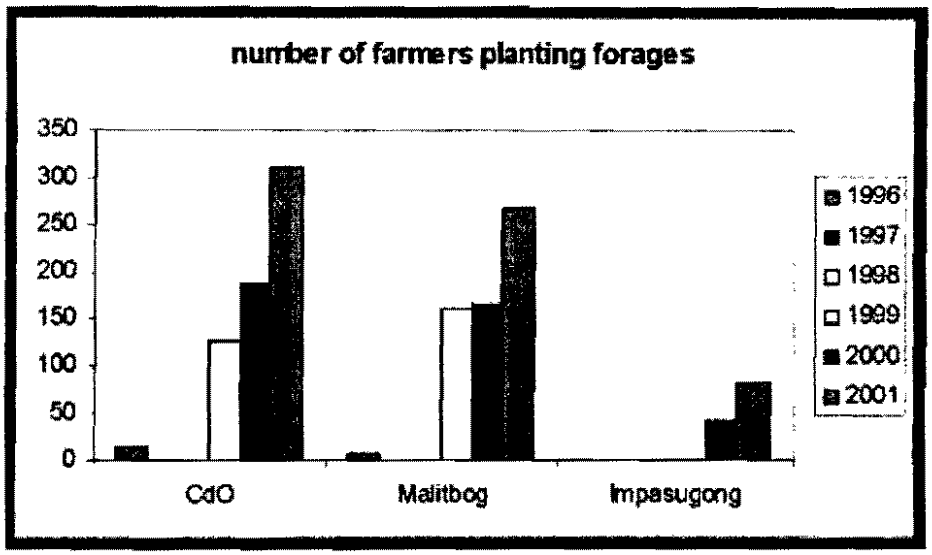

Figure 4. Number of farmers planting forages in the Philippines

Tools and essentials for going to scale

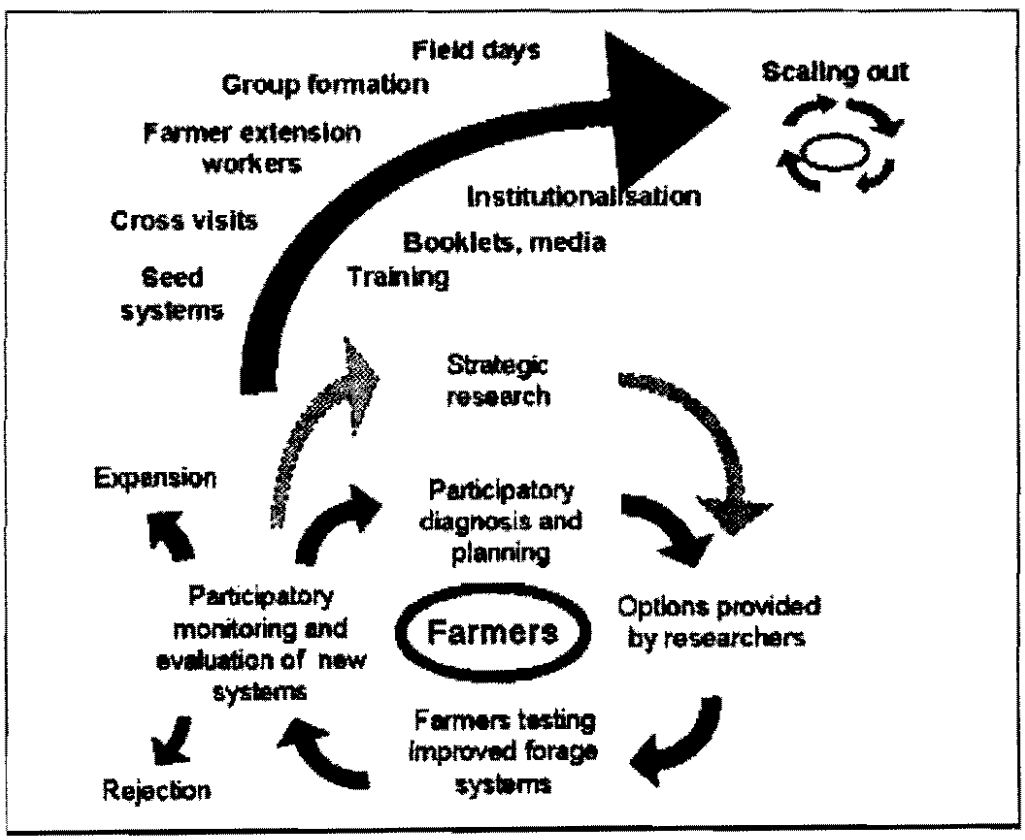

Figure 5. Strategy and tools for scaling-up

Role of information flows in scaling process

	Managers	Farmers	Reasons managers	Reasons farmers
Technicians Training	☺ ☺		Basic principles, skills	
Part. Diag & Planning	☺ ☺ ☺		Morale, partnership, direction	
Field visits & days	☺ ☺ ☺ ☺	☺ ☺ ☺	Technology awareness	Exposure, planting material
Farmer train. and technicians visits	☺ ☺	☺ ☺ ☺ ☺	Direct contact, understand problems, enhances interest	New learnings on forage management, animal husbandry, Experimentation on natural resources management
Cross visits	☺ ☺ ☺ ☺	☺ ☺ ☺ ☺	Effective in convincing farmers, Sharing of experiences and knowledge, supplementary information.	Knowledge on new species, forage management, animal husbandry, feeding, milking. Source of planting materials.

☺ ☺ ☺ ☺ ☺ = highest

Targets FSP Phase II

(i) Development of sustainable forage technologies for resource-poor farmers in upland farming systems:
- Forage availability
- Ruminant productivity increased
- Labor requirements for feeding livestock reduced

(ii) Strengthening the capacity of participating Bank countries to develop and deliver technologies in item (i) above to farmers
- Number of skilled researchers and extension workers increased and improved

Results of impact studies

Indonesia

- 20 % reduction in labor time
- Improved animal production
- Increased off-take
- Better body condition and carcass quality
- Increased herd sizes
- Income per day worked in livestock system increased more than 70 %

Philippines

- Income on monthly basis from livestock more than doubled
- Slight financial benefits due to saved labor and reduced erosion
- Reduced tasks for women and children
- Reduced social tension

Vietnam

- Net income from ruminant - fish production systems increased from US$ 32 to US$ 86 per month labor
- Another US$ 29 increase per month due to labor saved
- Women and children benefited most
- Spent more time on study, education and cultural activities

Section 2:

Country Reports – Experiences, Achievements and Learning

The situation of agricultural development and farming systems in Cambodia

Khieu Borin[1] and Chan Phaloeun[2]

Introduction

Cambodia is a predominantly agrarian society, with agriculture representing a major share of GDP (about 40%). Within agriculture, crops and fisheries are the most important sub-sectors with 45 and 30 percent of agricultural GDP, over the period 1993-2001, followed by livestock (14 percent of agricultural GDP) and forestry (10 percent). The majority of the population (about 85%) lives in rural areas and depends mostly on agriculture for their livelihood (UNFPA, 1998; MOP, 1998).

Productivity is low, both in terms of labor (about US$166/worker) and in terms of land (US$480/ha). In comparison with neighboring countries; rice yield in Cambodia is approximately 2 tons per ha while Vietnam and Thailand reach 4.2 and 3.4 tons respectively (FAO, 2002). Poverty is widespread in the country (36 percent of the population are poor) and concentrated in rural areas (40 percent of the rural population are poor) (ADB, 2002).

As the natural resources base comprises the principal wealth of many rural communities in the country; projects are often concerned with the management and utilization of natural resources. The more fertile their land and the more productive their crops and trees, the more possibilities these communities have to ensure their livelihood and improve their well-being. Many Cambodian rural communities depend upon the natural resources including fish and forest for survival (MAFF, 2002). However, due to civil war, which occurred during a decade in Cambodia, the infrastructure of government has broken which makes its difficult to control natural resources. Those natural resources include forest and wildlife, which support the lives of more than 80% of the population in Cambodia.

Interest is emerging in the important role of livestock in Cambodia. From small to large livestock species, animals generate revenue for all farmers. They provide labor such land cultivation

[1] Department of Animal Health and Production, Ministry of Agriculture Forestry and Fisheries, Phnom Penh

[2] Cambodian Agricultural Research and Development Institute (CARDI), Phnom Penh

and transport in rural areas and produce such as meat, milk, eggs, skins, and hides. Livestock also play an important role in farming systems by converting farm residues into fertilizer (manure), which is an important input for crops.

Problems in agricultural development in Cambodia such as the lack of a strong rural structure, the lack of access to resources for agricultural inputs, poor market access and support services such as technical and extension services, all of which hinder farmers in taking up opportunities to produce a wider range of crops and livestock. Despite these constraints, it is still expected that agriculture will be the lead sector of the economy for the next decade. The Royal Government of Cambodia (RGC) aims to reduce poverty from 36 percent to 31 percent during the SEDPII period by increasing the rate of economic growth to 6-7 percent per annum (RGC, 2002)

Challenges of Regional Integration

It is a good opportunity that Cambodia joins and becomes a full member of the Southeast Asian Countries (ASEAN) to bind the country closely into the region. However, in other hand, this will reduce significantly the revenue to the national budget derived from taxation (FAO, 1999). Membership in the organization will obligate the country to reduce tariffs towards the agreed target of zero to 5 percent within ten years and remove non-tariff barriers such as quotas and licenses. The reduction of tariff within ASEAN is a very critical issue discussed at the moment at the National Assembly in Cambodia. While under the taskforce chaired by the Ministry of Economy and Finance, several working groups are currently identifying commodities to be placed in the inclusive list (items for which tariff rates will be reduced) and the temporary exclusive list (list of goods viewed to be too sensitive for immediate rate reduction).

Since the country economy relies mainly on agriculture, this sector will generate the mayor products for export to other ASEAN countries. However, the current level of the production (mainly subsistent), Cambodia will not be able to compete in the regional markets (FAO, 1999). In order to improve competitiveness and respond to demands in the region, the RGC, especially the Ministry of Agriculture Forestry and Fisheries, has targets in the Agriculture Development Plan for long,

medium and short term, taking into account constraints to the growth of this sector. The constraints are the absence of clear policy framework, undeveloped marketing systems, barriers to exportation of the products, low productivity, institutional problems, financial constraints, inadequate extension services and limited access of farmers to production resources (Khieu Borin, 2000).

Agriculture and Livelihood

The Government's strategies for developing the economy, for food security and poverty reduction demand a much stronger focus on agricultural development, which is the most effective way to create employment (ADB, 2002). Therefore, crop, livestock, fisheries and forestry production will only improve food security and reduce poverty when adequate and specific measures are taken to protect and assist the poor and natural resources are used and managed sustainably.

The total land area of Cambodia is approximately 18.1 million hectares, of which about one-third, or 6.4 million hectares, is considered suitable for agriculture (RGC, 2001). Currently, the land effectively utilized for all agricultural purposes is only about 2.7 million hectares, which implies that there is an additional 3.7 million hectares of land that could be brought into cultivation (Table 1).

Table 1: Land Use (million ha)

Land Use	1992/93	1996/97	Change, %
Forest	10.86	10.64	-0.2
Agriculture	3.69	3.90	0.2
Grassland	0.48	0.49	0.0
Scrub land	2.20	2.52	0.3
Urban	0.03	0.03	0.0
Wetland	0.54	0.55	0.0
Other	0.36	0.02	0.3
Total	18.15	18.15	0.0

Source: ADB, 2002

Besides natural disasters, the subsistence nature of agriculture is another productivity-inhibiting factor. There is, for example, limited use of improved varieties and fertilizers. The need for mechanization to ease on-farm labor shortage is also not being met. In addition, most programs/projects providing direct support to this sector such as agricultural inputs and supply,

research and extension, marketing and credit, are just being started from scratch with foreign technical assistance, grants and loans.

1. Crop production

Paddy rice by far is the predominant agricultural crop occupying 90 percent of the cultivated land and accounting for 43 percent in 1999. Rice yield is still very low as compared with neighboring countries because most fields are rainfed only and are dependent on the irregular rainfall pattern. Only about 11 percent of the rice cultivation area has supplementary irrigation and less than 13 percent of the total cropland is cultivated in the dry season (ADB, 2002). Other important crops are maize, soybean, mung bean, peanut, cassava, sweet potato, sesame, fruit trees and vegetable (Table 2). Recently, interest in the industrial crops such as cotton, sugar cane, cassava, cashew nut, palm oil, coffee, etc. has increased particularly in the provinces with low-density population.

Table 2: Cultivated areas of mayor crops ('000 ha) and annual production ('000 tons)

Crops	1985		1990		1995		2000	
	Area	Production	Area	Production	Area	Production	Area	Production
Paddy rice	1,462	NA	1,890	2,500	2,086	3,448	2,318	4,026
Maize	50.7	42	47	88	52	55	72	157
Cassava	NA	NA	11	60	14	82	16	148
Sweet potato	NA	NA	8	31	10	39	7	28
Vegetable	NA	NA	30	170	42	193	34	196
Mung bean	43	21	28	12	26	20	25	15
Sugar cane	NA	NA	6	258	9	202	8	164
Soybean	NA	NA	15	22	17	17	33	28
Peanut	11	5	4	7	10	7	10	7
Sesame	NA	NA	10	5	9	4	19	10
Tobacco	NA	NA	16	8	14	11	10	8
Rubber	NA	NA	54	35	44	35	35	40
Jute	NA	NA	2	2	1	1	0.208	0.18
Total			2,122		2,331		2,587	

Source: DPSIC, 1985, 1990, 1995 and 2000.

2. Agricultural Production Systems

Several production systems are found in Cambodia, corresponding largely to agro-ecological regions: The central Mekong basin (the large inundated plains around Tonle Sap lake and in the Delta, the ancient alluvial terraces, the river banks and the levees, and the back swamps and lakes behind the levees) and the periphery of the basin (the northern edge of the plain, the southern mountain range and the central plateau and north-eastern highlands). The most common production systems found are:

- *Rice-Based Production Systems.* Rice is the major crop for almost every ecological region; however, the cultivation practices depend on the geographical conditions. Five major rice systems found in Cambodia are: (a) rainfed lowland rice, (b) deep water floating rice, (c) dry season flood recession rice with complementary irrigation, (d) dry season lowland irrigated rice, and (e) rainfed upland rice.
- *Multicropping Systems.* While, for physical and historical reasons, rice based cropping systems dominate agricultural production in Cambodia, other production adapted to different agroecological conditions have also developed over the years. Four major systems are: (a) multicropping Mekong river levee and back slop systems, (b) multicropping brown and red soil (c) multicropping black clay system, and (d) slash and burn systems.

2.1. Rainfed Lowland Rice

Rainfed lowland rice production, accounting for 85% of the total rice area, is concentrated in the plats plains surrounding the Tonle Sap Lake and the Mekong and Bassac rivers. The cultivated area per household is up to 5 hectares in the sparsely populated west (Battambang), but less than 1 hectare in provinces with the highest population (Kampong Speu and Takeo). The area cultivated does not vary much from one village to another; but there is certain diversity between households depending on: a) financial resources, b) draught power, c) access to water and fertility of the soil, d) family labor availability and e) off-farm economic opportunities.

The average number of draught animals per farming household is 1.3 drought animals, which is sufficient for provinces with high population density and small land holdings, but insufficient for

the sparsely populated western provinces. Areas around houses are intensively farmed with various fruit trees, vegetables, herbs. Most farmers raise chickens, pigs and cattle. Human protein intake is improved with the capture of wild food including frogs, crabs, fish and insects. Apart from the sale of farm animals and sugar palm syrup, farmers supplement their income by gathering and selling homemade mats, thatches, basket and seeking off-farm employment.

2.2. Deep Water Floating Rice

Deep water floating rice is grown in low-lying areas and depressions that accumulate floodwater at a depth of 50 cm or more for at least 1 month during its growing period. Maximum water depth ranges from this depth to more than 3 m. The area of cultivation is around Tonle Sap Lake and in the back swamps of the Mekong and Bassac rivers. The deep-water rice areas are mainly located in the provinces of Kompong Thom (29,520 hectares), Banteay Meanchey (16,450 hectares), Battambang (10,507 hectares), Takeo (7,970 hectares) and Siem Reap (6,660 hectares) and the other provinces like Pusat, Kandal, Kampong Chhnang, and Kampong Cham cover small areas from 1,000 to 4,000 hectares.

The cultivation of deep-water rice is starting by burning stubble straw remaining after being grazed by cattle and buffaloes and this takes place between February and early April. After single or double plowing, seed broadcasting starts late April to May in southern provinces (Takeo, Prey Veng and Kandal) and from May to mid-June in the northern provinces (Battambang, Siem Reap, and Banteay Meanchey).

2.3. Dry Season Flood Recession Rice with Complimentary Irrigation

Dry season flood recession rice accounts for 8% of the rice area (143,000 hectares) and it found mostly in the provinces of Takeo, Prey Veng, Kandal and Siem Reap. This type of production benefits from the annual siltation of the Mekong River and presents a high potential in term of productivity improvement. The areas are flooded for 3-5 months before water recession takes place. The acreage cultivated in flood recession rice is increasing yearly due to: a) the clearance of inundated forest particularly around Tonle Sap Lake and b) the transformation of floating rice areas

into flood recession cropping systems. Broadcasting before water is receded (0.5 m) is the common practice in Pouk District, Siem Reap Province.

2.4. Rainfed Upland Rice

Upland rice areas in Cambodia are unbounded fields that depend entirely on local rainfall. They are generally found scattered in rolling lands, some of which are mountainous forested area. Thus upland rice is also known as mountainous rice. The rainfed upland area is relatively small when compared with other rice farming practices. The rainfed upland rice areas found in 1994-95 were: Ratanakiri (9,000 hectares), Kampong Cham (8,000 hectares), and Siem Reap (7,000 hectares) (FAO, 1994). 1,000-2,000 hectares are found in Mondulkiri, Kampong Thom, Kandal, Koh Kong, Preah Vihear, Stung Treng, and Kampot (FAO, 1998).

Shifting cultivation or slash-and-burn method is the major upland rice production system in Cambodia. Forest is cleared and planted with rice for 2-5 years before farmers shift to the new area. Farmers often return to the old upland rice site after several years of fallow. This is the common method practiced in the north and northeastern provinces and in hilly forest areas of other provinces. Mainly various ethnic minorities practice shifting cultivation. Crops like cassava, maize, sweet potato, pumpkin, taro, bitter gourd, sponge gourd, chili, eggplant and tobacco are inter-cropping techniques. Cassava, banana, papaya, maize and sweet potato are also found around the rice fields.

3. Livestock Production Systems

Livestock is an integral part of the agriculture production system in Cambodia. The development of the animal production has been restrained during the last 20 years due to the war and the continually changing system of economic management. The chronic shortages in government funding have meant that even the most basic service for control of diseases has not been able to be provided. In spite of these constraints the basic system of production remains intact and it is continuing to fulfill its traditional role as a major source of cash income for the farming community and the main vehicle for saving and accumulating wealth in farming households. Livestock is estimated to have contributed an 11.2% share of real GDP in 1991 (down from 17.1% in 1987) and make up 24% of

agriculture's contribution to GDP (down from 33% in 1987) (FAO, 1994).

The number of cattle and buffalo fell dramatically from 2.2 million in 1970 to just 779,000 in 1980 and the number of pigs fell from 1 million to under 200,000 due to the civil conflict in the country but the animal population started to increase again when peace and political situation were stabilizing. According to the statistics from MAFF (from 1983 to 2000) the population of animals has increased almost 3 times for cattle and pigs, about 1.3 times for buffaloes and about 3.3 times for poultry. However, only the population of buffaloes in 2000 has decreased due to a strong market demand from Thailand.

Table 3: Livestock population

Types of animal	Population	
	1983	2000
Cattle	1,271,000	2,992,640
Buffalo	540,000	693,631
Pig	824,000	1,933,930
Poultry	4,595,000	15,249,201

Source: DPSIC, 1985 and 2000.

Cattle. In Cambodia, cattle are kept exclusively for draught purposes. However, they can be sold for meat when animal cannot provide labors such transporting and plowing. Most of households keep a few animals (2-5), typically a pair of oxen and cows. However, until present there are still many households without draught animals. A survey in six provinces (Kampong Cham, Kampong Thom, Kandal, Kratie, Prey Veng and Svay Rieng) reported that about 50% of the crop producing households has no cattle (DPSIC, 2001). Common cattle breeds found in Cambodia are local small cattle and Haryana with live weight of 180-220kg and 350-450 kg respectively. The local cattle are very well adapted to all agro-ecological regions, while the Haryana cattle are only found in the areas close to rivers. During the rainy season cattle are fed on roadsides and tethered between paddy fields, however, most of the times they are tied under the house or trees and fed them rice straw. In the dry season, cattle are allowed to grass freely during the daytime. In a few cases, farmers feed their draught animal with paddy rice or rice bran with banana stem or rice straw with sugar palm juice.

Milk production has been ignored in Cambodia, as there is not much demand for fresh milk in the local market. A few Muslim families who live along Bassac River produced fresh milk but later stopped. Milk used is limited to condensed milk sold in cans. However, fresh processing and non-processing milk is importing from Australia, Vietnam and Thailand. The potential of local cows to produce milk can be considered once the nutrition and management has improved. Presently, Nestle is promoting milk production by introducing Holstein sperms through IA.

Buffalo. While there are fewer buffaloes than cattle in Cambodia they are an important part of the farming system, particularly for cultivation in the wetter areas and on heavy clay soils. They are most important in the provinces of Svay Rieng, Kompong Som, Koh Kong, Preah Vihear, Stung Treng and Ratanakiri where they outnumber cattle and in Mondulkiri, Kratie, Kompong Thom, Prey Veng and Pursat where they provide 30-50% of draught animals. These buffaloes are of the swamp type and are generally well grown, attaining body weights of 350-450 kg for mature males and 300-350 kg for mature females. Buffaloes appear to do better than cattle under the prevailing nutritional conditions, however, they are more susceptible to Haemorrhagic Septicemia and mortality in young calves is thought to be higher than in cattle.

Pigs. Pigs are very popular animals kept by the majority of Khmer people. Generally 2-4 pigs are being raised in most households. The purpose of raising pigs is to generate income and the utilization of kitchen waste as feed. Some farmers raise pigs for marriage and festivity purposes.

This raising system is not efficient because of the high mortality caused by diseases and insufficient feed supplementation. The lack of farmers raising sows compared with farmers who prefer fattening may also impede the development of pig production. There are many farmers who do not like to raise sows because of a traditional belief. This is one of the reasons why piglets of 8-10 kg are relatively expensive when compared with full and grown pigs of 100 kg.

The pig population shows signs of upgrading through the introduction of improved European breeds. There are a large numbers of white colored pigs and now only minimal expression of the characteristic of the traditional pig is evident. Sows are commonly raised in the south and southeastern parts of the country (Prey Veng, Kandal, Takeo and Kampot). High mortality occurs in

piglets after weaning due to the quick change of feed and stress during transportation for sale.

Chicken. Poultry production is based on backyard operations involving a few birds (5-10 hens per villager). Chickens are found in most of the households in the rural areas (about 90-95%). Chickens are preferred over ducks and pigs, as they require low or no investment. A major problem for chicken development is diseases. It is estimated that each hen lays approximately 3-4 clutches of eggs per year and that 10 chicks are hatched per clutch, and that 50% survive[1] until they can be sold at the market.

Ducks. There are two types of ducks, for meat and egg production and they are mainly local breeds. There is little specialized duck production for meat, but the males are fattened for sale and females are kept for egg production. The selection is done when they are 3 months old. Villagers start to purchase ducklings in the late rainy season (November-December). The reason to buy ducklings of that time is because farmers match the ducks with the feed resources available during the rice harvesting period. There are two categories of duck enterprises: about 30% of the small-holders raise from 5-20 ducks per family and about 10% raise from 100-1,000 ducks per family. Most ducks are released on water areas (paddy fields, ponds and canals) during the day and penned at night when they are supplemented rice.

3.1. Common Diseases and Prevention

Common diseases in cattle in Cambodia are: Haemorrhagic Septicemia (HS), Black leg and Foot and Mouth Disease (FMD). There is a general belief that HS causes major problems when cattle are exposed to the poor quality and quantity of feed during dry season and forced to work hard in the early rainy season. The outbreak of FMD has always occurred during the rainy season when there is optimal condition for the virus. However, at present, an outbreak of FMD commenced in the dry season and infected on both cattle and pigs. Major diseases in pigs are Pasteurellosis, Salmonellosis, Hog Cholera and Erysipelas. Vaccines are imported legally or illegally from Thailand and Vietnam. During the last 5 years, FMD caused major problems in small-scale pig

[1] Hatched during the rainy season, after the outbreak of Newcastle, therefore there is less risk of high mortality.

production in some provinces like Takeo, Kampong Cham and Siem Reap. Newcastle, Fowl Pox and Fowl Cholera are common in village chicken production and cause about 70-80% mortality. They occur from the early dry until early rainy season. Similarly, high mortality in ducks seems to occur during the dry season, particularly affected are female ducks for egg production. Duck plague is blamed for the high mortality.

Parasitism, without doubt, causes considerable reduction in productivity and the efficiency of feed conversion in most species. However, there is virtually no systematic or strategic use of any control measures. In cattle and buffalo, liver fluke in adult animals and ascaris in calves are probably the major problems and there is possible, also a major increase in nematode burdens with the onset of the wet season following the long dry period. Heavy burdens of Ascaris spp. are reported in young pigs and are associated with death, ill-thrift and pneumonic disease. In chickens coccidia and roundworm infection in young birds cause death and slow growth respectively. In general, the economic important of parasitism is somewhat discounted by local authorities because the loss is not generally expressed in terms of high mortality.

Almost all kind of vaccines for small animals (pig and poultry) are found in the local market, either pharmacies or veterinarian supply stores. The quality cannot be guaranteed as they are imported through many channels. DAPH produce a HS vaccine there is a concern about the strategy to implement vaccination. Recently, the Government adopted the decree on Village Animal Health Worker with the expectation that only those who have been trained are allowed to serve villagers with a reasonable charge.

3.2. Animal Feed Resources

As livestock production relies mainly on the natural and available feed resources, any technology introduced in the village must start to improve from this basis. Additionally, there are agricultural by-product and residues, which can be used as animal feed. Although these available feed resources are poor quality due to high fiber (e.g. rice straw), water (duckweed) and anti-

nutritional factors (sweet potato tubers) or toxicity (cassava leaves), technologies can be introduced to improve the quality of these feeds.

Rice straw is the most common feed for both cattle and buffaloes during the whole year but most important during the rainy season due to the shortage of grazing areas, or farmers are too busy to take them to grazing areas or to cut grass. After harvest, rice straw is stored near house. Other by-products are maize stover, soybean, mung bean and peanut straw, sugar cane tops and leaves. Cassava and sweet potato leaves are also available in the some times during the harvest (e.g. in areas close to the rivers, the harvest is normally in June or July before flooding). The feed used for monogastric animals are paddy rice, rice bran, broken rice as energy source but generally protein supplement is the main problem for these animals. In some areas, where fish is available, farmers also feed fish to their animals.

As the conventional feed resources, particularly protein sources from fish and soybean, face difficulty due to the availability, price and human food. Innovative technologies must developed allowing farmers and small livestock producers to feed their animal with non-conventional feed resources.

New areas for research to improve protein supplementation for livestock production must look into water plants and leguminous plants including trees and crops. The research must look into both production in term of fertilization and the management of the plants for yield and soil improvement. Plants and crops of interest are: water spinach (*Ipomea Aquatica*), duckweed (*Lemna spp.*), water hyacinth (*Eichhornia crassipes*), forage sweet potato (*Ipomea batata*), Cassava (*Manihot escolenta*), Mulberry (*Morus alba*) and Moringa (*Moringa oleifera*). In addition, other leguminous plants need for research which have been introduced by CAAEP with the financial support from AusAid such as Stylo hamata, Stylo scabra, Stylo 184, Wynn cassia, Aztec atro, Centurion, Leucaena, Desmanthus, Guinea, Gamba grass and Atro paspalum. These introduced plants should also be tested in the mountainous and upland in order to see its acceptance and impact.

4. Research and Extension

4.1. Situation of Agricultural Research

The shortage of government budget and interest to support agricultural research, the poorly qualified and unskilled staff, and low salaries are part of the reason for the poor agricultural productivity. The difficulties that stand in the way of implementing research activities include: The absence of a policy framework; lack of budget, human resources and infrastructure; unplanned, uncontrolled and uncoordinated research and development work; lack of skilled and experienced staff; lack of reliable information; and poor linkages between research and other stakeholders (May Sam Oeun, 2000). The only significant research carried out currently is related to rice with the financial support from Australia through IRRI, which is transformed into the Cambodian Research and Development Institute (CARDI). A few other research stations are working with maize (formerly supported by Hungary) and vegetables funded through several NGOs in Cambodia and others are under World Bank loan (APIP). Recently, interest in livestock development has been expressed by the donor community (EU and Japan).

Although little effort has been devoted to research on animal production (Men Sarom et al., 2000), numerous research projects have been carried out since the establishment of the University of Tropical Agriculture in Cambodia (UTA). UTA was established in Cambodia in 1997, but came into full operation in 1999 after the second National General election. UTA was founded by scientists from several countries with the objective to provide training and research to people of the developing countries to use and manage their natural resources in a sustainable manner. Topics for research and study include integrated management of livestock and crops, use of renewable energy, low-cost bio digesters and solar panels, recycling of nutrients, use of local resources, local livestock breeds and promotion of biodiversity in plants, trees and animals (UTA, 2002). In addition, UTA is working strongly on the recycling of waste and methane gas production for small holders.

Since 2001, SAREC, the Swedish Agency for Research Cooperation, extended its successful program in Vietnam to embrace the whole region of the Lower Mekong Basin (Cambodia, Laos, northeast Thailand and Vietnam). The program with the annual budget of about US$640,000

established a regional network called Mekong Agricultural Research Network (MEKARN) with the purpose to provide training at MSc. and Ph.D levels and research funds for member institutions from each country. One important immediate objective is to promote livestock as epicenter of sustainable farming systems. Presently 18 students from the 4 member countries are trained at the MSc. level and 3 at Ph.D level.

Recently, the Australian Government, through ACIAR (Australian Centre for International Agricultural Research) and AusAID are extending their financial support by establishing the Cambodian Australian Research Fund (CARF) in 2002. The areas for research funded under CARF are crop production, protection and post-harvest technologies, livestock production and health, natural resource management as it relates to sustainable agricultural production, farming systems economics and socio-economics and aquaculture as it relates to farming systems. Applications are open for government institutions, universities or colleges and NGO organizations based in Cambodia. In the medium term, it is expected that the CARF will be institutionalized within Cambodia and allow other donors contribution to the trust fund and/or support projects linked to trust fund projects.

Research projects that have been carried out or planned, related to livestock production improvement in Cambodia, are listed in Annex 1.

4.2. Extension systems

At present stage of development of agricultural research and extension services and systems in Cambodia, linkages between all stakeholders are very weak and there are few effective mechanisms in place to foster these links. However, there are informal links on the basis of discussions at meetings and field days and also through related aid projects. These are unplanned, unstructured and conducted entirely on an ad hoc basis. For example, some NGOs use their own recommendations of fertilizer rates in their development areas, while CARDI and Department of Agronomy and Agriculture Land Improvement might have other recommendations.

Several forms of agricultural extension are used in Cambodia and these depend on each project. Field demonstration, intensive farmer training and field days have been used in agricultural extension. Recently, interest has been on the Farmer Field Schools, although some donors are skeptical due to the shortage and limited capacity of human resources in the country who can effectively implement this type of extension. IPM has been the leading project to promote the Farmer Field School methodology and presently the Special Program for Food Security is using it as the main component to introduce technologies into villages.

Due to the strong research interest in rice production, the extension activities are also concentrated on rice development. Few development agencies are working on livestock development except for veterinary services. In 1993, through the project TCP/CMB/2254, the DAPH in coordination with some NGOs (LWS, WVI, CWS, VSF, GRET, JRS) and FAO launched the first feed improvement project in Cambodia in order to improve feeding quality during the dry season. Major technologies introduced were: (i) urea treatment of rice straw, (ii) multi-nutritional blocks, sugar palm and cane juice for pigs and low cost plastic biodigester technology. Presently UTA in collaboration with FAO Special Program for Food Security is introducing fodder trees, earthworm production and plastic biodigesters in some provinces of Cambodia.

Forage production has been targeted as an important area for the development of livestock production. Desmanthus, para grass and Leucaena are of significant in terms of adaptation and distribution. Gliricidia sepium has been introduced in rubber plantation in Kampong Cham during the French time and it is also very well adapted. In 1993, a forage tree (*Trichantera Gigantea*) from Colombia was introduced and at present, this forage tree has been distributed in several provinces in Cambodia.

Forage production under CAAEP has been implemented in Banteay Meanchey, Battambang, Pursat and Kampong Chhnang (northwest provinces), in Takeo, Prey Veng and Kampot (southeast provinces) and in Kampong Thom, Kampong Cham and Ratanakiri (northeast provinces). The implementation of this project is targeted to backyards and roadsides. GTZ, Concern and LWS are collaborating in the implementation while Department of Animal Production and Health is taking

the lead role (Robertson, 1998). The impact of backyard fodder development is not known but the roadside forage development is significant on National roads 1 and 4.

5. Conclusions and Recommendations

- Improved collaboration within and between government institutions and the donor community on the development of policy and guidelines to guarantee the smooth implementation of agricultural development plans. Links must be established within and between ministries (agriculture, water resources, rural development and environment) and donor community including NGOs working in Cambodia in order to coordinate and use resources effectively and efficiently.
- More resource and investment should be put into high-quality human resource development to enhance efficient and effective contribution of research to agricultural development. Agricultural education must incorporate socio-cultural subjects so that students can work farmers in the field. Cambodia will need considerable human resource development to strengthen research capacity and accelerate information exchange if multi-disciplinary research in crop-animal systems is to be successful.
- Livestock is an epicenter of Cambodian farming systems. Given the important role of livestock in the Cambodian economy and revenue for different categories of farmers, effort and investment should give priority to both veterinary services and feeding improvement. This will improve the food security and income of farmers, and help them to better cope with the flood.

Annex 1: Research in livestock improvement conducted in Cambodia

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Activities, outputs and impacts of FSP Phase II in Hainan Province, P.R. China

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Introduction

Farmer participatory research in forage technology development has been conducted by CATAS in China, for three years since the Forages for Smallholders Project Phase II started in 2000. Hainan province has been the focus site. The component objectives of the project focus on participatory forage technology development, multiplication, dissemination, scaling-up, capacity building and networking. Activities have included participatory diagnosis, participatory on-farm trial, farmer-to-farmer extension, nursery establishments, seed and planting material production, training and cross-visits, monitoring and evaluation. In the past three years, the project made an impact on people, livestock and environment on sites of FSP in the province.

General condition in Hainan

Hainan is the only tropical province in China. Hainan Islands is situated in South China Sea from 18°10'to 20°10' north, and 108°10'to 113°3' east. The island covers 34000 km^2, 40 % of which is hilly and mountainous with altitudes over 100 meters above sea level. The average annual temperature is 23.6 °C. Annual rainfall is 1800-2000 mm, with a rainy season from June to October, and dry season from November to May. The main crops are paddy rice and upland rice, sugarcane, cassava, sweet potato, maize, vegetable and cash crops such as rubber, mango, lychee, banana, and pineapple. Animals kept are pigs, buffalos, cattle, goats, chicken, geese, ducks, rabbits and fish. The total population is about 7,000,000 and 80% are farmers.

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FSP sites in Hainan province

Farmer Participatory Research has been conducted in Baisha, Danzhou, Ledong and Dongfang counties in Hainan Province during FSP Phase II. Eighteen villages were involved in FSP.

Table 1. FSP sites in Hainan province

County (District)	Twon (Sub district)	Village	No. of groups participated	No. of farmers participated
Baisha	Fulong	Wentou	1	16
	Fulong	Xinkai	1	16
	Fulong	Daola	1	13
	Fulong	Keren	1	17
	Xishui	Zhaxi	1	15
	Xishui	Yacha	1	1
	Rongbang	Fanglao	1	7
	Rongbang	Pogao	1	12
	Rongbang	Fanghong	1	6
Danzhou	Yaxin	Laogen	1	1
	Dacheng	Jianbei	1	2
	Baodao	Sidui	1	11
Dongfang	Datian	Tangmayuan	1	4
	Basuo	Pucao	1	3
Ledong	Zhizhong	Da'an	1	6
	Zhizhong	Jiaba	1	22
	Zhizhong	Tianyu	1	8
	Zhizhong	Qiuwen	1	16
Total	9	18	18	176

Research team

From Tropical Pasture Research Center, CATAS:

1) Yi Kexian, FSP-coordinator-China, professor, forage scientist.
2) He Huaxuan, Assistant researcher, forage scientist.
3) Zhou Hanlin, assistant researcher, animal scientist.
4) Bai Changjun, associate professor, forage scientist.
   Tang Jun, Junior researcher, forage scientist.
   Wang Dongjing, associate researcher, veterinary scientist.
   Liu Guodao, professor, forage scientist.

From Local Animal Technologies Extension Stations:

8) Mr. Fu Nanping , Dongfang city.
9) Mr. Liang Yonghao, Baisha county
10) Mr. Lin Yansheng, Danzhou city

Activities and Output in 2000-2002

1. Shrub legume experiment

An experiment for shrub legumes introduction and evaluation started in CATAS from 1999. The results up to now show that *the* yield of *Flemingia macrophylla*(CIAT accession) is higher than the local variety and *Leucaena leucocephala* and *Cratylia argentea*.

Table 2. Yield of four shrub legumes (DM kg/10 m^2).

Species	1999	2000	2001	2002	Mean
Flemingia macrophylla (Hainan)	5.41	3.62	6.07	4.76	1.65
Leucaena leucocephala	1.10	7.01	5.00	6.62	1.69
Flemingia macrophylla (CIAT)	2.65	9.84	9.53	8.41	2.54
Cratylia argentea	2.52	4.34	3.30	6.96	1.43

2. Stylo evaluation

Yield. New Stylo accessions selection and evaluation for anthracnose resistance and 20 early flowering accessions including 9 CATAS accessions were evaluated using *Stylosanthes guianensis* cv. Reyan No.2 (CIAT184, later flowering) and *Stylosanthes guianensis* cv. Reyan No.5 (early flowering) as controls in CATAS from 2001-2002.

The two year's result show that 6 accessions are early flowering which are GC1578, FM03-2, E7(90038), E9, GC1576, FM07-3. They have the similar flowering stage to *Stylosanthes guianensis* cv. Reyan No.5 (early flowering), but 30-45 day early flower than *Stylosanthes guianensis* cv. Reyan No.2 (CIAT184). In general, the forage yields of early flowering accessions are lower than those of late flowering ones in this study (table 3). Among the early flowering accession group, GC1578 is the best one with highest yield, but no significant difference with *Stylosanthes guianensis* cv. Reyan No.5. Among all the tested accessions, CATAS R39, CATAS

90075, CATAS 90089 and CATAS 90028 have highest yield, but all of them no significant difference with *Stylosanthes guianensis* cv. Reyan No.2 (CIAT184).

3. Anthracnose resistance

Two years of observation show that GC1579, GC1463 and Reyan No.10 are higher disease resistant than Reyan No.2 (ck). But the differences are not significant (table 4). However FM05-3, FM07-3, GC1480, Reyan No.5, CATAS E9, CATAS90038, FM03-2, GC1578 and CATAS90071 are more susceptible to anthracnose than Reyan No.2.

Table 3. Fresh forage yield of 22 Stylo accessions and varieties.

Treatment no.	Accessions or varieties	Fresh yield[1] (kg/mu)			Significance[2]
		2001	2002	Total	
1	*Stylosanthes guianensis* CATAS 90089	6926	2111	9037	AB
2	*Stylosanthes guianensis* cv. Reyan No.10	5778	2000	7778	ABCD
3	*Stylosanthes guianensis* CATAS 90071	4426	1888	6315	DEFG
4	*Stylosanthes guianensis* CATAS 90028	6878	2218	9096	AB
5	*Stylosanthes guianensis* CATAS 90087	5778	2429	8207	ABCD
6	*Stylosanthes guianensis* GC 1578	4229	1603	5833	EFG
7	*Stylosanthes guianensis* FM03-2	2222	1288	3511	HIJ
8	*Stylosanthes guianensis* CATAS 90038	1581	1422	3003	IJ
9	*Stylosanthes guianensis* CATAS E9	1296	2103	3400	IJ
10(ck2)	*Stylosanthes guianensis* cv. Reyan No.5	3407	1933	5341	FGH
11	*Stylosanthes guianensis* GC 1480	2914	1537	4452	GHIJ
12	*Stylosanthes guianensis* GC 1576 IRRI	3340	1374	4715	GHI
13	*Stylosanthes guianensis* GC 1463	5166	1629	6796	DEF
14	*Stylosanthes guianensis* FM05-3	2944	1933	4878	GHI
15	*Stylosanthes guianensis* FM07-3	1851	1822	3676	HIJ
16	*Stylosanthes guianensis* GC 1579	5629	1926	7555	BCDE
17	*Stylosanthes guianensis* FM07-2	1285	1488	2774	J
18	*Stylosanthes guianensis* CATAS 90075	6726	2815	9541	A
19	*Stylosanthes guianensis* GC 1517 IRRI	4963	2126	7089	CDEF
20(ck1)	*Stylosanthes guianensis* cv. Reyan No.2	6408	2571	8978	ABC
21	*Stylosanthes guianensis* CATAS R93	6945	2622	9567	A
22	*Stylosanthes guianensis* CATAS 90134	4815	2322	7137	CDEF

[1] One mu = 666.7 m^2

[2] Means in the same row followed by different letters are significantly different ($P<0.05$)

Table 4. Severity of necrosis caused by anthracnose in 22 Stylo accessions and varieties

Treatment no.	Accessions or varieties	Rate of disease severity value (scale 1 to 10)			
		2001	2002	Mean	
1	*Stylosanthes guianensis* CATAS 90089	5.0	4.6	4.8	CDE*
2	*Stylosanthes guianensis* cv. Reyan No.10	5.1	4.2	4.6	DE
3	*Stylosanthes guianensis* CATAS 90071	5.4	4.9	5.1	ABCD
4	*Stylosanthes guianensis* CATAS 90028	5.3	4.3	4.8	CDE
5	*Stylosanthes guianensis* CATAS 90087	5.1	4.3	4.7	DE
6	*Stylosanthes guianensis* GC 1578	5.5	5.0	5.3	ABC
7	*Stylosanthes guianensis* FM03-2	5.5	5.1	5.3	ABC
8	*Stylosanthes guianensis* CATAS 90038	5.4	5.2	5.3	ABC
9	*Stylosanthes guianensis* CATAS E9	5.8	4.8	5.3	ABC
10	*Stylosanthes guianensis* cv. Reyan No.5	5.2	5.1	5.1	ABCD
11	*Stylosanthes guianensis* GC 1480	5.4	4.8	5.1	ABCD
12	*Stylosanthes guianensis* GC 1576 IRRI	5.2	4.4	4.8	BDCE
13	*Stylosanthes guianensis* GC 1463	5.0	4.1	4.5	E
14	*Stylosanthes guianensis* FM05-3	5.5	5.3	5.4	A
15	*Stylosanthes guianensis* FM07-3	5.7	5.0	5.4	A
16	*Stylosanthes guianensis* GC 1579	4.8	4.2	4.5	E
17	*Stylosanthes guianensis* FM07-2	5.3	4.4	4.8	BCDE
18	*Stylosanthes guianensis* CATAS 90075	5.4	4.4	4.9	ABCDE
19	*Stylosanthes guianensis* GC 1517 IRRI	5.1	4.2	4.7	DE
20(ck)	*Stylosanthes guianensis* cv. Reyan No.2	4.7	4.5	4.6	DE
21	*Stylosanthes guianensis* CATAS R93	5.3	4.2	4.7	CDE
22	*Stylosanthes guianensis* CATAS 90134	5.	4.5	4.8	CDE
Inoculum	*Stylosanthes guianensis* cv. Cook	5.8	7.8	6.8	

*Different letters in the same row mean significantly different (P<0.05)

4. A case study of on-farm research on Stylo intercropping in mango plantation

An on-farm Stylo intercropping experiment was carried out in one mango orchard at the semi-arid red soil site, the farm of Mr. Lin Mingcong Tangmayuan, Dongfang County, Hainan. Five forage treatments were arranged randomly in this monoculture of mango at random. Treatments were: without intercropping (control), intercropping with lablab (*Lablab purpureus*, treatment 1), Stylo (*Stylosanthes guianensis CIAT 184,* treatment 2), sweet potato (*Ipomoea batatas,* treatment 3), and peanut (*Arachis hypogea* , treatment 4). Plots were arranged based on the mango rows with 2 replications and each plot covered 480m^2 (160m ×3m). The mango orchards with intercropping produced an income 97.79%, 98.53%, 54.41 and 48.28% more than the mango orchards without

intercropping from mangoes alone (table 6). Together with the benefits of other products, total income increased by 108.55%, 98.53%, 97.98% and 91.58% (table 8). Meanwhile the soil organic matter, total N, available P and soil pH in the mango orchards were increased when intercropping. *Lablab purpureus* enhanced the soil organic matter in the mango orchard by 53.3%, and *Stylosanthes* improved the soil total N by 43.92% and available P by 78.16%. Intercropping in mango orchards improved farmer's income and the soil fertility.

Table 5. Effect of treatments on mango tree growth (n = 25)

Treatment	Year	Tree height (cm)		Stem size (cm)		Crown size (cm)	
		Mean	Growth rate%	Mean	Growth Rate %	Mean	Growth rate %
Control	1998	120.3		2.66		85.51	
	2001	166.3	40.4a	5.10	87.8ab	171.73	99.3ab
Lablab	1998	139.0		3.22		110.99	
	2001	212.3	52.7a	7.25	128.7a	225.90	103.6a
Stylo	1998	162.4		4.25		141.65	
	2001	217.1	34.5a	7.35	67.4b	234.46	65.8bc
Sweet potato	1998	155.0		3.98		133.83	
	2001	215.8	40.8a	7.32	77.4ab	220.30	65.1bc
Peanut	1998	160.7		4.51		136.01	
	2001	215.7	34.3a	7.35	67.4b	218.42	61.1c

* Means in the same row followed by different letters are significantly different (P<0.05)

Table 6. Mango fruit number per tree, output and incomes from sales

Treatment	Year	No. of mango fruit/tree Mean	Output (kg/plot) Mean	Price Yuan/kg	Income (Yuan/plot) Mean
Control	1999	1.08	23.0	1.40	32.2
	2001	12.31b	204.0c	3.60	734.4
Lablab	1999	3.56	30.5	1.40	42.7
	2001	43.2ab	403.5a	3.60	1452.6
Stylo	1999	7.34	53.0	1.40	74.2
	2001	50.82a	405.0a	3.60	1458.0
Sweet potato	1999	13.34	76.5	1.40	107.1
	2001	37.54ab	302.5b	3.60	1089.0
Peanut	1999	17.30	94.0	1.40	131.6
	2001	47.44a	315.0b	3.60	1134.0

** Means in the same row followed by different letters are significantly different (P<0.05)

Table 7. Output of intercrops and incomes

Treatment	Year	Use	Yield (kg/plot) Mean	Income (Yuan/plot) Mean
Lablab	1999	food	25	50
	2000	food	15	30
	2001	food	39.5	79
	Mean	food	26.5	53
Stylo	1999	Green manure	611.7	
	2000	Green manure	480.4	
	2001	Green manure	380	
	Mean	Green manure	490.7	
Sweet potato	1999	forage	233.6	23.4
		tuber	968	193.6
	2000	forage	750	75.0
		tuber	550	110.0
	2001	forage	1175	117.5
		tuber	401	200.5
	Mean	forage	719.6	72.0
		tuber	639.7	168.0
Peanut	1999	forage	94.3	
		seeds	48.5	96.96
	2000	forage	147	
		seeds	80	160
	2001	forage		
		seeds	160	320
	Mean	forage	120.7	
		seeds	96.2	192.3

* Stylo Intercropped was used mainly as green manure; sweet potato is for sale and its stem and leaves are feed for pigs. This farmer household raised 8 pigs each year with the sweet potato as the main pig feed. The income from pig was 4800 Yuan/year. Lablab, sweet potato and peanut were intercropped twice a year in some cases but depended on weather. Other crops were planted only once.

Table 8. Overall income from intercropping in mango orchards

Treatment	Year	Mango income (Yuan/plot)			Intercrops income (Yuan/plot)			Total	Significance	
		Rep 1	Rep 2	Mean	Rep1	Rep2	Mean		0.05	0.01
Control	1999	33.6	30.8	32.2				32.0		
	2001	478.8	720.0	734.4				734.4	b	B
Treatment1	1999	25.2	60.2	42.7	48	52	50	92.7		
	2001	1465.2	1440.0	1452.6	84	74	79	1531.6	a	A
Stylo	1999	56.0	92.4	74.2				74.2		
	2001	1656.0	1260.0	1458.0				1458.0	a	A
Treatment 3	1999	109.2	105.0	107.1	363.2	7.07	217.0	324.1		
	2001	1008.0	1170.0	1089.0	185	451	318.0	1407.0	a	A
Peanut	1999	168.0	95.2	131.6	100.8	93.1	96.96	228.6		
	2001	1278.0	990.0	1134.0	320	320	320	1454.0	a	A

*Different letters in the same row mean significantly different

5. On farm research on fattening of goats

An on farm grazing experiment with goats was carried out on improved pasture sown with Stylo CIAT 184, Scabra and *Brachiaria brizantha*. It was compared with natural pastures which were composed of *Imperata culindrica, Leptochloa chinensis, Axonopus compressum, Eupatorium odoratum, Miscanthus floridulus* and some shrubs. The experiment was conducted in Yaxing, Danzhou city from November to December, 2000. 20 goats were selected and separated in two groups in average randomly. One grazed on natural pasture and the other on improved pasture. The result showed that the body live weight gain of goats was 1.50kg/30d/hd on improved pasture in contrast to 1.13 kg/30d/hd on natural pasture. The body live weight gain increased 32.7% from improved forage. Thus the improved forage is very important for goats to increase body weight during dry season and winter time.

Table 9. Bodyweight gain of goats on improved and natural pasture.

	Bodyweight before experiment (kg/head)	Bodyweight after experiment (kg/head)	Bodyweight increase (kg/30d/head)
Mean of natural forage group	24.79	25.91	+1.12
Mean of improved forage group	26.53	28.03	+1.50

6. On-farm research on intake and palatability by pigs and geese

Intake and palatability by pigs. 18 pigs were separated in 3 groups randomly. Each group with 6 was fed a kind of tested forage from 9 am to 4 pm.

Intake and palatability by geese. 10 adult geese with body weight 2-2.5kg were fed 500 grams in the morning and 500 grams in the afternoon. Fresh forage was cut in 1 cm pieces.
The result showed that both pigs and geese preferred King grass and Panicum to Stylo. The highest intake rate was King grass, second Panicum. The lowest was Stylo.

Table 10. Intake of three forage species by pigs (fresh material kg/d/6heads)

Test date (date/month)	King grass	*Panicum maximum*	*Stylosanthes guianensis* CIAT 184	P value (ANOVA)
Total	115	79	64	
Mean	5.48	3.75	3.03	.....
%	100	68.4	55.3	

Table 11. Intake of three forage species by geese (fresh material g/d/10heads)

Test date (date/month)	King grass	*Panicum maximum*	*Stylosanthes guianensis* CIAT 184	P value (ANOVA)
Total	14207	3682	12123	
Mean	947	245	808	.....
%	100	25.9	85.3	

Table 12. Nutrient components in dry matter of three forage species tested

Species	CP %	Fat %	Fiber %	Ash %	Water %	P %	Ca %
King grass	8.02	2.24	32.38	8.15	6.06	0.212	0.331
Panicum maximum	7.68	2.25	33.94	7.39	4.49	0.274	0.542
Stylo CIAT 184	15.64	2.57	18.46	6.35	-	0.19	1.18

Dissemination of forage technologies in FSP Phase

Table 13.Frequency of species used, and the way they are used by farmers of FSP, Hainan, 2002. Total no. of farmers = 176

Species	Planting system							Usage							Animals fed to						
	linear	Plot	Contour	Grazing	Cut & carry	Fence	Cover crop	Feed	Soil water	Soil improve-ment	Weed control	Supply planting materials	cattle	buffalo	goats	rabbits	geese	ducks	chicken	pigs	fish
Stylosanthes	2	130	7	7	89	0	27	91	19	27	7	111	24	48	27	4	10	49	43	46	7
King grass	29	40	0	1	69	28	0	69	2	2	2	50	20	38	16	34	15	6	34	36	12
Panicum	1	54	0	1	55	0	1	55	3	0	1	42	6	24	18	34	2	1	8	7	5
Paspalum	2	39	0	4	41	0	1	41	3	0	2	29	8	13	19	28	5	3	14	17	5
Brachiaria	0	41	0	1	41	0	1	41	1	1	1	18	10	21	13	29	2	1	17	18	2
Macroptilium	2	35	0	5	37	0	10	37	1	9	0	33	6	15	21	29	3	2	14	20	0
Leucaena	13	13	0	2	26	0	0	26	4	4	6	17	0	11	5	12	1	1	8	11	2
Arachis	2	17	0	13	0	9	5	15	6	2	2	13	4	11	2	9	4	3	11	10	0
Cratylia	0	1	0	0	1	0	0	1	0	0	0	1	0	0	1	1	1	1	1	1	0
Pennisetum	0	1	0	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0	0

Table 14. Source of information that triggered farmers to plant a certain species.

Species	Farmer-Farmer	Seminar	Cross visits	F S P to Farmer FSP
Stylosanthes	66	9	35	49
King grass	7	13	20	69
Panicum	6	6	12	51
Paspalum	5	7	12	39
Brachiaria	2	3	7	41
Macroptilium	5	4	12	21
Leucaena	3	4	13	24
Arachis	1	2	5	19
Cratylia	1	1	1	1
Pennisetum	1	0	0	0
Total	**97**	**49**	**117**	**314**

Table 15. Household characteristics in villages where FSP operates, and area of forage grown.

County	Village	Year	No. of households in FSP	No. of people affected	No. of buffaloes	No. of goats	No. of geese	No. of ducks	No. of chicken	No. of rabbits	No. of pigs	Size of fish pond (mu)	Total farm area (mu)	Forage (mu)
Baisha	Keren	2002	17	103	25	0	19	0	296	25	57	14.9	179	4.2
Baisha	Keren	2001	17	103	25	0	20	57	275	2	55	14.9	179	0
Baisha	Xingkai	2002	16	77	22	0	0	0	166	32	34	0	75	2.9
Baisha	Xingkai	2001	16	77	21	0	0	0	181	0	57	0	75	0
Baisha	Daola	2002	13	71	9	23	152	30	63	31	11	0	216.8	5.4
Baisha	Daola	2001	13	71	8	20	0	450	170	0	27	0	252	0
Baisha	Wentou	2002	16	83	3	60	28	24	250	59	9	2.5	308.5	7.9
Baisha	Wentou	2001	16	83	3	35	0	11	130	23	4	2.5	308.5	6

Table 16. Income sources by village of FSP

County	Village	Year	Income from rubber (Yuan)	Income from Sugarcane (Yuan)	Income from Cassava (Yuan)	Other income (Yuan)	Income from areca (Yuan)
Baisha	Keren	2002	58,700	35,260	27,900	115,200	0
Baisha	Keren	2001	53,700	40,760	20,650	92,500	0
Baisha	Xingkai	2002	2,800	22,880	6,800	21,500	0
Baisha	Xingkai	2001	4,000	13,000	3,600	20,300	0
Baisha	Daola	2002	96,000	35,400	0	24,100	9,402
Baisha	Daola	2001	96,000	33,000	0	20,300	9,402
Baisha	Wentou	2002	7,200	50,400	4,800	5,000	1,720
Baisha	Wentou	2001	7,000	32,000	2,200	0	850

FSP forage multiplication systems during FSP Phase

Table 17. Farmers producing / receiving planting material in 2002 Ledong, Baisha county.

Species	Total area used for supplying planting materials (m^2)	No. of farmer supplied	No. of farmers received	Type of material	Amount supplied to other farmers (kg)
Stylosanthes	7,444	52	64	Seeds/seedlings	2064
King grass	715	37	79	Cuttings	448
Panicum	223	35	44	Splits	148
Paspalum	127	20	28	Splits	175
Brachiaria	118	33	33	Cuttings	12
Macroptilium	57	22	23	Seeds/seedlings	3
Leucaena	9	9	9	Seeds/seedlings	1
Arachis	24	16	16	Cuttings	2
Pennisetum	17	1	1	Cuttings	30
Total	8733	225	297		2882

Table 18. Farmers producing and receiving planting material in Wentou village, Baisha.

Year	Species	Area used for growing planting material (m^2)	No. of farmer supplied	No. of farmers received	Type of material	Weight supplied to other farmers (kg)
2002	*Stylosanthes*	1.7	9	9	Seeds/ Seedlings	2.75
	King grass	2.2	12	16	Cuttings	145
	Panicum	1.4	11	16	Cuttings	69
	Paspalum	0.9	9	10	Cuttings	25
	Brachiaria	1.1	7	9	Splits	30
	Macroptilium	0.1	1	1	Seeds/ Seedlings	0.1
	Arachis	0.5	2	2	Splits	10
	Cratylia	0.1	1	1	Splits	1
	Total	**8**	**52**	**64**		**283**
2001	*Stylosanthes*	1.2	5	6	Seeds/Seedlings	1.6
	King grass	0.9	4	5	Cuttings	80
	Panicum	0.7	4	7	Cuttings	64
	Paspalum	0.7	3	6	Cuttings	36
	Brachiaria	0.2	5	5	Splits	2.8
	Macroptilium	0.1	2	2	Seeds/Seedlings	0.15
	Arachis	0.1	1	3	Splits	2
	Cratylia	0.03	1	1	Splits	1
	Total	**3.93**	**25**	**35**		**188**

Capacity building and networking

1. Workshop and training

a. A workshop on forage technologies and participatory research was held in CATAS headquarters from 20-25 Feb, 2001. Total 38 participants who were Researchers/Field workers/key farmers/Local government officers mainly from Hainan took this training course. The trainers included two from CIAT, one from Integrated Agricultural Development (CIAD), College of Rural Development (CORD), China Agricultural University, three from CATAS, one from Guangxi.

b. A seven day Monitoring and Evaluation workshop was held in CATAS, Hainan, July 9-15, 2002. With 39 participants coming from the provinces of Hainan, Guangxi and Yunnan.

c. A county level on-farm training course and demonstration on forage and animal feeding technologies was held in Wentou village, Baisha County on 18 September, 2001 by the FSP project. Over 100 participants who were extension workers, farmers, local government officers from Baisha County took this training course. The trainers included three from CATAS, one from local animal extension station.

Networking

Yi Kexian attended the network meeting of Farmer Centered Research Network, China (FCRNC) sponsored by Center for Integrated Agricultural Development (CIAD), College of Rural Development (CORD), China Agricultural University in Beijing on 27 November to 1 December, 2002. TPRC, CATAS is a co-sponsored member of the network.

Publications

1. The Chinese version of booklet: Developing Forage Technologies with Smallholder Farmers---How to plant, manage and use forage was published and distributed in November, 2001.
2. Four SEAFRAD articles from China team are published.
3. Developing Forage Technologies with Farmers, A manual for FPR training in CATAS was translated in Chinese in Feb, 2001. Total 291 pages.

Other Impacts from FSP Phase

1. The impact of FSP on people

Labor. The time that is needed to manage and feed animals before growing forages and after growing forages is showed below. One farmer normally only keeps one buffalo, but it still need one member from the family, adult or child to look after. However one person can look after a herd of goats, average10-20 goats raised by one household. So after growing forages farmers feeding buffalo improved forages as a supplement can save more time than goats.

Table 19. Quantitative impact on time needed to manage and feed animals (hours/day) in Wentou village, Baisha county.

Animals	Before growing forages	After growing forages	Time saving per day	Time saving percentage
Buffalo	3	1	2	66.7%
Goats	5.5	4	1.5	27.3%

Regarding to the labor that is required for planting, weeding and managing forages, King grass needs more labor, especially more labor for frequent cutting, but it can get the highest yield among the used forage species. The case of *Paspalum atratum* is similar. Stylo and Leucaena can be easier planted, with low frequency of cutting and low labor cost. With Leucaena, farmers can save labor through fencing and tethering grazing.

Table 20. Quantitative impact on labor that is required for planting, weeding and managing forages (labor/ 666m^2)

Forages	Land preparation	Planting	Weeding	Fertilizing	Cutting
King grass	4	3	3	2	30
Stylosanthes	4	0.5 (sowing)	6	0	12
Brachiaria	4	2	3	0	grazing
Paspalum atratum	4	2	3	0	20
Leucaena	4	0.5 (sowing)	6	0	9

* 1 mu=666m^2

As mentioned above, improved forages can save labor, especially during the dry season and busy farming season (for example rice planting and sugarcane harvest). Sometimes when animals cannot go grazing outside e.g. when there is heavy rain, or when animals get sick, farmers can easily collect forages. In this case growing improved forage can both save time and labor for farmers.

Social impacts. Development of new groups. They have learnt from the existing groups who grow forage that forage can benefit them by improving their animal condition and increasing productivity and providing income.

Building confidence. Farmers gain confidence that they can overcome poverty by improving animal production. At the beginning, farmers had a very little knowledge about forage and animal production. Most poor farmers thought they had no way to improve their economic condition from agriculture. Through three years FSP practice, their knowledge on forage and animal technology has improved. They have known how to plant and manage forage such as weeding, fertilizing, cutting, grazing, and seed harvesting. They can tell which species of forage look like and which one

performance better and which their animals like better. They also got to know that different animals like different forage species. For example goats and buffalo like Stylo more than grasses. And rabbits like Panicum, Paspalum. Chicken like Brachiaria and Arachis. Pigs like King grass. Farmers also learned how to feed animal at night and how to look after their pregnant rabbits. Some farmers use this kind of knowledge of agricultural technologies not only in forage and animal production but also in production of other crops like sugarcane production. Thus a more solid confidence was built to improve their livelihood and to reduce poverty through forage and animal production.

Increased enthusiasm for community work and cooperation. Since the countryside System Reform in China in 1979, land has been divided in small plots. Every household can keep their farmland and grow the crops in their own way. Farmers become more independent in their agricultural production. Meanwhile enthusiasm for community work among farmers decreased and cooperation weakened. Through FSP practice like farmer to farmer cross visit and group activities farmers become more enthusiastic for community work and strengthen their relationship in forage and animal production. They become active to participate or organize activities themselves to exchange experiences and information about forage technology development.

Attraction of government. Poverty is the major adverse factor that prevents rural economy from development in Hainan, China. Thus local government is paying more and more attention to relieve poverty, which has resulted in the development of rural economy. However most aid for poor farmers was financial and technological without farmers' participation, thus farmers are becoming used to depending on the direct financial help from government rather than being self-reliant. Hence, we must help farmers to know and solve their most concerned problems and build their capacity and confidence to solve their problems through appropriate technology extension and economic help. Farmer participatory research can be such a way.

Farmer participatory research in forage technologies development started in China not long ago. It is a new methodology for agricultural technologies and rural development, not only for researchers, extension workers, farmers, but also most importantly for government officers. When some leaders from Hainan provincial government and Baisha County visited the FSP sites such as Wentou and Xingkai villages, Baisha County, they were surprised and impressed by the activities and impacts. They said this could be a new effective way to help poor farmers against poverty. This is also a main reason why Dr. Ralph Roothaert won the Coconut Island Commemorative Award

from Hainan provincial government for his contribution to Hainan agricultural and economic development in the rural area.

2. The impact of FSP on livestock

With the forage areas growing, numbers of animals that consume forages more than grains or concentrates increase, such as buffalo, goats and rabbits. In contrast, heads of pigs go down. With the number of the animals increasing, animal birth rate, manure production, ploughing efficiency, animal health and body condition also improve. Farmers consider animal mortality more important that sickness. If an animal gets sick, the animal is still there. If an animal dies, that means nothing remains to the farmer.

3. Environmental impacts

Through FSP Phase II, farmers have learnt that forage is not only used as feed for animals but can also be used as green manure, green cover, weeds control, erosion control, living fence and firewood.

Lessons learned from FSP Phase II

- Suitable Key farmers selection
- More forage options for farmers
- Some animal support to farmers at the beginning
- Forage intercropping with other crops
- Local government support
- Cooperate with other projects
- Difficulty: Women group

Future plans

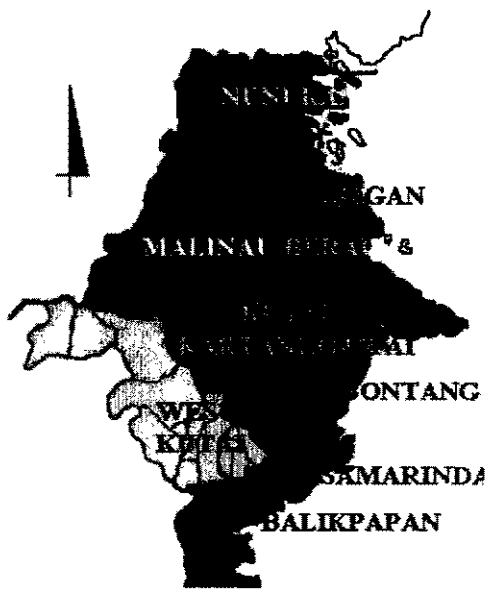
Though farmers have improved their forage knowledge by practices and trainings through FSP Phase II, they still need to obtain further knowledge on forage technologies and animal production to improve their livelihoods significantly in the future.

FSP activities in East Kalimantan, Indonesia

Ir. Ibrahim[1] and Maimunah Tuhulele [2]

Introduction

Forages for Smallholders Indonesia has been implemented since 1995, starting with 5 project location, namely East Kalimantan, Central Kalimantan, North Sulawesi, North Sumatera, and Aceh., during Phase I. During Phase II, FSP concentrated on East Kalimantan, involving more than 400 farmers. Many visitors from different institutions came to East Kalimantan, and they are impressed by the development of forage technologies, and how farmers integrated the technologies into their farming system. Based on this, DGLS would like to disseminate the FPR methodology to other provinces with similar ecological and socio-economic condition, among others, South Kalimantan, South Sumatera, and West Sumatera.



East Kalimantan divided into:
- 4 municipalities
- 9 districts
- 94 sub-districts
- 1230 villages
- Total land area 24,523,780 ha

Focus sites: Makroman and Sepaku
Farmer groups: Tani Maju, Sidodadi, Lestari

Type of forage technologies developed and adopted

- Cut and carry
- Improving Imperata grassland for grazing by integrating new forage species
- Grazing under coconut with new forage species
- Oversown Imperata areas with legume species
- Using forages as contour hedgerows and fence line
- Planting tree legumes for fire woods

[1] FSP Country Coordinator, Dinas Peternakan, Samarinda, East Kalimantan, Indonesia
[2] FSP local consultant, Jakarta, Indonesia

Dissemination of Forage Technologies

- Selection of Sites
- PD and PP
- Cross visits & field days
- Demonstration on forage technologies (i.e. demonstration on forage species under oil palm and coconuts)
- Use of radio, TV and newspaper for broadcasting farmer activities.
- 29 PDs have been conducted with 686 farmers
- 22 cross visits have been conducted involving 220 farmers.

Multiplication of forages

Forage multiplication is done through

- Farmer groups
- Individual farmers

Kinds of planting material produced:

- Vegetative planting materials (root & stem cuttings) produced = 1,400,000

Kinds of species produced:

- *Andropogon gayanus*
- *Brachiaria humidicola* CIAT 6133, Tully
- *Brachiaria decumbens* cv. Basilisk
- *Brachiaria brizantha* CIAT 6780
- *Paspalum atratum* BRA 9610
- *Setaria sphacelata var. Splendida*
- *Pennisetum purpureum* cv. Mott

Achievements and output in 2000-2002

1. Forage technology development

Table 1. Forage technology dissemination activities achieved in 2000- 2002

Activities	Achievement
No. of new areas for forage expansions	28
No. of farmer group	35
No. of PDs conducted	29
No. of farmers who participated in PDs	686
No. cross visits organized by project	22
No. of farmers planting forages	1267
No. of farmers who participated in cross visits	220
No of farmer training courses or field days conducted	18
No. of farmers who participated in training courses and field days	230
No. of farmers carrying out experiments	21
No. of key farmers volunteering as extension workers	7

2. Training of farmers, field workers and technicians

Table 2. Number of farmers, fieldworkers and technicians trained in 2000-2002

Activities	Achievement
No. of farmers trained in forage agronomy	15
No. of farmers trained in Urea molasses block	15
No. of farmers trained in animal nutrition	35
No. of farmers trained in the cattle fattening	11
No. of extension workers and technicians trained in development of forage technology	47
No. of farmers trained in measuring body weight with scale	55
No. of local, national and regional presentations made by site coordinator	12

3. Case studies on the reproductive performance of livestock

Table 3. Reproductive performance of cattle before and after introduction of improved forages

Reproductive performance	Before introduction of new forage	After introduction of new forage
Calving interval of Bali cattle in Samboja and Loa Kulu	14 months	12 months
Reproduction rate of Bali cattle	60-70%	85%
Age of first calving of Bali cattle	3 years	2.5 years
Calving interval of Ongole cattle	18 months – 3 years	17 months
Reproduction of Ongole cattle	50-60%	65%
Age of first calving of Ongole	3.5 years	3 years

4. Collaborative activities

Training center in Samarinda

- Training of extension workers and technicians in the development of forage technology.

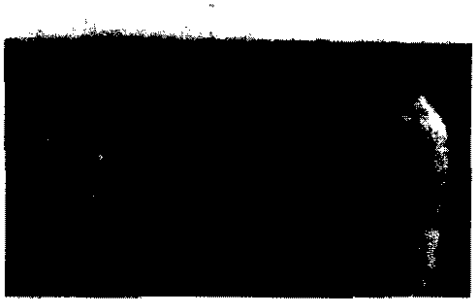
Delivery Project

- Training of field workers and technicians in the participatory rural appraisal (PRA).

Food crop services

- Training farmers in soil erosion control using forage species.

Farmer group associations at district level (KTNA)



The Bupati of Penajam Paser Utara inspects an experiment on agroforestry systems in Sepaku

Lessons learnt from Activities

- In developing forage technologies with farmers, most farmers are very active and creative when informal education learning processes are used.
- With the farmer as voluntary field worker, dissemination and adoption of forage technologies are quicker.
- In using participatory approach, one has to be patient because through time the farmers will adopt forage technologies based on their experience.

Conclusions

- Most farmers are already starting with planning participatory approach in other agricultural management systems.
- In sloping areas, many farmers have planted forages as erosion control and as fencing.
- Farmers already think that forage is not only for feeding to increase weight and number of cattle or goat, but also for cash income.
- Most farmers are very enthusiastic to produce planting materials (split/cutting) for sale.
- With the forage activities, most farmers will sell forage as feeding cattle and also cutting/root cutting.

Recommendations

- More farmer have to be involved in field days and cross visits as they are very effective for dissemination of new forage technology.
- Key farmer who succeed in livestock raising and using new forage species for feeding can used for propaganda when talking about forages in the new areas.
- Training in animal nutrition needed for field workers and farmers.
- Need to find model/tool of participatory monitoring and evaluation that is easy to apply in the field.
- Need to know the nutritional value of each species of forage.
- Need to survey natural grass that has potential for feeding livestock.

Forages for Smallholders Project in Lao PDR

Phonepaseuth Phengsavanh[1] and Viengsavanh Phimphachanhvongsod[2]

Introduction

FSP in Laos (1995-2000)

- Forage nurseries
- On-farm evaluation
- Summary of FSP (2000-2002) activities and some achievements. (Technology development, Dissemination, Multiplication systems, Training and capacity building and Lesson learnt)
- Future plan

FSP Phase I in Lao PDR

FSP started working in Lao PDR with two main objectives:

1. Identification of broad adapted species
2. Evaluate adapted species with farmers and helping them to integrate forages into their farming systems

Main activities

1. Environmental forage nursery evaluation
   - Forage nursery evaluation started from 1995-1997
   - 5 nurseries were established in 4 provinces
   - 7 promising forage varieties were identified (*B. brizantha*, *B. decumbens*, *B. ruziziensis*, *P. maximum* TD 58, *A. gayanus* cv. Kent, *S. guianensis* CIAT 184)

2. Forage evaluation on farm
   - On-farm evaluation started in Luangphabang and Xiengkhuang in 1997
   - In 2000, 425 farmers tried some forages on their farms.

[1] FSP National Coordinator, NAFRI, Laos
[2] FSP National Coordinator, NAFRI, Laos

FSP Phase II in Lao PDR

Objective

1. Develop appropriate forage technologies for smallholders
2. Develop appropriate participatory extension to disseminate forage technologies

Main Activities

- Technology development
- Dissemination
- Multiplication systems
- Training and capacity building

Technology development

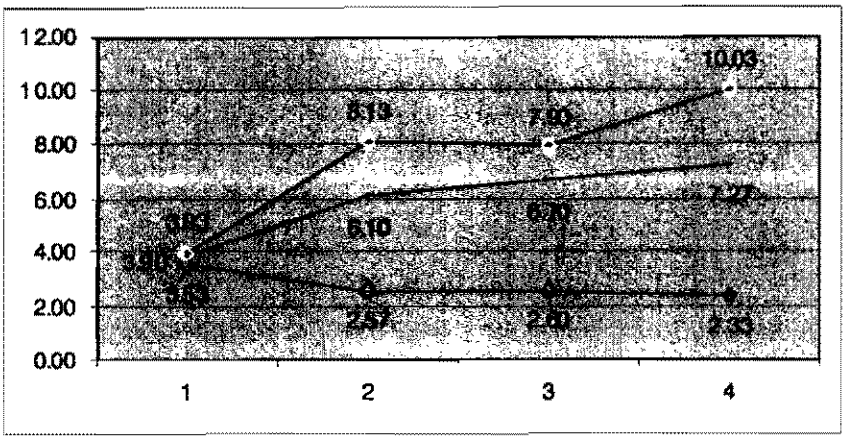
1. Indigenous fodder tree survey in Luangphabang

The survey was conducted in 4 villages in two districts (Xieng Ngeun and Luangphabang)

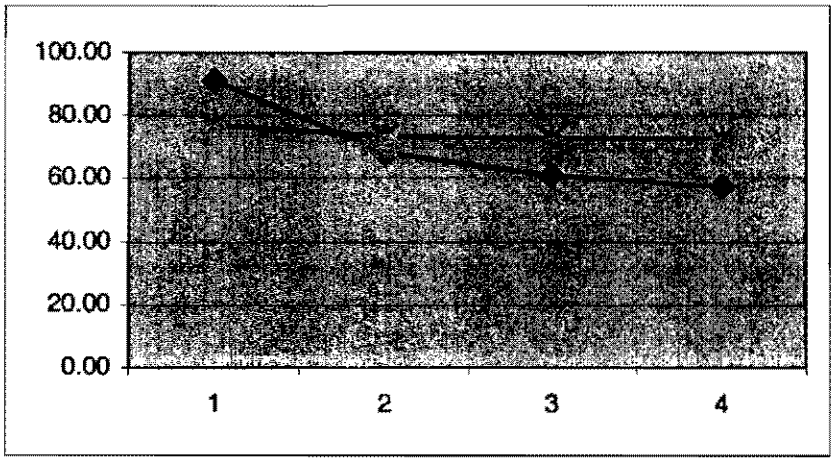
- 6-17 species were identified from different villages and used for animal feeding
- Only 3 species (*Bauhinia, Trema orientalis* and *Broussonetia papyrifera*) that are used in every village and are the best in term of productivity, availability and also nutritive values.

2. Experiment on cutting management of Stylo 184 (5, 15 and 25 cm)

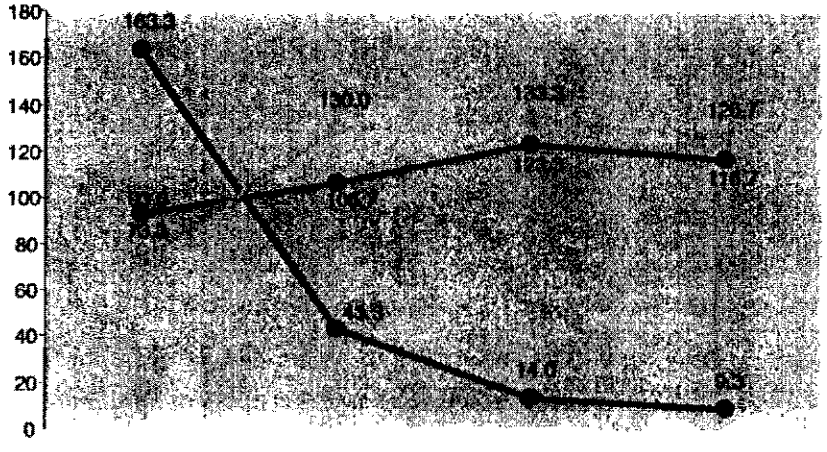
- Measurement for yield, No. of plants and No. of branches were measured (see diagrams below).
- The result showed that 25 cm was the appropriate height for cutting Stylo 184.



Number of plants



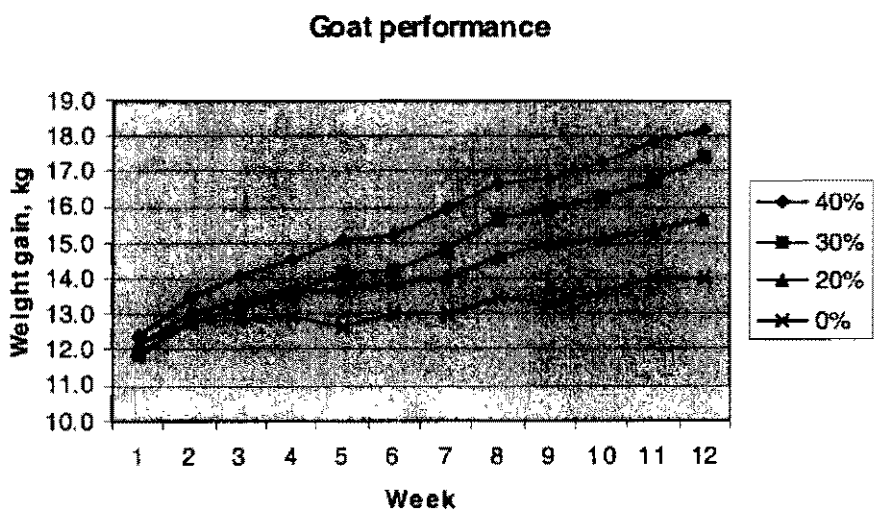
Number of branches



Yield (g/m2)

3. Feeding Stylo 184 for goats at different level

Items	Treatment (% of stylo 184)				SE
	0	20	30	40	
Initial weight (kg)	12.1	12.2	11.9	12.4	0.1
Final weight (kg)	14.2	15.7	17.3	18.3	0.9
Live weight gain (g/day)	24.3	41.0	63.9	70.5	10.6



4. Study on different establishment methods of Gliricidia

Treatment	% of survive	Height (m)	Yield (kg)
By seed	100.0	0	0
Seedling	2.8	4.18	54.6
Cuttings (Fresh)	20.6	3.57	99.4
Cuttings (1 week)	24.4	3.9	117.9
Cuttings (3 weeks)	2.8	3.21	123.5

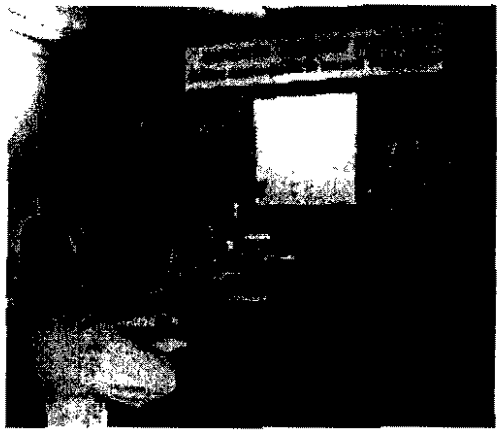
Dissemination of forage technologies

- 40 PDs were conducted in 2000-2001.
- 10 village feedback meetings were organized in 2002.
- FSP worked with about 425 farmers in 2000 and 316 (90) jointly with FLSP in 2001-2002.
- Participatory extension methods were used to expand forage technologies to new farmers.
- There was little expansion in 2002 in term of new villages and farmers, as the project focused on impact of forage technologies on households rather than increasing the number of households.

Multiplication systems

- Seed production was produced at Nam Suang Livestock Center; approximately 1000-1500 kg of Ruzi, Gamba, Guinea and Stylo 184 seeds were produced each year. Fodder tree multiplication and demonstration plots were established in Xiengkhuang and Luangphabang(8 Gliricidia multiplication plots, 5 Leucaena and 4 Calliandra demonstration plots)
- Cuttings are the best solution up to now. Village nurseries were or will be established in each village.

Training and capacity building



- Technician training courses (FPR, PE, Agronomy and other) were organized for provincial and district staff (nearly 100 people attended)
- Cross-visits and field days were organized for provincial, district staff and also farmers. (40 people attended)
- Other trainings (2 for computer and 2 for English, 1 small ruminant production) were also organized for 4 provincial and national staff.
- International workshops meetings

Conclusions

- Participatory approach has big impact on district staffs, but there will need:
  - Mentoring
  - Decentralized decision-making
  - Challenge is decentralized management
- Development workers need to learn new skills when we move from PR to PE.
- Nutrient decline in cut and carry systems is big problem for some farmers
- We need some more work on legumes for special places.
- Village seed production vs. cuttings in the villages

Future plans

Developing smallholders goat production systems

- Introduction of fodder trees (especially *Gliricidia*) to farmers for feeding goats in central part of Lao PDR.
- Thousands of *Gliricidia* will be planted this year
- Study on effect of legume supplementation on reproductively of the goat
- Expansion of the results of these studies to farmers
- Expansion the success of forage technology development to new potential areas in the northern provinces of Lao PDR

Scaling-up new forage systems in northern Mindanao, Philippines

E.C. Magboo[1], J.G. Samson[2] and E.C. Villar[3]

Outline of presentation

- Introduction
- Technology Generation
- Technology Dissemination
- Forage Multiplication System
- Capability Building
- Networking
- Conclusions

Table 1. FSP Sites in the Philippines

1999	2000	2001	2002
Cagayan de Oro Malitbog	Cagayan de Oro Malitbog M. Fortich Impasugong	Cagayan de Oro Malitbog M. Fortich Impasugong Cebu Leyte	Cagayan de Oro Malitbog M. Fortich Impasugong Cebu Leyte
2	4	6	6

Highlights of R. Bosma (2002) Economic Study on Forage Adoption

Objectives

- Assess the financial and social benefits of forage technologies in Cagayan de Oro and Malitbog, Bukidnon
- Calculate the cost of actual feeding practices and compare those with theoretical feed requirement
- Train farmers and technicians on the use of girth measurement in estimating live weight of animals

[1] FSP Country Coordinator, Livestock Research Department, PCARRD, Los Baños
[2] Researcher, Forages for Smallholders Project II – CIAT, Los Baños, Laguna
[3] Director, Livestock Research Department, PCARRD, Los Baños, Laguna

Methods (Bosma 2002)

- A combination of different participatory tools and methods were applied
- 27 farm households from Malitbog and 26 farm households from Cagayan de Oro
- April 25 to May 22, 2002

Figure 1: Livestock ressource diagram, Cagayan de Oro.

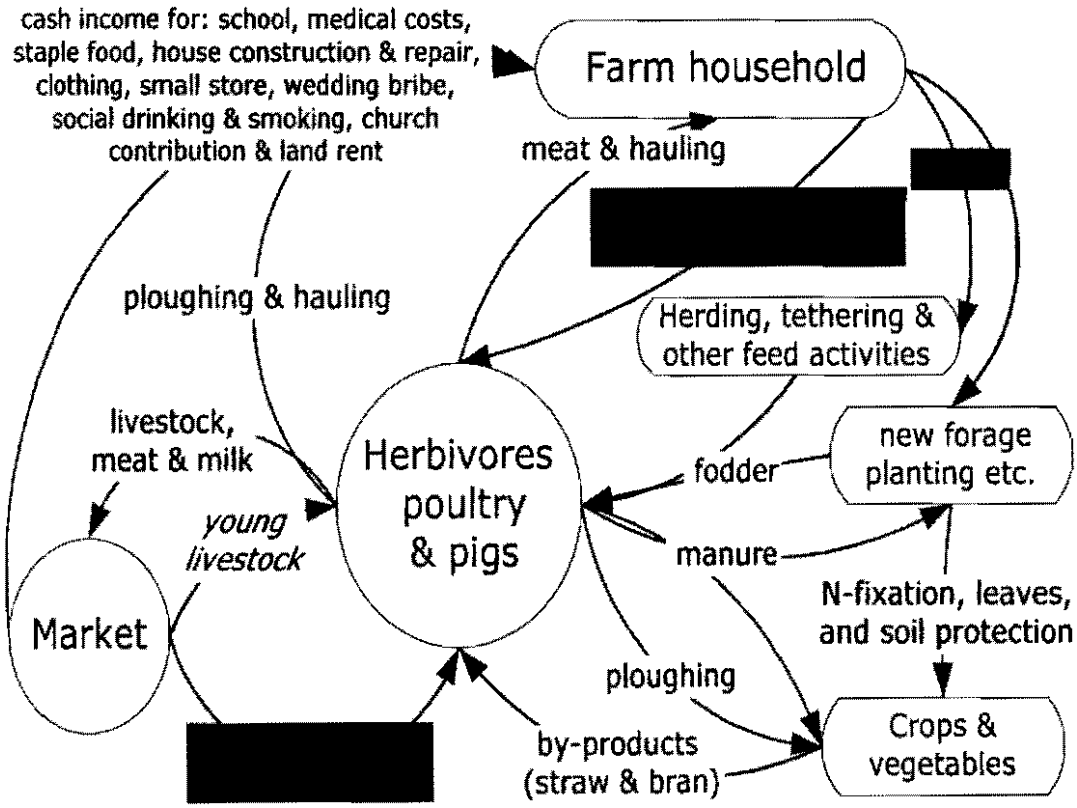
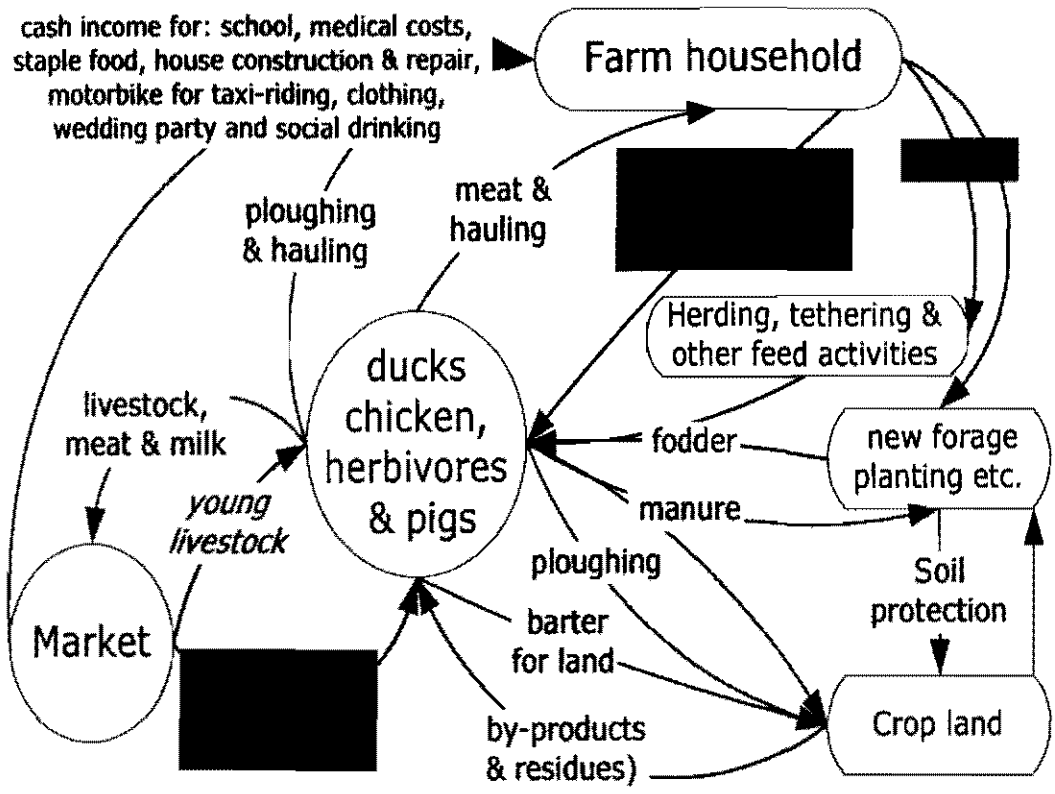


Figure 2: Livestock ressource diagram, Malitbog.



Type of Animal that profited from new forages and its purpose for farmers (Bosma, 2002)

	Animal	Purpose
➢	Cattle	- draft, sold for urgent need
➢	Buffaloes	- draft, sold for urgent need
➢	Horses	- draft, sold for urgent need
➢	Pigs	- marketing, home consumption
➢	Goat	- marketing
➢	chickens/ducks	- home consumption, marketing
➢	Rabbit	- home consumption
➢	Guinea pig	- Pet

Table 2. Use of Income from livestock (Bosma, 2002)

Cagayan de Oro	Malitbog
Medical Cost	Medical cost
Savings	Investment in motorcycle
Food	Food

Benefits from forages (Bosma, 2002)

- Improved body condition of the animal
- Increased length and quality and quality of work by drought animal
- Greater pig and poultry production
- Manure
- Control of soil erosion
- Water conservation
- Firewood
- Time saving due to reduced time for herding
- Social conflict greatly reduced

Role of animal manure farming (Bosma, 2002)

If farmers did not have manure from their own farmer, they bought poultry manure

- PhP 75 per 30 kg sack
- Applied 40 sacks for corn
- Applied 80 sacks for tomato
- Extra labor input - 10 days/ha
- Yield increase 200 percent

Three major reasons for farmer not adopting new forage systems (Bosma, 2002)

1. No animal
   - Even if the effect on soil erosion control was evident
2. No land (tenant or caretakers)
   - Not motivated to increase incomeNot aware of new forages

The rate of adoption of forage technology was very dependent on the government program of livestock dispersal. Farmers that did not own land (caretakers and tenants) have less interest in making investment in land that resulted in medium term returns.

Case Study of J. Samson (2002) on Forage Barriers for Soil Conservation

Objectives

- Evaluate and compare soil conservation options under a participatory framework
- Farmer perception of the problem
- Soil loss vs. crop productivity
- Cost-benefits analysis
- Factors affecting adoption of soil conservation technology
- Appraise the role of participatory process technology adoption

Methods

- Site: San Migara, Malitbog, Bukidnon
- Participatory interactive research
- Participatory tools
  - FGD
  - PD
  - Problem tree analysis
  - Weight ranking
  - Survey
  - Cross-visits

Treatments

Control	- Vertical plowing (down the slope)
Treatment 1	- Contour plowing
Treatment 2	- Mixed forage
Treatment 3	- Setaria hedgerows

Highlights of the study (Samson, 2002)

Soil erosion (farmer's definition) - "Top soil carried by water during strong rainfall events to the lower portion of their farm". They relate this to

- Amount of soil captured by other crops at the lower slope of the farm

- Compacted soil at the upper slope
- Low crop yield
- Change in color of water in nearby creeks and streams
- Lowering of water levels in the creeks and streams
- Increase population of insects in the streams and creeks

Table 3. The effects of different soil conservation systems on corn grain and total dry matter yield.

Treatments	Grain yield at ~ 14% moisture (tons/ha)	Total dry matter (tons/ha)
Control (vertical ploughing)	2.21[c]	3.89[a]
Treatment 1 (contour ploughing)	3.41[ab]	5.40[a]
Treatment 2 (mixed forage)	3.37[ab]	5.12[a]
Treatment 3 (Setaria hedgerows)	2.80[bc]	4.69[a]

Means with a common letter are not significantly different at 10% level.

Table 4. The effects of different soil conservation systems on top soil loss as compared to a vertical ploughing system.

Treatments	Slope %	Soil loss	
		tons/ha	mm of top soil
Control (vertical ploughing)	23a	59.27a	6.59a
Treatment 1 (contour ploughing)	26a	32.74b	3.64b
Treatment 2 (mixed forage)	26a	19.60c	2.18c
Treatment 3 (Setaria hedgerows)	28a	23.62c	2.62c

Means with a common letter are not significantly different at 10% level.

Table 5. Soil chemical properties of the different treatment plots.

Treatments	Soil Chemical Properties				
	pH	Total Kjeldahl Nitrogen (%)	Bray 2 Extractable Phosphorus (mg/kg)	Exchange-able Potassium (meq/100 g)	Organic carbon (%)
Control (vertical plowing)	4.7 [a]	0.18 [a]	2.53 [a]	0.28 [a]	2.58 [a]
Treatment 1 (contour plowing)	4.6 [a]	0.19 [a]	1.75 [a]	0.14 [a]	2.99 [a]
Treatment 2 (mixed forage)	4.6 [a]	0.21 [a]	2.73 [a]	0.22 [a]	2.89 [a]
Treatment 3 (Setaria hedgerows)	4.6 [a]	0.19 [a]	2.88 [a]	0.11 [a]	2.28 [a]

Means with a common letter are not significantly different at 10 % level

Table 6. The effects of different soil conservation systems on nutrient losses as compared vertical plowing system.

Treatments	Estimated nutrient and organic matter loss (kg/ha)			
	N	P as P_2O_5	K as K_2O	OM
Control (vertical plowing)	111	0.34	9.66	2580
Treatment 1 (contour plowing)	66	0.11	1.85	1724
Treatment 2 (mixed forage)	56	0.18	1.61	1226
Treatment 3 (Setaria hedgerows)	45	0.16	1.27	1193

Table 7. Cost and Return Analysis/ha (Samson, 2002)

Items	Treatments			
	Control	1	2	3
Costs				
Labor inputs	6787	7645	9022	8680
Material inputs	2032	2032	2032	2032
Total Costs	**8819**	**9677**	**1054**	**10712**
Returns				
Grain yield (corn)	13272	20448	20220	16800
Fodders	-	-	2600	2421
Total Returns	**13272**	**20448**	**22820**	**19221**
Net Income	**4453**	**10771**	**11776**	**8509**
Incremental Net Income	**-**	**6318**	**7323**	**4056**

Conclusions (Samson, 2002)

- The introduced intervention gave positive financial benefits and greatly reduce soil erosion
- Participatory approach improves the chances of higher adoption of the introduced technology
- Involving farmers developed their "sense of ownership' of the research for the community
- The researcher got a better understanding and appreciation of farmers problem in soil erosion (better and practical options can be formulated)

Table 8. Forage dissemination sites in the Philippines

Sites	1999	2000	2001	2002
Cagayan de Oro	15/41	15/52	15/69	15/77
Malitbog	8/19	8/27	8/31	8/42
M. Fortich	-	2/2	2/2	3/8
Impasugong	-	-	1/1	7/8
Cebu/Leyte	23/60	25/81	26/103	36/136
Total	23/60	25/81	26/103	36/136

The farmer participatory approach (FPR) to the development of forage technologies

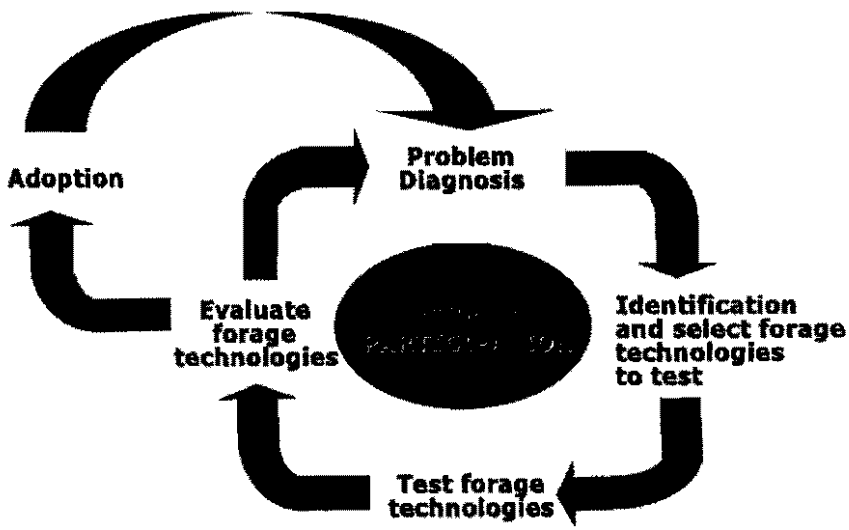


Figure 3. Farmer participatory research for development of forage technologies

Ranking of forages most preferred species by farmers in Malitbog, Bukidnon

Rank	Nov. 2001 & May 2002	No. of farmers (N=30)
1	*Setaria sphacelata*	26
2	*Pennisetum purpureum* ex. Xavier	23
3	*Paspalum atratum*	20
4	*Brachiaria ruziziensis*	16
5	*Arachis pintoi*	15

Ranking of forages species with largest areas in Malitbog, Bukidnon

Rank	Nov. 2001 & May 2002	Area planted 2002
1	*Setaria sphacelata var. Splendida*	13,042
2	*Pennisetum purpureum* ex. Xavier	9,187
3	*Paspalum atratum*	5,580
4	*Setaria sphacelata* cv. Nandi	4,945
5	*Arachis pintoi*	4,005

Table 9. Ranking of forage area most expanded within 6 months by farmers. (Malitbog)

Rank	Species	Area of expansion (m^2)	Characteristics				
			A	B	C	D	E
1	*Setaria sphacelata var. splendida*	5,950	√	√	√	√	√
2	*Pennisetum purpureum* ex. Xavier	3,425	√		√	√	√
3	*Paspalum atratum* CIAT 6299	2,891	√	√	√	√	√
4	*Flemingia macrophylla*	1,957		√	√	√	√
5	*Paspalum atratum*	1,949	√	√	√	√	√

A – Cooler climate (high elevation)
B – Moderate to extreme infertile soil (e.g. acidic)
C – Wet tropics with no or short dry season
D – Cut and carry
E – Hedgerows

Table 10. Top ten forage species by systems and area, Malitbog, Bukidnon (May 2002)

Forage System	No. of Farmers (N=30)	Rank	Top 10 Species Used	Area Planted
Contour	16	1	*S. sphacelata (Splendida)*	6971
		2	*P. purpureum ex-Xavier*	4291
		3	*P. atratum*	3000
		4	*S. sphacelata (Nandi)*	2790
		5	*F. macrophylla*	1810
		6	*P. maximum* 6299	1676
		7	*P. maximum* T-58	1365
		8	*B. ruziziensis*	1225
		9	*B. brizantha*	1200
		10	*P. purpureum*	805
		Total		26,553
Grazing	8	1	*S. sphacelata (Splendida)*	6145.5
		2	*S. sphacelata*	2955
		3	*P. purpureum ex-Xavier*	2285
		4	*P. maximum T-58*	505
		5	*P. atratum*	418
		6	*A. pintoi*	310
		7	*B. ruziziensis*	225
		8	*P. maximum 6299*	133
		9	*P. purpureum*	47
		10	*L. leucocephala K636*	25
		Total		13,057.5
Cut and carry	24	1	*S. sphacelata (Splendida)*	6591
		2	*P. purpureum ex-Xavier*	6001
		3	*P. atratum*	5320
		4	*A. pintoi*	3820
		5	*P. maximum 6299*	3058.6
		6	*S. sphacelata (Nandi)*	2710
		7	*F. macrophylla*	2070
		8	*P. maximum T-58*	1690
		9	*C. calothyrsus*	1500
		10	*B. decumbens*	1420
		Total		39,959.6
Fence line	2	1	*P. purpureum ex-Xavier*	101
		2	*D. cinerea*	40
		Total		141

Table 11. Monitoring of forage area by forage system within the 6 month period (Malitbog)

Forage System	Forage Area		
	Nov. 2001	May 2002	Expanded Area
Contour	12,182	26,553	14,371
Grazing	6,469.5	13,959.5	6,588
Cut & carry	22,042	39,959.6	17,917.6
Fence line	141	141	0

Table 12. Farmer's species preference for different usage (Malitbog)

Forage Usage	No. of farmers)	Rank	Top 10 Species used	Area planted
Feeds	29	1	*S. sphacelata* (Splendida)	13036.5
		2	*P. purpureum* ex-Xavier	9086
		3	*P. atratum*	5578
		4	*S. sphacelata* (Nandi)	4945
		5	*A. pintoi*	3905
		6	*P. maximum* CIAT 6299	2369.6
		7	*F. macrophylla*	2279
		8	*P. maximum* T-58	2095
		9	*B. ruziziensis*	1900
		10	*C. calothyrsus*	1500
		Total		46,694.1
Planting Materials	30	1	*S. sphacelata* (Splendida)	13042.5
		2	*P. purpureum* ex-Xavier	9187
		3	*P. atratum*	5380
		4	*S. sphacelata (Nandi)*	4945
		5	*A. pintoi*	4005
		6	*P. maximum* CIAT 6299	3191.6
		7	*F. macrophylla*	2279
		8	*P. maximum* T-58	2095
		9	*B. ruziziensis*	1900
		10	*C. calothyrsus*	1500
		Total		47,525.1
Soil & Water Conservation	17	1	*S. sphacelata* (Splendida)	7716
		2	*S. sphacelata* (Nandi)	4190
		3	*P. purpureum* ex-Xavier	3141
		4	*P. atratum*	3050
		5	*F. macrophylla*	2210
		6	*A. pintoi*	2192
		7	*P. maximum* CIAT 6299	1976
		8	*B. ruziziensis*	1480
		9	*P. maximum* T-58	1465
		10	*B. brizantha*	1400
		Total		28,820
Crop cover	3	1	*A. pintoi*	1272
		2	*F. macrophylla*	200
		3	*P. atratum*	200
		4	*B. ruziziensis*	150
		5	*G. sepium* Retalhuleu	
		Total		1,823
Soil Improvement	5	1	*A. pintoi*	1597
		2	*F. macrophylla*	840
		3	*S. guianensis*	750
		4	*S. sphacelata* (Nandi)	720
		5	*S. sphacelata* (Splendida)	710
		6	*C. calothyrsus*	640
		7	*P. purpureum*	480
		8	*P. atratum*	353
		9	*B. ruziziensis*	350
		10	*P. maximum* T-58	300
		Total		6,740

Table 13. Monitoring of forage area by forage use within the 6 month period (Malitbog)

Forage usage	Forage area (m^2)		
	Nov. 2001	May 2002	Expanded area
Feeds	28,008.5	53,915	25,907
Planting materials	30,389.5	53,924	23,535
Soil & water conservation	13,836	31,524	17,688
Crop cover	256	1,823	1,567
Soil improvement	2,740	7,210	4,470

Table 14. Ranking of forages most planted by farmers in Cagayan de Oro

Nov 2001	June 2002
1. *Arachis pintoi*	1. *Arachis pintoi*
2. *Panicum maximum*	2. *Panicum maximum*
3. *Pennisetum purpureum* & *Calliandra calothyrsus*	3. *Paspalum atratum* & *Calliandra calothyrsus*
4. *Paspalum atratum*	4. *Leucaena leucocephala* K636
5. *L. leucocephala, Gliricidia sepium* & *P. purpureum* Florida	5. *Gliricidia sepium* & *P. purpureum* Florida

Table 15. Ranking of forages planted in larger areas by farmers in Cagayan de Oro

November 2001	June 2002
1. *Pennisetum purpureum* Florida	1. *Leucaena leucocephala* (local)
2. *Leucaena leucocephala* (local)	2. *Pennisetum purpureum* Florida
3. *Pennisetum purpureum* cv. Capricorn	3. *Pennisetum purpureum* (local)
4. *Pennisetum purpureum* (local)	4. *Panicum maximum*
5. *Panicum maximum*	5. *Pennisetum purpureum* cv. Capricorn

Table 16. Ranking of forages species most expanded by farmers in Cagayan de Oro

Ranking of species	Area of expansion (m^2)
1. *Leucaena leucocephala* (local)	1711
2. *Panicum maximum*	1510
3. *Paspalum atratum*	1470
4. *Brachiaria brizantha*	1077
5. *Pennisetum purpureum*	1070

Table 17. Top ten forage species by systems and by area planted (Cagayan De Oro)

Forage System	No. of Farmers (N=30)	Rank	Top 10 species used	Area planted (m^2)
Contour	7	1	*P. maximum*	1,000
		2	*P. purpureum*	320
		3	*P. purpureum* Florida	150
		4	*S. sphacelata*	100
		5	*P. atratum*	50
		6	*G. sepium*	25
		7	*L. leucocephala*	20
		8	*C .calothyrsus*	20
		9	*D. virgatus*	10
		10	*L. leucocephala* K636	10
		Total		1,705
Grazing	22	1	*A. pintoi*	3,165
		2	*P. purpureum*	2,500
		3	*P. maximum*	1,600
		4	*B. brizantha*	1,300
		5	*B. decumbens*	150
		6	*P. atratum*	125
		7	*S. sphacelata*	103
		8	*P. maximum* T58	100
		9	*B. humidicola*	50
		10	*P. purpureum* Guatemala	3
		Total		9,096
Cut & carry	30	1	*L. leucocephala*	12,390
		2	*P. purpureum* Florida	9,225
		3	*P. purpureum*	5,444
		4	*P. maximum*	4,928
		5	*P. purpureum* cv. Capricorn	3,500
		6	*P. atratum*	2,363
		7	*S. sphacelata*	2,353
		8	*C. pubescens*	1,610
		9	*B. brizantha*	1,420
		10	*P. purpureum* Guatemala	1,160
		Total		44,393
Fence line	22	1	*L. leucocephala*	10,340
		2	*C. calothyrsus*	851
		3	*G. sepium*	766
		4	*L. leucocephala* K636	632
		5	*S. sesban*	420
		6	*S. rostrata*	380
		7	*D. cinerea*	158
		8	*S. grandiflora*	82
		9	*P. purpureum*	40
		10	*L. trichandra* 53/88	37
		Total		13,706

Table 18. Monitoring of forage area by forage system within the 6 month period (CDO)

Forage system	Forage area (m^2)		
	Nov. 2001	June 2002	Expansion
Contour	1175	1705	- 70
Grazing	10649	9246	- 1403
Cut and carry	52764	51715	-1049
Fence line	2988	13739	10751

Table 19. Monitoring of forage area by forage use within the 6 month period (CDO)

Forage usage	Forage area (m^2)		
	Nov. 2001	June 2002	Expansion
Feeds	48761	57514	8753
Planting materials	36825	29533	-7292
Soil & water conservation	28483	8664	-19819
Crop cover	20744	7100	-13644
Soil improvement	36642	21875	-14767

Table 20. Farmers' species preference for different usage (CDO)

Forage Usage	No. of farmers	Rank	Top 10 species used	Area planted (m^2)
Feeds	30	1	*Leucaena leucocephala*	12,340
		2	*Pennisetum purpureum* Florida	9,225
		3	*Pennisetum purpureum*	5,944
		4	*Panicum maximum*	4,943
		5	*Pennisetum purpureum* cv. Capricorn	3,500
		6	*Arachis pintoi*	3,301
		7	*Paspalum atratum*	2,463
		8	*Brachiaria brizantha*	2,420
		9	*Setaria sphacelata*	2,353
		10	*Centrosema pubescence*	1,610
		Total		48,099
Planting Materials	25	1	*P. purpureum* Florida	9,175
		2	*P. purpureum* cv. Capricorn	3,500
		3	*A. pintoi*	3,061
		4	*P. maximum*	2,293
		5	*P. atratum*	2,113
		6	*S. sphacelata*	1,903
		7	*P. purpureum* Guatemala	1,165
		8	*P. maximum* T58	933
		9	*C. calothyrsus*	887
		10	*B. brizantha*	800
		Total		25,830
Soil & water conservation	24	1	*A. pintoi*	2,991
		2	*L. leucocephala*	1,290
		3	*P. maximum*	1,023
		4	*P. purpureum* cv. Capricorn	1,000
		5	*P. purpureum* Florida	575
		6	*G. sepium*	435
		7	*P. purpureum*	360
		8	*P. purpureum* Thailand	300
		9	*P. atratum*	208
		10	*S. sesban*	163
		Total		8,345
Crop cover	24	1	*A. pintoi*	3,171
		2	*C. pubescens*	1,280
		3	*P. purpureum* cv. Capricorn	1,000
		4	*P. purpureum* Florida	425
		5	*P. purpureum*	360
		6	*P. purpureum* Thailand	300
		7	*G. sepium*	200
		8	*S. guianensis* CIAT 184	130
		9	*S. sphacelata*	80
		10	*P. atratum*	68
		Total		7,014
Soil improvement	27	1	*L. leucocephala*	12,220
		2	*A. pintoi*	3,003
		3	*C. pubescens*	1,610
		4	*P. maximum*	1,000
		5	*C .calothyrsus*	625
		6	*L. leucocephala* K636	579
		7	*G. sepium*	566
		8	*P. purpureum*	500
		9	*S. guianensis* CIAT 184	480
		10	*B. brizantha*	200
		Total		20,783

Table 21. Forage multiplication system in Cagayan de Oro, 2002

Species	No. of farmers producing	Amount produced	Type of planting materials
Arachis pintoi	4	881 pcs.	Seedlings
Calliandra calothyrsus	6	699 pcs.	Seedlings
L. leucocephala K636	2	96 pcs.	Seedlings
Sesbania sesban	2	105 pcs.	Seedlings
Indigofera	2	20 pcs.	Seedlings
Cratylia	1	11 pcs.	Seedlings
Assorted fodder trees	1	100 pcs.	Seedlings

Table 22. Forage multiplication system in Cagayan de Oro, 2002

Species	No. of farmers producing	Amount produced	Type of planting materials
Paspalum atratum	1	3 sacks	Vegetative splits
Setaria sphacelata	1	2 sacks	Vegetative splits
Assorted grasses	3	95 sacks	Vegetative splits
Gliricidia sepium	2	110 pcs.	Stem cuttings
Pennisetum purpureum	2	8 sacks	Stem cuttings
L. leucocephala K636	1	8.5 kg	Seeds
Sesbania sesban	4	15.545 kg	Seeds
Stylo CIAT 184	1	2.0 kg	Seeds
Flemingia macrophylla	1	5.5 kg	Seeds
Desmodium cinerea	3	3.5 kg	Seeds
Desmanthus virgatus	1	1.13 kg	Seeds

Capability Building/Trainings

- Developing forage technologies with farmers(2/41)
- Participatory Development and Gender Analysis (1/19)
- International Course on PRD (Upwards)
- PM&E Workshop (5)
- Cross-visits (Managers, DWs, Farmers)
- Farmers Training
- Farmers Field Days

Networking

- Department of Agriculture
- Department of Agrarian Reforms
- Department of Environment and Natural Resources
- Philippine Carabao Center

- National Dairy Authority
- Leyte State University
- ICRAF
- Mag-uugmad Foundation, Inc.

Conclusions

- Forage introduction to smallholder farms showed positive economic benefits to the farmers
- Cross visits and farmers' field days are powerful tools for technology transfer
- The greatest impact of the project was on capability building/training of people
- Sustainability of the participatory approach is still very fragile. The forage adoption by farmers is highly dependent on government program

Achievements and lessons learned during FSP Phase II in Thailand, 2000-2002

Chaisang Phaikaew[1] and Ganda Nakamanee[2]

Background of FSP in Thailand

During 1995 – 1999 Thailand is one of 7 countries in Southeast Asia that the Forages for Smallholders Project (FSP) had objective to develop close linkages in forage development activities among Thailand, Indonesia, Lao PDR, the Philippines, Vietnam, Malaysia and China. The FSP in Thailand is a cooperative program involving the Thai Department of Livestock Development (DLD) and CIAT/CSIRO, which have been financed and supported by AusAID. Local staffs and facilities were mostly provided by the Animal Nutrition Division of DLD.

In the first phase the project emphasized on selection of forage species. The work on farmer participatory research and forage technologies development had just started in 1998. Farmers' participation on introduction of forage species commenced at Sung Nuen District, Nakorn Ratchasima Province in the northeast of Thailand. Twenty dairy farmers were participated. The result from participatory diagnosis showed that the main problem of the dairy farmers was the lack of good quality roughage in dry season. Farmers were looking for the alternative feed supplies for their dairy cows. Farmers planted a range of *Brachiaria* accessions in individual farm. Participatory evaluation of forages by farmers was conducted. The most promising species were *Brachiaria brizantha* CIAT 6780, 6387, 16827 and 16829.

FSP Phase II "Developing Sustainable Forage Technologies for Resource – Poor Farmers in Asia" being part of the Technical Assistance of the Asian Development Bank for the Agriculture and Natural Resources Research at CGIAR Centers. Expected outputs were:

- Productive and sustainable forage technologies for upland farming systems developed and tested by farmers,
- Forage technologies extended to other farmers using participatory approaches for scaling – up from the farm level to the community and provincial levels,
- Effective local seed and planting material multiplication systems established and operational,

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- Capability in Developing Member Countries for developing and disseminating forage technologies using farmer participatory approaches and
- Network for sharing information among NARS and the region.

Achievements

1. Developing forage technology

During this phase the FSP Thailand continuously working with farmers in Sung Nuen District, Nakorn Ratchasima province. From 20 farmers who had evaluated new Brachiaria since 1999, there were 4 farmers who expanded their Brachiaria planting area. In addition, the year 2000, there were 9 new dairy farmers who had evaluated the new Brachiaria for cut and carry system in dairy farm. One farmer planted *Paspalum atratum.* At the same time, ten dairy farmers planted forage legume species, which consisted of *Centrosema pascuorum* cv. Cavalcade, *Stylosanthes guianensis* CIAT 184 and *Stylosanthes hamata* cv. Verano for evaluation.

1.1 Fodder tree evaluation

One farmer from three male farmers who planed to establish nursery of fodder trees tried to plant fodder tree in poly bags. Suggested species consisted of

- *Calliandra calothyrsus* Prov. Patalul
- *Calliandra calothyrsus* ex. MBRLC
- *Enterolobium cyclocarpum*
- *Indigofera constricta*
- *Leucaena leucocephala* K 636
- *Leucaena pallida*
- *Leucaena trichandra* 53/88
- *Sesbania sesban*

Almost all of them had low germination except *Calliandra calothyrsus.* The lowest germination species was *Enterolobium cyclocarpum.*

1.2 Stylo evaluation

The objective is to find alternative Stylo variety for *Stylosanthes guianensis* CIAT 184, with the aim to identify accessions with high resistance to anthracnose, high dry matter yield, persistence, and high seed yield.

Treatments consisted of (a) a resistant control (CIAT 184) (b) Stylo black seed from China (c) composite hybrid 1 (ATF 3308) (d) composite hybrid 2 (ATF 3309). Treatments arranged in 3 replications of randomized complete blocks. The plots are 6m x 8 m swards. To build up natural inoculums in the area rows of susceptible Stylo (*Stylosanthes guianensis* cv. Graham) was established around the experiment as well as between blocks.

Germination percentage of composite hybrid 1 and 2, Stylo 184 and Graham Stylo were good but black seed gave low germination percentage.

Score for anthracnose damage were done. Graham was severely infected from *Collectrotricum gloeosporiodes*. Symptoms of anthracnose were found on Stylo 184 and composite strain ATF 3309 but were not severe and low incident. In 2002, early flowering accession from CIAT was added to this trial. Composite strain ATF 3308 tended to give high forage yield. The trial will be continued in 2003 to confirm the result.

1.3 Lablab evaluation

Two sets of *Lablab purpureus*, 20 accessions (615 gm of seed) from ILRI and 25 accessions (767 gm of seed) from CSIRO, were introduced in 2000. Due to small amount of seed, in the first year, seed were multiplied at Pakchong Animal Nutrition Research Center, Nakorn Ratchasima for future evaluation. At the same time, preliminary observations were done to determine the adaptability and seed production potential. There were a number of accessions affected by disease and insects. There were large variation on the age of first flowering as show in Table 1 and 2.

Table 1. Days to flowering, insect damage and seed production of different Lablab accessions grown at Pakchong.

Source	Accession No.	Day to flowering	Insect damage	Seed production g/m^2	Summary (+ve/-ve factors)
ILRI	13689D	70	2.7	0.63	
	11615D	23	2.8	121.1	
	13694D	45	2	0.59	(-ve no seed)
	13695D	48	3	0.4	
	6536D	69	3.6	0	
	13700D	69	3.2	14.02	
	14437D	58	2	233.5	4(-ve low vigor)
	13692D	45	1.5	0.59	
	14442D	72	2.3	146.5	2(-ve low vigor in Jan, low seed production)
	11613D	69	3.4	28	(-ve low seed production)
	11630D	88	2.9	568.8	2(-ve insect attack, bad smell)
	6930D	23	3	280.3	3 (-ve low vigor in Jan, insect damage)
	14440D	69	3.4	0	
	7072D	48	4	4.1	(-ve low seed production)
	13687D	118	3.7	0.63	(-ve late seeding & insect damage)
	11632D	24	2.3	275.6	1 (+ve early flowering)
	14411D	63	2.8	180.2	3 (-ve low vigor in Jan, low seed production)
	14441D	70	2.2	326.1	1
	13701D	83	3.5	43.1	
	6533D	83	3.1	8.4	(-ve low seed production)
CSIRO	96924	21	4.4	1.37	
	76996	58	2.6	371.4	2 (-ve low vigor in Jan)
	52437	88	5	0	

*summary by Dr. Peter C. Kerridge
Rating: 1=poor (P), 2= fair (F), 3 = moderate (M), 4 = good (G), 5 = excellent (E)
Insect damage: 1 = low, 5 = high, score on 8 Oct 2000

Table 2. Days to flowering , insect damage and seed production of different Lablab accessions grown at Pakchong.

Source	Accession No.	Day to flowering	Insect damage	Seed production g/m^2	Summary (+ve/-ve factors)
CSIRO	106494	78	4.3	0	(-ve no seed)
	52535D	52	3.1	95.2	
	L9-87	58	3	299.9	3(-ve low vigor in Jan and insect damage)
	60216	88	4	0.32	
	L16-88	88	2.5	296.8	2
	34777	52	2.4	97.5	5(-ve low seed production)
	30702	107	2.9	1.2	(-ve low seed production)
	51564	63	2	0.3	
	35894	20	3.3	84.4	
	106548	69	2.2	232.1	5 (-ve low vigor)
	CQ2975	79	2.8	178	5
	76998	45	3	258.7	4 (-ve high insect damage)
	106500	66	3.2	49	
	81626	23	2.5	142.4	3 (-ve low seed production)
	52508	24	2.6	128.7	5
	29398	63	3.2	313.4	3 (-ve high insect damage)
	69498	53	3.7	1.78	
	67639	63	1.8	166.7	
	99985	113	4	0	
	100602	89	3.6	60.6	
	36903	63	3.6	166.7	
	52544	63	1.8	103.4	

*summary by Dr. Peter C. Kerridge
Rating: 1=poor(P) 2= fair (F) 3 = moderate (M) 4 = good (G) 5 = excellent (E)
Insect damage: 1 = low, 5 = high, score on 8 Oct 2000

In the following year, fourteen accessions of *Lablab purpureus* from previous Lablab evaluation (45 accessions) include one new accession and three commercial cultivars were evaluated for their performance.

Criteria for selection for new trials:

1. Low insect damage on both plant & seed
2. High seed production
3. High forage production (vigor)
4. Late flowering (high forage production)
5. Regrowth (2-3 cuttings)
6. Dry season feed - Standing feed or used to make hay.

Experimental design. Design of the experiment is a randomized complete block design with 3 replications. Plot consists of 3 rows, 7.5 m long with an interrow spacing of 30 cm and 1 m path.

Measurements. Dates of first flowering (mean of days when 5 plants per accessions have set flowers) were recorded. DM yield harvested at 100 days after planting, cut at 10 cm height, record fresh weight and took sub sample 1,000 g. and oven dry at 70°c for 72 hrs to estimate dry matter and chemical analysis for CP, ADF Crude Protein of leaf at 100 days after germinated of Lablab were between 24 – 28% (table 3)

Table 3 Crude protein and ADF of Lablab at 100 days after germinated (2001 trial).

Accession	Leaf		Stem	
	CP (%)	ADF (%)	CP (%)	ADF (%)
14441	25.87	31.5	11.39	53.14
11632	25.94	26.19	8.34	53.31
L16-88	27.38	28.6	10.89	51.72
14442	28.58	29.17	8.9	54.64
11630	24.26	31.54	9.01	55.34
76996	28.94	24.42	10.38	50.15
29398	28.9	26.77	12.17	51.45
L9-87	28.22	28.21	8.74	54.02
81626	27.56	22.51	9.99	55
6930	28.4	27.6	10.29	53.37
14411	28.91	29.31	9.99	52.28
14437	26.82	30.17	10.26	52.08
76998	28.91	29.06	11.93	48.51
106548	28.74	28.09	9.19	53.42
Endurance	24.79	23.98	8.36	48.45
Highworth	22.3	23.4	8.85	47.11
Rongai	23.93	24.76	8.95	46.83
106471	24.88	24.14	11.76	44

In 2002 the experiment was continued to evaluate Lablab performance. In this year, 9 accessions were used. There were 14441, 11632, L16-88, 11630, 76996, L9-87, 6930, 14437 and 76998. Among these 9 accessions; L9-87, 14441 and 11630 tended to give high forage yield and gave high yield in the second cut. L9-87, 14441 and 11630 had good ground cover and regrowth (table 4). Due to low rainfall in 2002, the experiment will be confirmed in 2003.

Table 4. Ground cover, regrowth and leafiness of 9 Lablab accessions.

Lablab Accessions	Ground cover[1/]	Regrowth[2/]	% leaf
14441	3.6	3	63.5
11632	3	2.7	53.5
L16-88	4	3.2	60.8
11630	3	3.3	66
76996	2.3	2.1	68.4
L9-87	3.7	4.1	53.5
6930	1.7	2.3	62.5
14437	3	3	61.8
76998	3	2.7	67.1

1/ score for ground cover 1 month after planting: 1 = poor, 5 = excellent
2/ regrowth two weeks after the first cutting :1 = poor, 5 = excellent

At the same time, seed of 14 accessions have been sent to Lao PDR for evaluation. Criteria for selection for small farmers in upland Laos:

- Quick cover
- Vigor
- High seed production
- Pod is edible

Table 5 Amount of Lablab seed had been sent to Lao PDR

Lablab Accession No.	Amount (g)
14441	277
11632	185
L16-88	250
14442	251
11630	238
76996	287
29398	209
L9-87	258
81626	300
6930	340
14411	323
14437	262
76998	234
106548	242

1.4 Effect of conditioning cut on seed production and seed quality of *Brachiaria spp.*

Selection of *Brachiaria spp.* For seed production and dry season forage yield in upland area was conducted at Pakchong Animal Nutrition Research center during FSP phase I. Five accessions from the first set (33 accessions) showed potential to produce high seed yield and good dry season forage yield. This experiment was conducted with the aim to improve seed crop management of those promising accessions.

Experimental design. Split plot in randomized block design. Treatments consisted of

Mainplots: *Brachiaria brizantha* CIAT 16827
Brachiaria brizantha CIAT 16829
Brachiaria brizantha CIAT 16835
Brachiaria brizantha CIAT 6387
Brachiaria brizantha CIAT 6780

Subplot: no cutting
Cut on 15 June
Cut on 15 July
Cut on 15 August

The result from two year study showed that *Brachiaria brizantha* CIAT 6387 gave the lowest seed yield whereas the other four were not significant different from each other. Cutting seed crop at 15 July gave significant high seed yield.

1.5 Integrated use of improved forages, cassava and legume hay for beef fattening

Improved forages species was introduced to 35 farmers in Pakchong District. Feeding technology (using cassava chip and Cavalcade hay) for beef fattening was introduced to 3 farmers in Pakchong district. Farmers are interested to use Cavalcade hay but are not keen to produce it themselves.

2. Dissemination of forage technologies, starting in 2001

2.1 Participatory Diagnosis with Beef Cattle Farmers

Scaling up from Sung Nuen District to another three Districts. Participatory Diagnosis (PD) was done in three villages of Sikhue District, Nakorn Ratchasima Province. The farmer members raised beef cattle mainly through herding. The grazing areas were communal and uncropped areas. Crop residues, such as rice straw, corn husk and empty cobs were also used at a certain times of the year.

The three villages were established for at least 100 years. The houses were located in clusters at the village center. Farm areas were thus located surrounding the living area. Farmers used lowland for paddy rice whereas upland used for each crops such as cassava and maize. Cattle and buffaloes graze on forest area, communal land and cropping area after harvested. In recent years, farmers used tractor instead of buffaloes for ploughing. The need of buffaloes for draft decreased dramatically. The cattle had been upgraded from native to Brahman and Indu Brazil.

Crops were the main component of the farming system in all 3 villages. However, high input cost and low price of the products were recognized as the major problems. Although beef cattle production is secondary to crops, it plays an important role as source of income.

As the population has grown up, the demand for cropping area has increased and expanded. Therefore, grazing area become limited, feed availability for cattle become a major constraint for cattle production.

In one village, this has gone to the extent where the whole area has been devoted to cropping. In this case, the farmers had to herd their animals to other villages for grazing. For such high pressure of feed shortage, rice straw was being fed to cattle immediately once it is available, while the other two villages' farmers kept rice straw for feed to animal in the following cropping season.

All cattle farmers in the 3 villages established forages using small portions of their crop areas. They expressed interest in establishing *Brachiaria ruziziensis* (grass). The main purpose was to address the problem of thinner animals.

One reason why farmers chose to grow Ruzi was that there were some who have grown the species before. They found Ruzi grass grew well but at the time of the PD, it was learned that the species did not persist. Apparently, this could be due to overgrazing. Overgrazing could be either because the farmers did not feel the necessity to manage it well or that Ruzi could not withstand the grazing pressure in the area. Those constraints imply the need for farmers to evaluate other species compared to Ruzi. Since farmers were very interested to Ruzi, farmers could plant this forage in relatively bigger plots but at the same time, try out the other species smaller plots.

The fact that grazing is the major management system in the area should not rule out the need to test cut and carrying species. It was learned during the PD that farmers paid more attention to feeding the breeder bulls (especially Indu Brazil). These animals were often confined and just allowed to go with the herd when there are cows in heat. When confined, the bulls are fed cut forages as well as other feeds (*e.g. banana fruit*). Bulls were valued not only for improving the farmers' own herd but are also used to generate income. Income is generated from payment of breeding services of the bull to other farmers' cows. The existing rate was 500 Baht for each successfully bred cow.

2.2 Numbers of farmer plant forage crops

There were 26 beef cattle farmers in Dan-khuntod District who evaluated Ruzi grass and Stylo 184. The main problem in beef cattle production was lack of feed for animal during rainy season. During dry season raise their animal in cropping area, after harvesting.

Thirty dairy farmers in Kornburi District tried forage legumes; Stylo184 and Verano Stylo mixed with Ruzi grass or Purple guinea.

Developing forage technologies with 20 dairy cattle farmers in Sung Nuen district started since 1998. In this area intensive cut and carry for dairy cattle was developed. Six accession no. of *Brachiaria brizantha* were evaluated by those farmers, the area planted new species started with 1685 m^2. In 2000, there were 13 farmers (9 new) evaluated such accessions and at the end of 2001 there are 9 farmers expanding their area. The farmers expand 1,430 m^2 of *Brachiaria brizantha* CIAT 6387 and 10,980 m^2 of *Brachiaria brizantha* CIAT 6780. In 2000, intensive cut – and – carry for dairy cattle being develop, three forage legume species; *Centrosema pascuorum* cv. Cavalcade, *Stylosanthes guianensis* CIAT 184 and *Stylosanthes hamata* cv. Verano were integrate into the systems. Initial areas were range from 20 m^2 – 3200 m^2 with total of 11,620 m^2. At the end of 2001, 19 farmers (10 new) are planted these three legumes in associated with Ruzi grass, the area range from 50 m^2 – 3,200 m^2 with the total of 80,000 m^2. In both systems, forages were cut and carry for their animals in the morning and afternoon in wet season and grazing during dry season. Both men and women manage forage feeding.

Planting *Brachiaria brizantha,* which the farmers noticed is still green in the dry season, could provide feed for animal longer into the dry season. That can help them reduce duration of using agricultural by product for dairy cow. In these cases they can also reduce use of concentrate feed because good quality roughage is available. It means that they can reduce cost of feed for dairy cattle. Base on farmers' opinion farmers accepted the effectiveness of *Brachiaria brizantha* in increasing milk yield. From the survey, number of animal increase by 20% and the cost of concentrate feed reduce by 41%.

Integration of forage legumes into dairy farming system had increased milk fat percentage in the farmer point of view that leads to high price per kg of milk. Planting forage legume does not only affect animal production but also improve soil fertility in the area. Ninety percent of farmers would be willing to extend the area planted to these forage legumes, especially in association with grasses. The farmers requested for Stylo 184 and Cavalcade seed to expand about 188 rai or

300,800 m^2 in 2002. The request was from the former group and ten new farmers. It was indicated that integrated legume into dairy farming system have been accepted in these area.

In the case of beef cattle farmers, instead of using only rice straw or native grass in communal grazing land, farmers are benefit from planting forage species. Animals can be fed with Ruzi grass, Stylo 184 and Verano Stylo up to dry period that prevent them from loosing their weight during dry season. In Sekew district there were only 6 farmers who planted 2 – 3 species as an evaluation plot in the area. At the end of the year there is a set of farmers who would like to try Stylo 184 and Verano Stylo because they noticed that these species can provide feed supply during the dry season. Planting forage near the house reduced labor in raising animal in communal gazing land far from their house.

2.3 Cross visits. Five cross visits for 144 farmers were organized.

In conclusion of dissemination of forage technology during this phase, four Participatory diagnoses (PDs) were conducted in 3 villages of Sikew District and 1 village in Pakchong District Nakorn Ratchasima province. A total of 45 farmers participated in PDs. At the end of this phase 50 farmers in Pakchong district, 100 farmers in Sungnuen District, 100 farmers in Sikew District, 26 farmers in Dankhuntod District and 30 farmers in Khonburi District of Nakorn Ratchasima province planting forages for their cattle. Five cross visits for 144 farmers were organized.

3. Training

To develop the capability of local staff and farmers, several training courses, on-site training and cross visits were conducted.

Year 2000

- One staff attended a training course on gender and stakeholder analysis in Vietnam
- One staff went to Philippines for M&E training course.
- Two training courses on forage agronomy and FPR were held for 24 extension workers and researchers during 20 – 24 November, 2000 at Pakchong Animal Nutrition Research Center
- On-site training on participatory evaluation for extension workers was done during conducted participatory evaluation at Sung Nuen site.
- Informal training on forage establishment, management and utilization were done at Sung Nuen site for ten farmers who participated in developing forage technology.

Year 2001

- District livestock officers visit to Pakchong Animal Nutrition Research Center
- Twenty eight dairy farmers in Khonburi District, Nakorn Ratchasima Province were trained on Forage establishment, management and utilization
- On-site training on forage management and utilization for dairy farmers in Sung Nuen District, Nakorn Ratchasima province.
- Training course on 'Forage Agronomy and Developing Forage Technology with Farmers' was conducted for 19 field workers and one researcher.

Year 2002

- Training course on 'Forage agronomy and Utilization' was conducted for 50 farmers.
- A field day on 'Forage establishment and management were conducted for 50 farmers.
- Training course on 'Forage agronomy, management and utilization' was conducted by Division of Self-help Land Settlement, Department of Public Welfare, and Ministry of Social Welfare for 20 beef fattening farmers.

4. Multiplication

Forage grass and legume seed was produced by both Division of Animal Nutrition and by farmers under contracted with the Division of Animal Nutrition. Quantity of seed and cuttings that have been distributed to farmers in the project area are show in Table 6.

Table 6. Seed (kg) and cutting (bag) distributed to farmers in the project sites

Species	2001	2002
Brachiaria ruziziensis	422	95
Brachiaria brizantha CIAT6780	4	10
Brachiaria brizantha CIAT6387	11	-
Brachiaria brizantha CIAT16835	18	-
Panicum maximum TD58	5	-
Stylosanthes hamata cv. Verano	25	15
Stylosanthes guianensis CIAT 184	200	140
Centrosema pascuorum	-	112
Arachis pintoi	4,000 bags	-

Forage seed were made available for other FSP countries on request every year as show in Tables 7–9.

Table 7. Freight of seeds to other countries in year 2000 (kg).

Species	Vietnam (CIRAD)	Vietnam	Indonesia	Philippines	Laos
Brachiaria brizantha 'Marandu'	10	20	3	20	-
Brachiaria brizantha 'Serengeti'	5	-	-	-	-
Brachiaria brizantha 'Karanga'	5	-	-	-	-
Brachiaria ruziziensis	-	-	-	-	-
Panicum maximum 'Simuang'	-	20	-	20	-
Paspalum atratum	-	20	-	20	-
Centrosema macrocarpum	-	-	-	10	-
C. pubescens	-	-	-	4	-
D. virgatus	-	-	-	3	-
S. guianensis CIAT 184	-	20	20	20	40

Table 8. Forage seed sent to the FSP countries in 2001 (kg).

Species	China	Indonesia	Lao	Philippines	Vietnam
Panicum maximum 'Simuang'	1	-	30	20	12
Brachiaria ruziziensis	-	-	-	-	3
Brachiaria brizantha 'Marandu'	1	3	8	4	14
Brachiaria brizantha 'Serengeti'	1	-	3	4	5
Brachiaria brizantha 'Karanga'	1	2	3	-	4
Paspalum atratum	-	2	-	30	11
Centrosema pubescens 'Barinas'	1	-	1	2	1
Centrosema macrocarpum	-	-	4	2	1
Centrosema pascuorum	1	-	-	-	1
Desmanthus virgatus	-	-	-	10	-
Stylosanthes guianensis CIAT 184	-	-	30	20	21
L. leucocephala 'Cunningham'	-	-	2	10	-
Stylosanthes hamata	-	-	-	-	5

Table 9 Amount of forage seed sent to FSP countries in 2002 (kg).

Species	Philippines	Lao	Vietnam	Indonesia
Panicum maximum 'Simuang'	12	25	35	5
Brachiaria ruziziensis	2	-	-	-
Brachiaria brizantha 'Marandu'	2	5	20	9
Brachiaria brizantha 'Serengeti'	2	3	6	5
Brachiaria brizantha 'Karanga'	2	5	11	-
Paspalum atratum	10	-	35	10
Centrosema pubescens 'Barinas'	2	-	-	6
Centrosema pascuorum	4	-	-	5
Desmanthus virgatus	7	-	-	-
Stylosanthes guianensis CIAT184	4	50	20	25
L. leucocephala cv. Cunningham	7	-	-	5
Stylosanthes hamata	1	-	-	-

In Thailand the demand for forage seed has increased in the past 3 years due to high price of beef cattle. A large amount of forage seed has been produced but it is still not enough. So there is room for farmers to produce forage seed for sale. Thirty farmers in Kornburi district and 35 farmers in Buayai district started producing Ruzi seed for sale in 2001. A training course on establishment and management of forage crop for seed production was conducted for 10 farmers from Buayai. They also visited seed producers in Khon Kaen province through facilitation of FSP. Farmers in Kornburi district did not continue producing forage seed, instead they used the forage area for feeding their animals. Only 16 farmers in Buayai District continued to produce forage seed. They can produce 462 kg of Ruzi seed in 2002 which generated income of about 25,410 Thai Baht or about 590 US$. Five dairy farmers in Sungnuen District started to produce forage seed for their own farm use.

In 2002, we multiplied 5 forage species that were received from CIAT for further study. The species namely *Brachiaria brizantha* CIAT 26560, *Brachiaria brizantha* CIAT 26424, *Brachiaria* hybrid 36061 and *Cratylia argentea* CIAT 18674.

5. Networking

In 2001 and 2002, one coordinator and one counterpart attended the 1st and 2nd annual regional project meetings of the Forages for Smallholders Project - Phase II, held at Samarinda, East Kalimantan, Indonesia, and Luang Phabang, Lao PDR.

Thailand held the editorship of SEAFRAD Newsletter in 2001 and published two issues of SEAFRAD in 2001 and 2002.

Lesson Learned

- To be success in using participatory approach it requires attitudinal and procedural changes in the organization.
- Participatory approach is labor–intensive rather than a capital intensive method and requires intensive supervision during the early implementation stage.
- Participatory approach could not be trained only from one formal training, it needs to learn from experience (learning by doing) to impart skills and during this stage it also requires 'teamwork'. In the field, supervision is not only from expert but also can get from the one who work together who has the same attitude.

- The difficulty of working in this field is lack of teamwork, and lack of institutional support.
- Planting materials of forage crop should be available for farmers to evaluate and expand.
- Because it takes time to work together with farmers, so local staffs need to be trained and at the early stage they should be supervise continuously.

Conclusions

1. In this phase, 306 farmers in Nakorn Ratchasima Province planted improved forage species which helps them to reduce the use of agricultural by-products for dairy cattle. It could also reduce use of concentrate feed because better-quality roughage was available. Cost of feeding was therefore reduced. Integrated forage legume can improve milk quality it lead to get high price of their product.
2. Forty three extension workers and researchers were trained in ' Forage agronomy and Developing forage technology with farmers'
3. One hundred and sixty seven farmers were trained on 'Forage establishment, management and utilization'
4. More than 1,000 kg of forage seed (of 9 forage species) have been distributed to farmers in the project area in Thailand.
5. More than 800 kg of forage seed was made available for other FSP countries.

Forages for Smallholders Project (Phase 2) Activities in Viet Nam, 2000 – 2002

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Abstract

This paper reviews the activities of the FSP Phase 2 project in Vietnam from 2000-2002. In the 3 years of FSP Phase 2 the project has carried out 10 forage evaluation trials at two site in Vietnam(Daklak and Tuyen Quang provinces) as well as extending forage technologies to nearly 2300 farmers in training courses and having over i480 farmers involved in forage evaluation and production. The FSP has trained 96 development workers in forage technologies and an extensive network between researchers, development workers, extension providers, local officials and farmers has been developed.

It is clear that participatory approaches are a very good way to develop forage technologies with smallholders in Vietnam. Adoption rates are quite high and are increasing every year. Training, cross-visits and capacity building activities are critical to the development of forage technologies with smallholder farmers and a good organization and network is the key to developing, scaling up, and dissemination of the forage technologies.

Introduction

The Forages for Smallholders Project (Phase 2) has been working in Viet Nam (Daklak and Tuyen Quang provinces) from 2000-2002. The purpose of the project is to improve livestock and agricultural production in smallholder farming systems in order to increase smallholder farmer income, as the consequence of the poverty alleviation. This is based on the introduction of new forage species into the farming system.

The main activities of the project are forage technology development, dissemination, forage multiplication, and the establishment of a forage technology development network across the country and provinces

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Firstly, forage technology development uses participatory research to identify, study, and solve problems highlighted by farmers and researchers involved in evaluating the use of forages for animal production. Between 2000 and 2002, ten different studies were conducted in Vietnam (six in Daklak and four in Tuyen Quang) on forage technology development. These concentrated on the evaluation of forages as cover crops, the use of shrub legumes in boundary areas, the evaluation of forages for pig and fish production in Tuyen Quang province and the use of forages to improve natural grasslands, evaluation of legumes under coffee trees, using tree legumes for fattening cattle, trials on new *Brachiaria brizantha* varieties, and an impact assessment of forages in fish and cattle production in Daklak province (see table 1).

Table 1. Forage Technology Development

In Daklak
Trial 1: Evaluation of legumes as cover crops under Tea and Fruit trees
Trial 2: Evaluation of shrub legumes in boundary area
Trial 3: Selection of forage species for pig production
Trial 4: Selection of forage species for fish production
Trial 5: Impact assessment of improved forages in fish production systems
Trial 6: Impact assessment of improved forages in cattle production systems
In Tuyen Quang
Trial 1: Evaluation of legumes as cover crops under Tea and Fruit trees
Trial 2: Evaluation of shrub legumes in boundary area
Trial 3: Selection of forage species for pig production
Trial 4: Selection of forage species for fish production

Secondly, dissemination activities were conducted in a number of districts, encompassing a wide selection of communes, villages and farmers who are involved in evaluating and using forages for livestock production. These activities used Participatory Technology Development (PTD) to expand the use of improved forages in the target areas. Activities included Participatory Diagnoses, Planning and Evaluation (PD, PP, and PE), training courses, field days and cross visits and farmer field schools.

Thirdly, forage multiplication systems have been developed in the country and in the provinces, providing an indigenous system of production and supply of planting material for local farmers and reducing their reliance on imported forage material.

Finally, a network of authority and development workers has been established for forage technology development in each province, thereby enhancing the commitment of local authorities for forage extension activities and the long-term sustainability of the forage development process.

These activities are continuously monitored and evaluated every 6 months. The information is fed back to stakeholders through reports, the participatory diagnosis, planning and evaluation cycle, meetings with development workers, and workshops.

The outline of this paper: With each activity mentioned follows is summarized in the country and in each province. Firstly, a summary of the forage technology development trials carried out by FSP Secondly, dissemination and training activities thirdly, information on forage multiplication networking between local authorities, development workers and forage researchers is provided.

Forage Technology Development in Vietnam from 2000-2002

1. Tuyen Quang site:

Trial 1: Evaluation of legumes as cover crops under Tea and Fruit trees.

Through Participatory Diagnosis with several farmer groups, one forage technology identified by farmers was the need for cover crops under tea and fruit trees in order to reduce soil erosion, produce feed for livestock, and to improve soil fertility and structure. In response to this identified need, an evaluation of legumes as cover crops was carried out by farmers in Tu Quan Commune in Tuyen Quang. Five potential cover crops were trialed by farmers - *Stylosanthes guianensis* CIAT 184, *Stylosanthes hamata, Vigna unguiculata, Wynn cassia* and *Arachis pintoi.*

Farmers involved in the trial identified vigor, cover crop potential and weed control as the main advantages of legumes and ranking and scoring exercises were carried out with farmers to evaluate the five trialed species (see Table 2).

Table 2. Evaluation of Legumes as Cover Crops

Species	Vigor	Cover	Weed Control	Ranking
Stylosanthes guianensis CIAT 184	+ + +	+ +	+ +	2
Stylosanthes hamata	+ +	+	+ +	5
Vigna unguiculata	+ + + +	+ + +	+ + +	1
Wynn cassia	+ +	+ +	+	4
Arachis pintoi	+ +	+ +	++	3

Note: Not good (+). Good (++). Very good (+++). Excellent (++++)

Farmers evaluated Vigna *unguiculata* as the most preferred species, followed by *Stylosanthes guianensis* CIAT 184 and *Arachis pintoi.* Farmers noted that Vigna was a very good cover crop because it grew very fast and established itself as a cover crop quite quickly. It is a leafy species and able to cover all of the exposed ground, resulting in very good weed control. Vigna also

has a very high seed production, over 2 tons/ha, while the seed is high quality and can be eaten by humans. In comparison, *Stylosanthes guianensis* CIAT 184 grows well and is a taller species compared with the other crops under trial. It has good coverage of bare soil and good weed control characteristics. It can be used for green fodder for pig and fish production.

Trial 2: Evaluation of shrub legumes in boundary areas

Three tree legume species were trialed in Phu Lam Commune in Tuyen Quang. These species (*Gliricidia sepium, Leucaena leucocephala,* and *Calliandra calothyrsus*) were planted as boundary fences around fruit tree crops, maize, and home gardens.

Farmers involved in the trial identified growth, leaf yield and animal acceptance as the main advantages of legumes and ranking and scoring exercises were carried out with farmers to evaluate the three trialed species (see Table 3). Farmers evaluated *Leucaena leucocephala* as the most preferred species, followed by *Calliandra calothyrsus* and *Gliricidia sepium.*

Farmers noted that *Leucaena leucocephala* and *Calliandra calothyrsus* were similar in growth habit and yield, but Leucaena was more accepted by livestock while Calliandra was still green in the winter time.

Farmers noted that Gliricidia grew very well with a high leaf yield and it was easy to plant by stem cuttings. However, animals had difficulty in accepting Gliricidia as forage. Some farmers noted that this feature was good when they wanted to establish Gliricidia as a living fence.

Table 3. Evaluation of Shrub Legumes

Species	Growth	Leaf Yield	Animal Acceptance	Ranking
Gliricidia sepium	+ + +	+ +	-	3
Leucaena leucocephala	+ +	+ +	+ + +	1
Calliandra calothyrsus	+ +	+ +	+ +	2

Good (++). Very good (+++)

Trial 3: Selection of forage species for pig production

Four forage species were planted for evaluation of their suitability for pig production; *Stylosanthes guianensis* CIAT 184, Ramie, Gigantea and Sweet potato. Farmers involved in the trial identified establishment, yield and animal acceptance as the main advantages of forages trialed and ranking and scoring exercises were carried out with farmers to evaluate the four trialed species (see Table 4). Farmers evaluated *sweet potato* as the most preferred species, followed by *Ramie* and *Stylosanthes guianensis* CIAT 184.

Farmers noted that sweet potato was the traditional plant fed to pigs and was the most suitable for pig production. Sweet potato was quicker to stabilize after planting compared with the other species trialed. Farmers also noted that sweet potato and Ramie have the highest yield and are more palatable than Gigantea (hairy) and Stylo (relatively hard). In addition, the yield of Stylo was lower than the other species.

Table 4. Selection of Forage Species for Pig Production

Species	Establishment	Yield	Animal acceptance	Ranking
Stylosanthes guianensis CIAT 184	+ +	+ +	+ +	3
Ramie	+ +	+ + +	+ + +	2
Gigantea	+ +	+ + +	+ +	4
Sweet potato	+ + +	+ + +	+ + +	1

Note: Not good (+). Good (++). Very good (+++). Excellent (++++)

Trial 4: Selection of forage species for fish production

Five forage species were planted for evaluation of their suitability for fish production; *Brachiaria brizantha* 'Toledo', *Brachiaria ruziziensis, Setaria sphacelata var. Splendida, Paspalum atratum,* and *Panicum maximum.*

Farmers involved in the trial identified growth, yield and animal acceptance as the main advantages of forages trialed and ranking and scoring exercises were carried out with farmers to evaluate the five trialed species (see Table 5). Farmers evaluated *Panicum maximum* as the most preferred species, followed by *Paspalum atratum* and *Brachiaria ruziziensis.*

Farmers noted that *Panicum* and *Paspalum* species have good growth, yield and acceptance by fish while *Setaria* looks like a nice species, has a good yield but limited acceptance by fish. *Brachiaria brizantha* 'Toledo' has good growth and yield but the leaf is sharp and hard and thus has limited potential for feeding to fish. Farmers overall liked *Panicum maximum* for feeding fish and called it the fish grass".

Table 5. Selection of Forage Species for Fish Production

Species	Growth	Yield	Animal acceptance	Ranking
Brachiaria Toledo	+ +	+ +	+	5
Brachiaria ruziziensis	+ +	+ +	+ +	3
Setaria sphacelata var. Splendida	+ +	+ + +	+	4
Paspalum atratum	+ +	+ + +	+ +	2
Panicum maximum	+ + +	+ + +	+ + +	1

Note: Not good (+). Good (++). Very good (+++). Excellent (++++)

2. Daklak site

Trial 1: Pasture composition in natural grasslands and the use of improved forages to increase livestock productivity.

This trial was carried out in M'Drak District in 2000-2001 and the main results were reported at the January 2002 FSP Regional Workshop in Lao PDR[1]. Natural grasslands in M'Drak are the result of many interacting forces due to deforestation, shifting cultivation, burning and animal grazing. The main types of grasslands in the area are tall robust communities dominated by either *Imperata cylindrica, Vetiveria sp.*, (distributed through the open grasslands), *Sacharum notatum* (present along the streams, rivers and lowland), or exotic grasses (around villages and farm households). There are also short-grass grasslands which are dominated by *Chrysopogon aciculatus* and are distributed throughout the tall-grass grassland. All grasslands have very few shrubs and trees, many unpalatable grasses (except when very young), and are of low productivity.

The ability to increase productivity of the natural grasslands with introduced grasses and legumes planted in strips are very high. In the grazing trials *Brachiaria* species and *Stylosanthes guianensis* CIAT 184 was used to replace up to 50-60 percent of the natural unproductive species such as *Imperata cylindrica* over a two year period even under grazing. Stylo 184 was established successfully, persisted well, and was only eaten in the dry season. *Arachis pintoi* can be established in *Imperata* grasslands, contributing up to 20-30 percent of dry matter after only 2 years. This has very positive implications for creating a productive and sustainable pasture system.

Trial 2: An evaluation of *Stylosanthes guianensis* CIAT 184 and *Arachis pintoi* as cover crops in coffee production.

Through Participatory Diagnosis with several farmer groups, one forage technology identified by farmers was the need for cover crops under coffee in order to reduce soil erosion, produce feed for livestock, and to improve soil fertility and structure. In response to this identified need, 10 farmers in M'Drak and Ea Kar Districts in Daklak carried out an evaluation of legumes as cover crops. Two potential cover crops were trialed by farmers - *Stylosanthes guianensis* CIAT 184 and *Arachis pintoi.*

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[1] Truong Tan Khanh (2002) "*Studies on Improving Productivity of Native Grasslands*". Paper presented at the Third Annual Regional Program Meeting of the Forages for Smallholders Project, 28 January - 3 February 2002. Luang Phabang, Lao PDR

Farmers involved in the trial identified soil erosion control, soil improvement and green manure production, weed control, and livestock feed as the main advantages of legumes as cover crops. However, farmers were also concerned about the cover crops competing with coffee for nutrients, and the cover crops becoming weeds themselves.

Ranking and scoring exercises were carried out with farmers to identify priorities for cover-crop characteristics and the evaluation of the two trialed species (see Table 6 and Table 7). Farmers identified livestock feed and soil improvement/green manure production as the two most important characteristics of the cover crops, while the potential of the cover crops to become weeds was a major concern of farmers (see Table 6). As Table 7 shows, *Stylosanthes guianensis* CIAT 184 was preferred over *Arachis pintoi* in all cases except soil erosion control, while the potential for Stylo to compete with coffee trees for water, nutrients and light was greater than that of *Arachis pintoi* – when farmers allowed Stylo to grow higher than the coffee.

Farmers noted that Stylo can be used for cut and carry purposes to feed cattle and make leaf meal for pigs and chickens, it produces good green manure and is good for weed control and soil erosion control. In contrast, Arachis pintoi has good shade tolerance, establishes itself as an effective cover crop quite quickly, and has good soil erosion control.

Farmers noted that Arachis has several disadvantages, including a low yield, difficulty in cutting for fodder purposes and, unlike Stylo, it is difficult to remove from the coffee garden once it becomes a weed.

Table 6. Farmer Ranking of Characteristics of Legumes as Cover Crops in Coffee

	Characteristic	Ranking of Importance
Advantages	Cutting - feeding animal	1
	Soil improvement, green manure	2
	Soil erosion	4
	Weed control	6
Disadvantages	Compete with main crop for nutrients	5
	Become weeds	2

Table 7. Farmer Evaluation of Legumes as Cover Crops in Coffee

	Characteristic	*S. guianensis* CIAT 184	*A. pintoi*
Advantages	Cutting - feeding animal	***	*
	Soil improvement, green manure	***	*
	Soil erosion	**	***
	Weed control	***	*
Disadvantages	Compete with main crop for nutrients	**	*
	Become weeds	*	***

* low, ** medium, *** high

Trial 3: Using improved forages and tree legumes for fattening cattle

Introduction. Fattening livestock before sale is not popular amongst cattle producers in Daklak Province. In participatory diagnoses (PDs) carried out in M'Drak and Ea Kar Districts, farmers noted that cattle were almost always sold when very thin and therefore fetched a low price. In a survey carried out in Daklak in 2001, the FSP identified some farmers who purchased these cattle and fattened them on concentrate feed before re-sale – thereby getting a substantial profit. However, the majority of poor farmers do not have the capital necessary to invest in concentrate feed. PDs with farmers identified the potential for forages and legume trees as a low-cost source of feeds for fattening cattle; thereby reducing the need to sell thin cattle. In association with farmer groups, FSP Development Workers and District Extension Staff set up a pilot research project with six households in 2002 to investigate the use of planted forages and legume trees already established by farmers (for other purposes like fencing and shade for coffee trees etc.) for cattle fattening.

Materials and Methods. In cooperation with the District Extension Offices in M'Drak and Ea Kar Districts, the FSP set up a forage feeding experiment with 6 households in M'Drak and Ea Kar Districts (3 households in each district). Each household had 6 cattle divided into 2 treatment groups (see Table 8). In the first treatment group (Plot 1), 3 cattle were each fed a daily ration of 10kg concentrate and 30kg grasses. In the second treatment group (Plot 2), 3 cattle were each fed a daily ration of 3kg concentrate, 45kg of grasses and 15kg of legumes (either *Stylosanthes guianensis* CIAT 184, *Leucaena leucocephala*, or *Gliricidia sepium;* depending on local availability). Concentrate feed was subsidized by the District Extension Offices. Starting and finishing weights were estimated using girth tapes and the FAO girth-weight conversion tables.

In addition to the 6 households involved in the feeding trials, 10 farmers in each district were invited to the experiment sites to evaluate the trials and exchange experiences with other farmers.

Table 8. Treatment Groups and Ration Formulation

Item	Treatments	
	Plot 1	Plot 2
Ration (kg/head/day)		
Concentrate (15% protein)	10	3
Grasses (native and forages)	30	45
Legumes	0	15
Number of Households	6	6
Number of Cattle	18	18
Length of Experiment (days)	60	60

Results and Discussion. Although experiments were conducted in M'Drak and Ea Kar Districts, the results below are only from the Ea Kar experiments as the M'Drak experiments are still ongoing.

Dry matter and protein intake data are presented in Table 9. The results indicate that dry matter and protein intake in the two treatment groups were similar, with dry matter intake averaging 2.5-3 percent of total body weight. On a percentage basis, Plot 2 treatment animals received 9.33 percent more total DM and 5.6 percent more protein.

Weight data are presented in Table 10. The average weight gain of animals in Plot 1 treatment was 27.5 kg/month/head, compared with 25.75 kg/month/head for Plot 2 treatment animals. The difference in weight gain between the two treatments was not significantly different (p=0.73) and shows that farmers can substitute part of a concentrate ration with grasses and legumes and still obtain the same weight gain as the high concentrate treatment Plot 1.

Table 9. Forage Dry Matter Intake, Ea Kar District

Treatment	Concentrate Intake (kg DM)	Forage intake (kg DM/day)	Total intake (kg DM/day)	Protein intake (g/day)	Feed conversion ratio (kg liveweight/kg DM)
Plot 1	2.86	2.5	5.36	714.8	0.169
Plot 2	0.86	3	5.86	754.8	0.146

Table 10. Starting and Finishing Weight of Cattle, Ea Kar District

Treatment	Weight (kg)	N	Mean	Std Dev	SE Mean	T-test	P-Value
Plot 1	Starting	9	182.52	13	5.3	-0.36	0.73
	Finishing	9	237.02	14.3	5.8		
	Weight Gain (kg/month)	9	27.25	2.88	1.2		
Plot 2	Starting	9	186.18	13.7	5.6	0.01	0.99
	Finishing	9	238.06	14.5	5.9		
	Weight Gain (kg/month)	9	25.94	4.4	1.8		

df =9

While weight gains under the two treatments are similar, farmers noted significant benefits derived from a combined concentrate and improved forages ration (Plot 2). Firstly, while most farmers could not afford to feed their cattle a high concentrate diet (Plot 1), and were forced to sell their animals at a lower weight, the Plot 2 ration enabled farmers to achieve the same benefits as the Plot 1 ration without the substantial outlay in scarce capital.

Irrespective of the treatment ration, cattle fed a high quality ration had a higher average daily weight gain and received a market premium of Đ2000/kg live weight over animals fed poor quality native pastures (which sold for Đ11,000/kg live weight). Most of the increase in average daily weight gain is due to increased intake of dry matter, with animals in Plot 1 treatment needing 5.9kg DM to achieve a weight gain of 1kg versus 6.7kg DM for Plot 2 animals (see Table 9).

As Table 11 show, while non-feed production costs were similar, feed costs were significantly different; with the Plot 2 ration being 27.5 percent cheaper. Combined with the weight gains shown in Table 10, this results in a significantly higher profit ($p=0.001$) for the Plot 2 compared with the Plot 1 ration. As Table 22 shows, animals on the Plot 2 ration sold for an average profit of Đ558,780 (US$365) compared with an average profit of Đ413,760 (US$270) for Plot 1 animals. Farmers noted that in practice the cash profit would be higher as they would not normally spend money cutting grasses and legumes.

While a traditional farmer practice control group was not included in the experiment, calculations of comparative breakeven weight gain can be obtained, assuming zero cost of feed (extensive grazing only) and the same profitability as the Plot 2 treatment. As Table 13 shows, assuming the same costs as in Table 11, traditional practice feeding would require animals to have a weight gain of 1.06kg per day over a two month period, compared with 0.86kg per day for Plot 2 treatment animals. Alternatively, if farmers kept their animals for 4 months, animals grazing extensive pasture would only require a daily weight gain of 0.67kg in order to achieve the same profitability as the Plot 2 treatment animals.

These results indicate that while it may not be profitable for farmers to graze their livestock on natural grasslands for the same time as farmers feeding their animals Plot 2 treatment rations, if they can achieve a weight gain of 0.67kg per day over a 4 month period (and are able to wait twice as long to sell them), then it may be profitable to extensively graze their animals; rather than feed an improved forage and concentrate diet. Research needs to be carried out to see what daily weight gain under traditional farmer practice is achievable, and what the time discount for farmers is.

Table 11. Input Costs for Cattle Fattening, Ea Kar District

Treatment	Cattle	Feed	Interest	Vet	Labor	House	Total
Plot 1	2007500	480000	45000	15000	100000	20000	2667500
Plot 2	2008000	348000	45000	15000	100000	20000	2536000

VND/head, 2 month period

Table 12. Revenue and Profit from Cattle Sales, Ea Kar District

Treatment		N	Mean	Std Dev.	SE Mean	T-Test	P-Value
Revenue	Plot 1	9	3081000	169499	64065	0.43	0.68
	Plot 2	9	3094780	172301	65124		
Profit	Plot 1	9	413760	67377	27506	1	0.00
	Plot 2	9	558780	103502	42255		

VND/head, 2 month period
df =11

Table 13. Hypothetical Breakeven Analysis, Traditional Farmer Practice versus Improved Forages Ration

Item	Units	Plot 2	Traditional Farmer Practice	
			2 Months	4 Months
Required Profit	VND	558780	558780	558780
Revenue	VND	3094780	2746780	2926780
Cost	VND	2536000	2188000	2368000
Sale Price	VND/kg	13000	11000	11000
Sale Weight	kg	238.06	249.71	266.07
Start Weight	kg	186.18	186.18	186.18
Weight Gain	kg	51.88	63.53	79.89
Daily Weight Gain Required	kg	0.86	1.06	0.67

Apart from those farmers involved in the experiments, and the 10 farmers in each district who were invited to visit the experimental plots, other farmers in the villages came and observed the results of the experiments. In discussions with visiting farmers several points of interest were raised. Firstly, cattle had to be trained to eat the leaves of *Gliricidia sepium* since none of the farmers had used Gliricidia leaves previously for feeding cattle. In the experiments farmers trained cattle by mixing Gliricidia leaves and chopped grass together for feeding when the cattle were being housed. Farmers were able to train all of the cattle to eat Gliricidia within one week. Secondly, farmers were able to identify high quality feed resources available on their farm. In Ea Kar and other districts within Daklak most of the farmers have planted Leucaena in their gardens and in their fields as living fences or for shade (especially for coffee gardens). Although they have not used these resources for feeding cattle, through these experiments and demonstrations many farmers are now starting to utilize these feed resources for their livestock.

Trial 4: An evaluation of new Brachiaria brizantha varieties for livestock production

Two new *Brachiaria brizantha* varieties were planted in 6 experimental plots in Ea Kar District from June 2002. While results of the trial have not been finalized, farmers involved in the experiments noted that both varieties are growing well but the yields of both varieties are lower than

that obtained by *B. brizantha* CIAT 6780, *P. maximum* TD 58, and *Paspalum atratum*. On a positive note, the leaves are soft and easy to cut, and both varieties look more palatable than *B. brizantha* CIAT 6789, especially for cattle production.

Trial 5: Impact assessment of improved forages in fish production systems.

Introduction. There is limited data on the impact of improved forages on livestock production systems in Daklak Province. This trial was instigated to examine the effects of improved forages on fish production systems, and the role of forages on improving the livelihoods of smallholder farmers involved in these systems.

Materials and Methods. Two groups of farmers involved in intensive fish production from Ea Kar and Buon Don Districts were selected to take part in the trial. Ten farmers with planted forages (8 in Ea Kar and 2 in Buon Don) and 5 farmers without planted forages were selected as the two treatment groups. For each farmer, the areas under planted forages and areas of fishponds were similar, with the planted forages only used for fish production purposes. Fish production was only carried out for 9 months of the year, with the ponds drying up during the dry season.

Farmers taking part in the experiment were given notebooks to record the main activities undertaken in fish production every month. Data on labor use, feeding, costs and returns were recorded. Development workers in each district collected data and interviewed farmers with a questionnaire.

Results and Discussion. At the time of reporting, only 5 of the 10 farmers with planted forages had harvested their fish and thus the other farmers only estimated their harvest amounts based on prior experience. Data on fish production is shown in Table 14 to Table 16. Farmers with planted forage obtained on average 64 percent (approximately 2/3^{rds}) of their grass requirements from planted forages and the rest from natural grasses. The results indicate that farmers who planted forages save a significant amount of time in cutting grass. Farmers who planted forages could cut 76kg of grass per hour compared with farmers without forages who could only achieve 14kg per hour. In total, farmers who had around 0.23ha of fishpond and 0.12ha of planted forages spent 384 hours cutting grass each year compared with 873 hours for those farmers who had to use natural grass. Farmers noted that the reduction in labor needed to feed fish through the introduction of planted forages was very important; particularly as women and children were usually involved in this activity.

Table 16 shows the costs and returns from fish production with and without planted forages. The data show that the profit per hectare of fishpond from farmers with planted forages is approximately 16 percent higher than the profit of those farmers without planted forages[1]. At current exchange rates (US$1=Đ15,300) this equates to a profit of US$260 per hectare more from planted forages compared with no forages. As Table 16 also shows, the majority of this difference in profitability comes from labor use, with farmers without forages having to spend 118 days of labor to feed their fish compared with 48 days for those with forages. When labor cost is not included (assuming opportunity cost of household labor being zero), the profitability from fish produced with natural grasses is actually slightly higher, with a 3 percent greater profit compared with fish production with planted forages. The reduction in labor cost due to planted forages corresponds with other data collected from experiments on cattle production.

Farmers indicate that the main two benefits from planted forages are the reduction in labor required to cut grass and the increase in yield. Increases in harvested yield are due to the increased palatability of planted forages compared with natural grasses, and the consequent larger amount of feed consumed. Farmers noted that fish usually consume only 40-60 percent of natural grasses cut for feeding, while around 80-90 percent of planted forages cut for feeding are consumed.

Table 14. Labor Needed for Cutting Forages

Month	Amount of grass needed (kg/day)	Number days for cutting grass (days/month)		Amount of grass cut (kg/hour)		Time for cutting grass (hours/day)		Total grass (kg/3months)	
		Natural	Planted	Natural	Planted	Natural	Planted	Natural	Planted
Apr – Jun	9	6	24	12	61	0.7	0.15	151	659
Jul – Sep	50	10	20	15	80	3.2	0.55	1440	2640
Oct - Dec	91	12	18	15	79	5.9	1.2	3186	5119
Average	38	9	21	14	73	3	1	1592	2806

Total labor for cutting grass (hours/year)	384
Total labor for cutting grass (days/year)	48
Average time for managing planted grass (days/year)	9.4
Average fish pond area (ha)	0.26
Average planted grassland area (ha)	0.15

[1] Assuming the same area of fish pond, number of fingerlings and yield of fish, this percentage reduces to 11 percent, which still indicates a benefit from planted forages over natural grasses.

Table 15. Labor Needed for Cutting Natural Grasses

Month	Amount of grass needed (kg/day)	Number days for cutting grass (days/month)		Amount of grass cut (kg/hour)		Time for cutting grass (hours/day)		Total grass (kg/3months)	
		Natural	Planted	Natural	Planted	Natural	Planted	Natural	Planted
Apr – Jun	8.8	30	0	12	0	0.8	0	864	0
Jul – Sep	68.25	30	0	15	0	3.2	0	4320	0
Oct - Dec	144.46	30	0	15	0	5.5	0	7425	0
Average		30	0	14	0	3.17	0	4203	0

Total labor for cutting grass (hours/year)	873
Total labor for cutting grass (days/year)	109
Average time for managing planted grass (days/year)	9.4
Average fish pond area (ha)	0.23
Average planted grassland area (ha)	0

Table 16. Costs and Returns from Fish Production with Planted Forages

Item		Units	Planted Forages			No Planted Forages		
			Quantity	Unit Price (VND)	Value (VND)	Quantity	Unit Price (VND)	Value (VND)
Indicators	Planted area	ha	0.15					
	Fish pond area	ha	0.26			0.23		
	Length of Production	Months	9 (March – December)					
Costs	Fingerlings	kg	13.8	102,000	1,407,600	12.5	105,000	1,312,500
	Management of planted forage	Labor Days	9.4	20,000	188,000			
	Forages	Tons	0.26	100,000	26,000			
	Labor for cutting grasses	Labor Days	48	20,000	960,000	109	20,000	2,180,000
	Fish pond repair	Labor Days	10.4	16,000	166,400	10	16,000	160,000
	Manure for fish ponds	kg	170	800	136,000	150	800	120,000
	Manure for planted forages	kg	120	600	72,000			
	Chemical for planted forages	kg	70	2,500	175,000			
	Concentrate feeds	kg	430	1,200	516,000	425	1,200	510,000
	Total Cost				3,647,000			4,282,500
	Total Non-Labor Cost				2,332,600			1,942,500
Returns	Sales of Fish	kg	1150	8000	9,200,000	998	8000	7,984,000
	Home Consumption	kg	270	8000	2,160,000	276	8000	2,208,000
	Total Production	kg	1420	8000	11,360,000	1274	8000	10,192,000
Profit	Profit	Labor Included			7,713,000			5,909,500
		No Labor			9,027,400			8,249,500
	Difference	Labor Included			1,803,500			
		No Labor			777,900			
	Returns Over Non Forage Use	Labor Included			131%			
		No Labor			109%			
Profit per ha fish	Profit	Labor Included			29,665,385			25,693,478
		No Labor			34,720,769			35,867,391
	Difference	Labor Included			3,971,906			
		No Labor			-1,146,622			
	Returns Over Non Forage Use	Labor Included			115%			
		No Labor			97%			
Profit per ha forages	Profit	Labor Included			51,420,000			
		No Labor			60,182,667			

Trial 6. Impact assessment of improved forages in cattle production systems.

Introduction. There is limited data on the impact of improved forages on livestock production systems in Daklak Province. This trial was instigated to examine the effects of improved forages on cattle production systems, and the role of forages on improving the livelihoods of smallholder farmers involved in these systems.

Materials and Methods. Two groups of farmers involved in intensive cattle production from Ea Kar, Buon Don and M'Drak Districts were selected to take part in the trial. Five farmers with planted forages (2 in Ea Kar, 1 in Buon Don and 2 in M'Drak) and 5 farmers (all from Ea Kar District) without planted forages were selected as the two treatment groups. The number and live weight of cattle in each treatment group was approximately equal (an average of 3.9 and 3.8 head of cattle in each respective treatment group, at a live weight of 211kg and 203kg respectively). Data was collected from farmers through 6 monthly interviews carried out by project development workers.

Results and Discussion. The results of the experiment are presented in Table 17 Labor Needed for Cutting Grass. Farmers with planted forages fed their animals almost 69 percent more than those without forages. Most of this was supplementary feeding at night when the animals were housed. On average, farmers with forages fed their animals 5kg of grass while those without forages only fed their animals 3kg of grass. Of those farmers with forages, almost 84 percent of the ration comprised planted forages while the rest was natural grasses.

Table 18 shows that the profit from a production system including planted forages is much higher than that without forages. Households with forages earn on average Đ966,000 (US$63) more than their counterparts without forages, and Đ228,000 (US$14) per Animal Unit. In the case of planted forages, farmers can earn approximately Đ7,966,000 (US$521) per hectare of forage.

The main two reasons for the difference in profitability between the two systems is the reduction in labor needed to cut forages compared with natural grasses (due to the proximity of large areas of grass close to the house), and the additional amount of feed given to the animals; resulting in higher sale weights of cattle and calves.

Table 17. Labor Needed for Cutting Grass

Treatment Group	Amount of grass needed (kg/day)	Number days for cutting grass (days/month)		Amount of grass cut (kg/hour)		Time for cutting grass (hours/day/AU)		Total grass (kg/year)		
		Planted	Natural	Planted	Natural	Planted	Natural	Planted	Natural	Total
Forages	20	25	5	70	15	0.29	1.33	6090	1197	7287
No Forages	12	0	30	0	15	0	0.8	0	4320	4320
Average planted grassland area (ha)				0.12						

Table 18. Costs and Returns from Cattle Production

	Item	Units	Quantity		Price ('000VND)	Value ('000VND)	
			Forages	No Forages		Forages	No Forages
Indicators	Farmers surveyed	Number				10	5
	Average Planted Forage Area	m2				1400	
	Average No of cattle	Number				4	3.8
	Average Animal Unit (AU)	1 AU=250kg LW				3.3	3.1
Costs	Time for cutting grass	hours/year	156	288	2.5	390	720
	Labor for Animal and Forage Management	day/years	45	36	20	900	720
	Housing Depreciation	VND				50	50
	Veterinary Costs	heads	4	3.8	100	400	380
	Land value	ha	0.12	0	1000	120	0
	Total Cost	VND				1860	1870
Returns	Weight gain	kg/year	327	255	13	4251	3315
	Manure	m3	4	3.8	100	400	380
	Number of calves born	heads	3	3	500	1500	1500
	Total income	VND				6151	5195
	Profit/Household	VND				4291	3325
	Profit/head of Cattle	VND				1072	875
	Profit/AU	VND				1300	1072
	Profit/ha of Forage	VND				7966	
	Difference	VND				228	

Dissemination Activities for 2000-2002

Site	Farmers at beginning of 2002	No. communes (old + new)	No. of PDs conducted	No. of cross visits/Field days	No. farmers using forages up to Nov, 2002	% adoption
Tuyen Quang	976	34	49	53	858	98.2
Daklak	671	34	42	74	491	73
Total	1647	68	91	127	1349	81.9

The project conducted 91 PD and 127 cross visits in Viet Nam. At the end of the project, 1,647 farmers planted forages and the percentage of farmers adopting forages was 81.9%.

1. The dissemination of forages in Tuyen Quang Province:

The dissemination of forage has been successful. At the beginning of Phase 2 of the FSP project in 2000, there were 343 farmers involved in evaluating and planting forages for livestock production (see Table 19). This number increased rapidly, and by the end of 2002 there were 976 farmers evaluating or planting forages for livestock production; with a 98.2 percent adoption rate. Currently dissemination of forage technologies encompasses 34 communes in 5 districts.

As Table 19 shows, there are differences in the percentage of farmers adopting forages across districts, with Yen Son, Han Yen and Son Duong Districts having more than 200 farmers in each, while Chiem Hoa and Na Hang Districts had only 5 and 27 farmers respectively. Yen Son District had 489 farmers adopting forages, comprising just over 50 percent of all adopters in Tuyen Quang Province. In addition to large numbers of farmers involved in cattle breeding in this district, Yen Son District is a pilot site for the fledgling dairy industry in Tuyen Quang Province – thus demand for forages is especially high in this district. The development of a dairy industry in Tuyen Quang Province, centered on Yen Son District, follows the government policy of diversifying agricultural production and in 2001, more than 700 dairy cows were imported from Australia. This resulted in 288 additional farmers adopting forages from 2001-2002, and 135 hectares of forages planted in Yen Son District alone (see Table 20). In Chiem Hoa and Na Hang Districts there is enough feed resources for the current state of their livestock production system and so the number of farmers adopting forages is still limited.

As shown in Table 20, the total area of forages went from 21.19 hectares in 2001 to 187.02 hectares in 2002. The majority of this increase occurred in Yen Son and Ham Yen Districts. As noted above, the introduction of dairy cattle in Yen Son District contributed significantly to the increase in planted area in this district. Average areas of forage per household increased from $1000m^2$ to $10,000m^2$.

The main forage species planted in Tuyen Quang include *Panicum maximum*, *Pennisetum purpureum* and *Paspalum atratum*. In 2002 the FSP helped provincial authorities in Tuyen Quang import 1000kg of *Panicum maximum* seed from Thailand to expand the planting of forages in the region.

Table 19. Dissemination of Forage Technologies in Tuyen Quang Province

District	Year	Farmers at beginning of year	No. Communes (old + new)	No. of PDs conducted	No. of cross visits/ Field days	No. farmers using forages by Nov, 2002	% adoption
Yen Son	2000	136	4	4	6		
	2001	201	7	3	4		
	2002	489	12	11	7		
	Total	489				480	98.2
Ham Yen	2000	161	5	5	4		
	2001	191	6	1	3		
	2002	241	8	4	4		
	Total	241				235	97.5
Son Duong	2000	37	3	3	3		
	2001	114	6	3	5		
	2002	214	9	7	7		
	Total	214				214	100
Chiem Hoa	2000	2	1	1	1		
	2001	5	2	1	1		
	2002	5	2	2	0		
	Total	5				4	80
Na Hang	2000	7	1	1	1		
	2001	17	2	1	1		
	2002	27	3	2	2		
	Total	27				25	92.6
Total	2000	343	14	14	15		
	2001	528	23	9	18		
	2002	976	34	26	20		
	Total	976				858	98.2

Table 20. Total Forage Area (ha) per District

Year	Yen Son	Ham Yen	Son Duong	Chiem Hoa	Na Hang	Total
2001	12.57	5.73	2.39	0.16	0.34	21.19
2002	135	39.74	9.98	2	0.3	187.02

2. The dissemination of forages in Daklak:

At the beginning of Phase 2 of the FSP project in 2000, 90 farmers in three communes in M'Drak District were participating in forage evaluation trials. In the three years since 2000, dissemination of forage technologies have been expanded to encompass 6 districts, 34 communes and 761 farmers; including the 90 farmers who started in 1999. As Table 21 shows, approximately 73 percent of farmers participating in forage evaluation trials are adopting forages. This has increased from 69 percent of farmers in 2000-2001 to 80 percent in 2002.

There are differences in the percentage of farmers adopting forages across districts, with farmers in Ea Kar having more farmers adopting forages than those participating in the trials (103 percent). The other districts have adoption rates between 50-70 percent. Results from Ea Kar indicate that forage adoption is highest were the development workers are skilled in participatory approaches, there is a high degree of cooperation between different extension programs, and there is a good network between the district and communes and villages. In addition, planting material production and distribution networks need to be well established in order to cater for sudden surges in farmer demands. As shown in the previous section, there are clear benefits to households from forage production.

Farmers in M'Drak District have the lowest rates of adoption of forage technologies, with only 58 percent of farmers adopting. This is particularly interesting as M'Drak was the initial site for forage development under FSP Phase 1. A focus group meeting of Development Workers in the Province was organized in March 2002 to identify the reasons for the low adoption rate.

The focus group noted that M'Drak has large areas of *Imperata cylindrica* and *Vetiveria sp.* grasslands and although the productivity of these grasslands is low farmers do not find these grasslands limiting at this stage. Secondly, while farmers were interested in evaluating new forage technologies, the large herd sizes combined with small areas of forage meant that while there was not enough planted forage for grazing. While the areas were large enough for supplementary cut-and-carry feeding, these areas could not be fenced and therefore were subject to unmanaged grazing pressure.

In the focus group meeting the development workers noted that many farmers in M'Drak and other districts were successful adopters of forage technologies when combined with fish production or small numbers of cattle but the number of farmers involved with extensive grazing of large areas of improved forages was still limited to around 5 farmers.

Table 21. Dissemination of Forage Technologies, Daklak Province, 2000-2002

District	Year	Farmers at beginning of year	No. communes (old + new)	No. of PDs conducted	No. of cross visits/field days	No. farmers using forages by Nov 2002	% adoption
Buon Don	2001	45	2	2	4	18	40
	2002	52	6	4	6	36	69
	Total	97	6	6	10	54	56
Cu Jut	2001	21	3	3	6	15	71
	2002	46	5	3	6	30	65
	Total	67	5	6	12	45	67
Boun Ma Thuot	2001	10	1	1	2	4	40
	2002	5	1	1	1	5	100
	Total	15	1	2	3	9	60
Krong Bach	2002	25	1	1	2	10	40
Ea Kar	2000-2001	147	6	7	12	142	97
	2002	80	10	7	9	92	115
	Total	227	10	14	21	234	103
M'Drak	1999-2001	168	5	7	14	89	53
	2002	72	11	7	10	50	69
	Total	240	11	14	24	139	58
Total	2000	2 (M'Drak)					
	2001	389	17	20	39	268	69
	2002	280	34	22	35	223	80
	Total	671	34	42	74	491	73

Training Activities 2000-2002

		Farmer Training Courses		Technical Training Courses	
		No. of Courses	No. of Participants	No. of Courses	No. of Participants
Country	T	90	2200	7	105
	A	94	2298	7	99
	%	104.4	104.5	100	94.3

A=Actual, T=Target, %=Percentage of Target Achieved

Organized 94 farmer-training courses with 2,298 participants and 7 technician courses with 99 participants.

1. Tuyen Quang

The training activities on forage technologies form a very important part of the success of the FSP program in Tuyen Quang Province. As Table 23 shows there were 50 farmer training courses and 3 technical training courses for Development Workers from 2000-2002. The farmer training courses attracted 1193 participants and covered topics on forage agronomy, forage seed production and animal nutrition. The development workers ran almost all of these training courses after they had attended the technical training courses. Over the 3 years of FSP Phase 2, 46 Development Workers were trained on forage technologies. In addition to the development workers involved in the FSP activities, the FSP also trained 3 development workers from other provinces and projects in Viet Nam – illustrating the networking and dissemination of the FSP approach to other development projects.

Table 23. Training Activities, Tuyen Quang Province, 2000-2002

Year		Farmer Training Courses		Technical Training Courses	
		No. of Courses	No. of Participants	No. of Courses	No. of Participants
2000	T	9	250	1	15
	A	10	245	1	16
2001	T	20	420	1	15
	A	20	420	1	15
2002	T	26	500	1	15
	A	20	528	1	15
Total	T	55	1150	3	45
	A	50	1193	3	46
	%	91%	103.7%	100%	102%

A=Actual, T=Target, %=Percentage of Target Achieved

2. Daklak

Training activities on forage technologies forms a very important part of the success of the FSP program in Daklak Province. As Table 24 shows there were 44 farmer training courses and 4 technical training courses for Development Workers from 2000-2002. The farmer training courses attracted 1105 participants and covered topics on forage agronomy, forage seed production and animal nutrition. Almost all of these training courses were ran by the development workers after

they had attended the technical training courses. Over the 3 years of FSP Phase 2, 53 Development Workers were trained on forage technologies.

In addition to the farmer and development worker training courses, each year a provincial workshop was held to evaluate the year, work and to plan for the coming year activities. During this workshop a technical training course on participatory approaches, forage technology development, and Participatory Monitoring and Evaluation (PM&E) was also carried out.

Table 24. Training Activities, Daklak Province, 2000-2002

Year		Farmer Training Courses		Technical Training Courses	
		No. of Courses	No. of Participants	No. of Courses	No. of Participants
2000	T	9	270	1	20
	A	8	225	1	17
2001	T	11	330	2	20
	A	18	360	2	20
2002	T	15	450	1	20
	A	18	520	1	16
Total	T	35	1050	4	60
	A	44	1105	4	53
	%	126%	105%	100%	88%

A=Actual, T=Target, %=Percentage of Target Achieved

Forage Multiplication Activities 2000-2002

Year	Number of farmers producing planting material	Sale of Forage Material (kg)	
		Seeds	Vegetative material
2000	10	0	1300
2001	25	77	25000
2002	85	155	52000

The situation of multiplication of forage material in the country was improved day per day. Number of farmers producing planting material increased quickly after two year and material planting of seed and cutting material are in the same tendency.

1. Tuyen Quang

Multiplication of forage material in Tuyen Quang has been a particularly successful program of FSP Phase 2. In 2001 and 2002, farmers in Tuyen Quang started to produce seed and vegetative planting material for sale to farmers in other districts in Tuyen Quang, especially in Yen Son District where a

large number of dairy cattle were being raised. Forage varieties include *Panicum maximum, Paspalum atratum, Pennisetum purpureum and Vigna sp.* As Table 25 shows, in 2002 production of seed reached 55kg and vegetative material 12 tons; almost double that produced in 2001.

Farmers producing forages for sale usually produce vegetative planting material or seeds for sale but some farmers find it more profitable to produce seeds for their own use and sell the resulting seedlings. For example, Mr. Binh in Ham Yen District produces *Panicum maximum* seeds which he then sows in his own nursery to produce seedlings. He then sells these seedlings to other farmers, obtaining a greater profit per kg of seed than if he had just sold the seeds direct to other farmers. The purchasers of his seed prefer to buy planting material as the establishment and growth is quicker, and they can start feeding their animals sooner.

Pennisetum purpureum for intensive livestock production has been introduced in Tuyen Quang Province and planting material has been produced for sale to other areas in the region, particularly for dairy cattle production in Yen Son district.

Table 25. Forage Multiplication, 2000-2002

Year	Number of farmers producing planting material	Sale of Forage Material (kg)	
		Seeds	Vegetative material
2000	10	0	1300
2001	15	27	5000
2002	55	55	12000

2. Daklak

Multiplication of forage material in Daklak has been a particularly successful program of FSP Phase 2. In 2001 and 2002 farmers in Ea Kar, Cu Jut and M'Drak districts started to produce seed and vegetative planting material for sale to farmers in Daklak and other provinces. Forage varieties include *Panicum maximum* TD58, *Paspalum atratum, Stylosanthes guianensis* CIAT 184 and *Gliricidia sepium*. As Table 26 shows, in 2002 production of seed reached 100kg and vegetative material 40 tons. Almost all farmers are producing seeds for their own use.

Table 26. Forage Multiplication, 2000-2002

Year	Number of farmers producing planting material	Sale of Forage Material (kg)	
		Seeds	Vegetative material
2000	0	0	0
2001	10	50	20000
2002	30	100	40000

Development of Forage Technology Networks in 2000-2002

1. Tuyen Quang

The forage technology network in Tuyen Quang Province was established including 23 participants working in the DARD or Province (the people of Agronomy Technology), Cattle Research and Development Center, Department of Extension Officer of the districts, Communes and head of farmer group at the commune and village level, and key farmers.

2. Daklak

The forage technology network was established including almost 50 participants working in the DARD of two provinces, Cattle Research and Development Center, Department of Extension Officer of the districts, Communes and head of farmer group at the commune and village level, and key farmers.

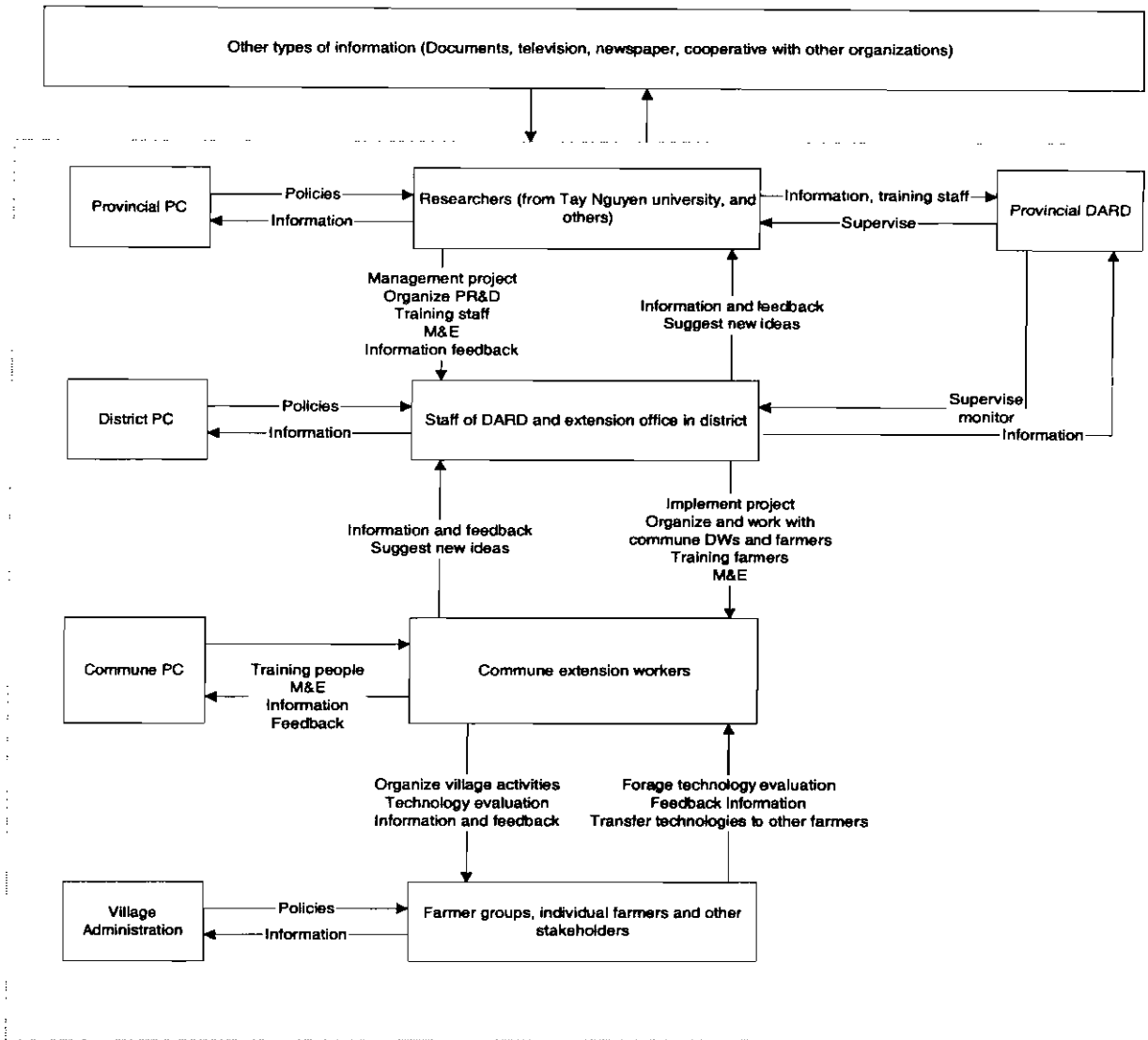

Figure 1. Networking with Stakeholders in Daklak

Conclusions

This paper reviewed the activities of the FSP Phase 2 project in Vietnam from 2000-2002. In the 3 years of FSP Phase 2, the project has carried out 10 forage evaluation trials at two site in Viet Nam (Daklak and Tuyen Quang provinces) as well as extending forage technologies to nearly 2,300 farmers in training courses and having over 1,480 farmers involved in forage evaluation and production. The FSP has trained 96 development workers in forage technologies and an extensive

network between researchers, development workers, extension providers, local officials and farmers has been developed.

In terms of experiments, the trials carried out in Tuyen Quang showed that *Vigna unguiculata* and *Stylosanthes guianensis* CIAT 184 are good cover crops in tea and fruit trees as well as providing secondary benefits such as edible seeds (for humans) and fodder for pig and fish production respectively.

Secondly, *Leucaena leucocephala* and *Calliandra calothyrsus* are good tree legumes for boundary fences and that while they were similar in growth habit and yield, Leucaena was more accepted by livestock while Calliandra was still green in the winter time.

Thirdly, while sweet potato remained the favored feed for pig production, farmers noted that Ramie also has a high yield and was more palatable than the other forage species evaluated, including *Stylosanthes guianensis* CIAT 184

Finally, *Panicum maximum*, *Paspalum atratum* and *Brachiaria ruziziensis* were evaluated by farmers as good feeds for fish production. Farmers noted that Panicum and Paspalum species have good growth, yield and acceptance by fish while Setaria looks like nice species, has a good yield but limited acceptance by fish. *Brachiaria Toledo* has good growth and yield but the leaf is sharp and hard and thus has limited potential for feeding to fish.

The experiments carried out in Daklak showed that the ability of introduced grasses and legumes planted in strips to increase productivity of the natural grasslands are very high. In the grazing trials *Brachiaria* species and *Stylosanthes guianensis* CIAT 184 was used to replace up to 50-60 percent of the natural unproductive species such as *Imperata cylindrica* over a two year period even under grazing. Stylo 184 was established successfully, persisted well, and was only eaten in the dry season. *Arachis pintoi* can be established in *Imperata* grasslands, contributing up to 20-30 percent of dry matter after only 2 years. This has very positive implications for creating a productive and sustainable pasture system.

Secondly, using legumes and planted forages for fattening cattle before sale has the potential to achieve higher profitability than fattening systems based on concentrate feeding.

Thirdly, *Stylosanthes guianensis* CIAT 184 has the potential to be a good cover crop under coffee but needs careful management to avoid competing with the coffee for nutrients, light and water. In contrast, Arachis pintoi appears to have less potential because it is difficult to harvest and is difficult to remove once it becomes a weed.

Fourthly, the new *Brachiaria* varieties being trialed in Daklak are well adapted, but the yields are lower than previously introduced *Brachiaria* varieties. While these varieties may be good for establishing new grazing areas, evaluation needs to continue before dissemination activities are contemplated.

Finally, there appear to be very positive impacts of improved forage use by households involved in fish and cattle production. There are significant savings in labor use and effort and farmers are able to increase the amount and quality of feed available to their livestock and fish. Labor savings impact particularly on women and children and households achieve significant increases in gross margins from their livestock production.

In terms of the organization of activities in country and provinces, it is clear that participatory approaches are a very good way to develop forage technologies with smallholders. Adoption rates are quite high and are increasing every year. Farmers are producing planting material and seeds in increasing quantities and they are able to find an expanding market demand for these products. Training and capacity building activities are critical to the development of forage technologies with smallholder farmers and a good organization and network is the key to developing, scaling up, and dissemination of the forage technologies.

Livestock-based livelihoods in Southeast Asia:

How can LLSP, ILRI projects and our partners work together to increase the development impact of our research?

Douglas Gray[1] and Rod Lefroy[2]

Introduction

Regional research projects involving several countries, many institutions and several hundred scientists, extensions, development workers and farmers are complex and require high levels of organization to be successful. The benefits from taking a regional approach come from sharing knowledge or expertise across countries that have similar problems and creating a critical mass or team of experts to address a common problem. In the FSP and now the LLSP, significant impact has come from sharing germless, exchanging information on forage technologies and participatory approaches, and creating national and international teams which have developed participatory research methods and become advocates for their use in the region. The project team has been sufficiently committed to overcome the barriers created by language, culture and geography. It is in the mandate of ILRI and CIAT to implement and contribute to these types of regional projects and of the Asian Development Bank to fund them.

There are similar arguments for CIAT and ILRI to collaborate closely. Both organizations have small teams of researchers working in the region, many research needs to address and complementary scientific skills. In the last 12 months we steadily developed closer links by sharing resources, participating in projects of common interest and joint planning at workshops such as this one in Hainan. The 'CASREN' project of ILRI is one that has been mentioned several times in the course of the workshop. The shared objectives of that project (which is also funded by ADB) and LLSP make collaboration between them both obvious and necessary. In this short note we would like to make two major points:

1) There is interaction between the projects which has already created mutual benefits, and

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[1] Regional Coordinator, ILRI

[2] Regional Coordinator, CIAT- Asia

2) There is scope for further collaboration if the benefits are clear and there is shared understanding of how the collaboration will work.

We would also like to discuss a third project being implemented by ILRI: the Sustainable Parasite Control (SPC) project which is funded by IFAD and ACIAR. Although the CASREN project has much *in* common with LLSP in developing local feed resources, SPC has much in common in using participatory approaches. This is reflected in the major objectives of the three projects (Table 1). Although not a regional project, the Forages and Livestock Systems Project (FLSP) being implemented by CIAT in Lao PDR brings together many of the best features of farmer participation for livestock development and a source of new ideas and methodologies.

Links between the SPC project and LLSP include the use of participatory approaches and improved nutrition as essential to an integrated approach to parasite control, including the use of tree and shrub leaves to reduce intake of ground-based and contaminated feeds; plants with possible direct or indirect anthelmintic effect; and cut-and-carry methods especially during times of heavy rain or heavy pasture contamination.

The countries and provinces where the regional projects are active are listed in Table 2.

Table 1. Objectives of LLSP, CASREN and SPC

LLSP	CASREN	SPC
. Improve the sustainable livelihood of small farmers through intensification of crop-livestock systems, using farmer participatory approaches to improve and deliver improved forage and feed technologies . Improve delivery mechanisms for dissemination of improved forage and feed technologies	1. To use participatory approaches to spread the application of appropriate technologies by farmers to enhance the productivity of crop-livestock systems 2. To develop and recommend policy changes to improve market participation, competitiveness, and trade for smallholders and conduct policy dialogue with governments on these policy issues 3. To continue to develop the capabilities of the NARs to conduct independent research on crop-livestock systems, and of extension workers to encourage adoption of technologies by farmers	1. Establish regional, national and local networks with capacity to research, manage and adapt parasite control programs that are technically and socially integrated 2. Develop technology options for parasite control developed and tested on-station and on-farm 3. Introduce, monitor and evaluate community-based approaches to parasite control at focal sites in the region 4. Increase capacity in laboratory diagnosis, research methodologies and participatory tools and techniques required for community-based parasite control

Table 2: Countries and provinces where LLSP, CASREN and SPC are focused.

Country	Project Locations		
	LLSP	CASREN	SPC
Cambodia	Kampong Chan	Not included	Kampong Cham
China	Hainan	Yunnan, Sichuan	Not included
Indonesia	East Kalimantan	Garut, West Java	Purwakarta, Majalengka
Lao PDR	Savannahkhet	Not included	Luang Phabang
Philippines	Cagayan de Oro, Leyte	Pangasinan	Pangasinan, Cebu
Thailand	Nakorn Ratchasima	Khon Kaen	Not included
Vietnam	Tuyen Quang, Daklak	Binh Phuoc	Hoabinh, Hatay, Thai Nguyen and Ninh Bin

Some Existing Links between LLSP and ILRI

- Shared implementation of CASREN, LLSP and SPC in the Philippines by PCARRD
- Participation in planning meetings
- Shared collaborators, for example, Leyte State University in the Philippines
- Partners in Cambodia: Ministry of Agriculture
- Joint activities and training in Lao PDR on SPC and goat production
- Joint development of project proposals
- Strong strategic commitment of CIAT and ILRI to work together

Possible Future Links between LLSP and ILRI

- Joint training in participatory processes and feed resources
- Building research network in China through ILRI Liaison Scientist
- Harmonizing efforts of LLSP, FLSP and SPC in Lao PDR
- Shared site in Cambodia
- Shared indicators to integrate outputs and impact.
- Links among publications and web sites
- Joint publication of a newsletter Livestock-Based Livelihoods in South East Asia and database which is in the early stages of discussion.

There are many ideas and possibilities. The important issue at this stage is that we have identified the need for stronger links and created sufficient understanding to be able to grasp opportunities when they arise. As LLSP, CASREN and SPC push ahead with their individual efforts, we ask everyone in the projects to be alert for opportunities us to work together to increase the development impact of our research.

Section 3:

Country Strategies

How to develop country strategies

Ralph Roothaert

The project purpose is:

1. Improve the sustainable livelihood of small farmers in the uplands through intensification of crop-livestock systems, using farmer participatory approaches to improve and deliver forage and feed technologies.
2. Improve delivery mechanisms in participating DMCs for the dissemination of these technologies.

The project outputs are:

1. Integrated feeding systems for livestock, that optimize the use of improved and indigenous fodders and crop residues, and farm labor;
2. Improved methods to develop forage feed systems and extend them to new farmers, optimizing the use of M&E for feedback to others in the community;
3. Increased capacity at different levels, to expand the use of improved forage and feed systems and respond to local needs;
4. Comparison of development opportunities and market and logistic constraints for intensification of smallholder livestock systems across sites in five countries;
5. Improved regional interaction and linkages with national and donor funded development projects that ensure synergistic and multiplier effects.

What to include in your strategy?

1. Objectives
   a. Are the goals, purposes and outputs feasible for your country?
   b. Do they correspond with your 'lessons learned' and future research priorities?
2. Project design
   a. Which performance targets for the purposes and outputs would apply to your country?
   b. Which activities listed are more relevant for you? What is missing? How would you adjust some to local circumstances?
3. Partners
   a. Which research and development partners are important for you?
   b. Which development projects can you link with in your country?
   c. Which GIS capacity can you link with?
4. Sites
   a. Which will be your focus sites? Why?
   b. Will you continue to work in all scaled out sites?
   c. What is your exit strategy in case you pull out of some sites?
   d. What are the reasons for taking on new sites?

Cambodia

How to prepare for the LLSP in Cambodia?

- Identification of institutions that project should be working with
- Identify appropriate sites
- Prioritize activities that should begin

Institutions and structure

- CARDI and DAHP
- Both CAAEP-DOE and APIP-DAHP will the collaborating projects.

Proposed sites

- Northwest, Battambang and Banteay Mean Chey
- Northeast, Kratie
- South, Kampot

How should we begin?

- Capacity building of staff involved in the project and the training topics will be:
  - Participatory Diagnoses
  - Farmer Participatory Research
  - Participatory Monitoring and Evaluation

How can we further continue?

- A combination of outputs iii and v will provide us means to implement the outputs i and ii.

Performance output 3

In 3 years:

- 5 researchers (central and provincial) and 5 technicians in each targeted province will be training on PD, FPR and PM&E, forage agronomy and animal nutrition.
- Other three points under output 3 will also be taken during 3 years.

P.R. China

Project Outputs

Output 1: Integrated feeding systems

1. Improved and indigenous forages
   a. Green feed
   b. Silage
   c. Hay and leaf meal
2. Multi-use of crop residuals
   a. Ammoniating of straws,
   b. Mushroom-feed-animal system
3. Sugarcane and cassava leaves

Output 2: Improved methods to develop forage and feed systems

1. Forage and feed systems
   a. Integration of forages with fruit tree and other cash crops
   b. Forage systems for erosion control
   c. Forage-crop rotation
   d. Forage-fish system
   e. Cut-carry system for goats
2. Method to extend to new farmers
   a. Demonstration
   b. Cross-visit
   c. Involvement of government agencies and NGO
   d. Training courses
   e. Publication
   f. Instructions

Output 3: Capacity building at different levels

1. Set up of FPR training center
2. Laboratory strengthening
3. Technical transfer system
   a. Family-relatives
   b. Government agencies
   c. NGOs (e.g. farmers associations)
   d. Research institutions (e.g. CATAS)

Output 4: Comparison of development opportunities and market and logistic constraints

1. Indications for impact assessment
2. Market opportunities analysis
3. Community organization for improved marketing
4. Development of local market
5. Market for processed products of forage and animals

Output 5: Improved regional interactions and linkages

1. Combating-poverty projects of government
2. Small loan project of Rural Credit Cooperation
3. ILRI activities

Answers to questions

1. What to include?

a. The objectives and design fit well to the country's priorities
b. Activities depends on fund budget
c. Special concern: introduction of new technologies

2. Partners?

a. ILRI
b. FCRNC
c. Government agencies
d. Rural Credit Cooperative
e. NGOs

3. Sites?

a. Mostly previous sites: Baisha, Danzhou, Dongfang and Ledong.
b. New sites may be added for increased compact

Indonesia

Forages for Smallholders Project in Indonesia has been implemented since 1995, starting with 5 project location, namely East Kalimantan, Central Kalimantan, North Sulawesi, North Sumatera, and Aceh during Phase I. During Phase II, FSP concentrated in East Kalimantan, involving more than 400 farmers. Many visitors from different institutions came to East Kalimantan, and they are impressed by the development of forage technologies, and how farmers integrated the technologies into their farming system. Based on this, DGLS plans to disseminate the FPR methodology to other provinces with similar ecological and socio-economic condition, among others, South Kalimantan, South Sumatera, and West Sumatera.

To achieve this goal, trainings, cross- visits for farmers as well as extension workers and technicians, will be needed and East Kalimantan will act as the center for training and development of forage technologies.

The FPR methodology itself is still fragile, and there is a need to review and improve it so that it is adaptable in other provinces.

Strategies for 2003

Project Outputs	Focus sites				Goals
	Makroman	Sepaku	Samboja	Loa Kulu	
1. Improved feeding systems for livestock	□□□	□□□	□□□	□□□	- Efficient use of available feed resources - Higher ADG - Higher market live weight
2. Improved methods for dissemination and expansion to new farmers	-	□□□□	□□	□□	- More farmers participate in the project - Adaptive methodology for further dissemination and delivery by DGLS
3. Capacity building					- Improved capability of local and provincial staff in developing and delivering livestock technologies to farmers - As needed for Outputs 1 and 2.
4. Comparison of development opportunities and market constraints					- Goal is to achieve better returns to farmers from livestock production - To be discussed further with local collaborators
5. Improved regional linkages and interaction					- Learning from other LLSP partners by sharing results, experiences and ideas
Responsible persons	Yacob P.	Ibrahim Heryanto	Mahmud and other technicians	Sugeng Tri Fathur	- Yacob and Ibrahim will be joint-coordinators
Partners: 1. Local government 2. Universities 2. Regional Research Institutions					

Proposed Activities for 2003

Output 1. Integrated feeding systems for livestock that optimize use of improved and indigenous fodders, crop residues, and farm labor

1. Botanical survey with farmers and collect samples for identification and nutritive analysis. Focus site: Sepaku, Partner: BPTP
2. Train interested target farmers method to evaluate legumes: all focus sites, and BPTP as partner.
3. Monitor and evaluate adoption of new feed systems with farmers and expansion of areas planted over time at sampled farms. Focus site: Sepaku. Partner:
4. Develop feed budgets for livestock at each site, for use by farmers and field workers
5. Livestock feeding trials at all focus sites for efficient use of existing feed resources.

Output 2. Improved methods for dissemination of forage and feed technologies

1. Select new farmers for dissemination activities
2. Facilitation and training of farmers who can become farmer extensionists and provide training.
3. Facilitate field days, cross visits and farmer-to-farmer extension, using farmers from focus sites.
4. Produce and distribute information on forages and feeding systems to farmer.
5. Train district officers to carry out PM&E.
6. Produce and publish a practical manual on PM&E for use by district officers.

Output 3. Increased capacity for dissemination of potential technologies

1. Conduct training in forage agronomy, animal nutrition, FPR methodology and PM&E.
2. On-site mentoring of technician and extension workers to strengthen skills.

Output 4. Development and market opportunities

1. Establish mechanism for providing market information on livestock products to farmer groups
2. Socio-economic study of livestock systems and their contribution to livelihoods.

Output 5. Enhance regional interaction and linkages

1. Support effective communication by e-mail and publication.
2. Facilitate sharing information within country.
3. National coordinator produces and distribute information in national language

Activity schedu

Sites	Component / Activities	Month												Output
		1	2	3	4	5	6	7	8	9	10	11	12	
	Output 1													
Sepaku, South Kalimantan, South Sumatera, West Sumatera	1. Botanical survey with Farmers			•	•					•	•			Indigenous fodder species identified
	2. Train interested target farmers on method to evaluate legumes			•										20 farmers trained in the method
	3. Monitor and evaluate adoption of new feed system with farmers			•			•			•			•	Report
	4. Develop feed budgets for dominant livestock type			•						•				Feed budget being developed and used farmers
	5. Livestock feeding trials			•		•		•		•		•		Farmer identified good ration formulation further use
	Output 2													
East Kalimantan, South Kalimantan, South Sumatera, West Sumatera	1. Selection of new farmers				•	•								4 PDs and PPs are conducted
	2. Cross-visits					•								6 Technicians from other provinces visite sites
	3. Field days for farmers from other provinces					•								6 key farmers from other provinces visite sites
	4. Training of farmers for farmers					•								10 farmers from the focus sites are traine
	5. Produce and distribution of forage and feeding system information					•								Information on forage and feeding systen produced and distributed
	6. Training of PM &E			•										20 technicians from focus sites and new are trained on PM&E methodology
	7. Produce and publish practical manual of PM &E				•									Practical Manual of PM&E are produced
	Output 3													
All sites	1. Conduct training in: ➢ FPR methodology ➢ Forage Agronomy ➢ Animal Nutrition			• •		•								20 technicians and extension workers ar trained
	2. On-site mentoring of extension workers and technicians				•									
	Output 4													
Selected focus sites only	1. Establishing mechanism for providing market information on livestock products to farmer groups				•									
	2. Socio-economic study of livestock systems and their contribution to livelihood					•								
	Output 5													
All sites	1. Support effective communication by e-mails and publications					•								
	2. Facilitate sharing information within country					•								
	3. National coordinator produces and distribute information in Indonesian language					•								

Objectives

1. To improve sustainable livelihood of smallholders in upland areas of Lao PDR through intensification of crop-livestock systems
2. Improve delivery mechanisms of dissemination of forages and feed technologies

Project Outputs

Output 1. Integrated feeding systems for Livestock that optimize use of improved and indigenous fodders, crop residue, and farm labor

1. Study on supplementation of 3 best indigenous fodder species for ruminants
2. Fodder trees for goats in upland areas
   a. Growth rate
   b. Reproduction performance

Output 2. Improved methods to develop forage feed systems and extend them to new farmers optimizing the use of M&E for feedback to other in the community

1. Study on methods of dissemination forage technologies in FLSP village
   a. Case studies
   b. Cross visits and other.

Output 4. Comparison of development opportunities and market and logistic constraints for intensification smallholder livestock systems

1. Agro-enterprise project will be started this year in Laos (Linkage and involvement of FSP).
2. Survey on marketing information in areas in where development project for several years.

Interaction and linkages

- NAFRI
- CIAT
- ILRI
- ADB rural development projects in upland areas
- EU and other NGOs project

Sites

- Savannakhet
- Luangphabang

Philippines

Project Outputs

Output 1: Integrated feeding systems for livestock that optimize use of improved and indigenous fodders, and crop residues, and farm labor crop

1. Identify focus group with existing livestock production
2. Develop strategic intervention thru new forage technology to improve the existing system
3. Establish PM&E for the new project right at the start

Output 2: Improved methods for dissemination of forage and feed technologies

1. Farmers-to-farmers cross-visit
2. Farmers' Field Day
3. Farmers' Seminar and hand-on Training
4. TechnoGabay (Farmers' Info System)
5. Production of IEC Materials

Output 3: Increased capacity for dissemination of potential technologies

1. Trainers training (Forage Agronomy, Feeds and Feeding, Use of participatory approaches, managing info from ME&E
2. Team approach to the project activities

Output 4: Increased awareness of development potentials opportunities and market opportunities

1. Establish mechanism for market info system
2. Assess options for enterprise development
3. Conduct case studies on market opportunities and constraints

Output 5: Enhanced regional interaction and linkages

1. Support effective communication by e-mail and publication
2. Facilitate sharing of information within countries
3. Publish and distribute newsletter with ILRI
4. Interact with other ADB project within the country
5. Provide feedback to policy makers

Partners

1. Department of Agriculture-Regional Field Units
- Local government units
  State University or College
  ILRI
  IFAD
  ICRAF

7. Existing NGO
8. Philippine Carabao Center
9. National Dairy Authority

Sites

1. Focused Sites
   a. Cagayan de Oro (Old site)
   b. Malitbog (Old site)
   c. Cagayan Valley (New site)
2. Reason for selecting new site – The existing livestock production is there and the apparent need for forage technology interventions
3. Phasing-out activities
   a. Trainers' training
   b. Initiate institutionalization/turn-over of FSP with the LGUs

Thailand

Background to the Forages for Smallholders Project in Thailand

In the first phase (1995-1999) the project emphasized on selection of forage species. Works on farmer participatory research and forage technologies development had started in 1998.

Farmer's participation in introduction of forage species commenced at Sung Nuen District, Nakorn Ratchasima Province. Twenty dairy farmers were participated. The result from participatory diagnosis showed that the main problem of the dairy farmers was the lack of good quality roughage in dry season. Farmers were looking for the alternative feed supplies for their dairy cows. We conducted the evaluation of 55 accessions of *Brachiaria spp.* Farmers planted a range of *Brachiaria* accessions in individual farms.

In the phase II (2000-2002), worked with more farmers on beef production farmers in other 4 districts and the forage technology development had conducted in Nakorn Ratchasima.

In the new LLSP (2003-2005), Thailand will have fewer activities, and is proposed to participate through providing technical assistance in farmer seed production and undertaking specific research studies as required by the other DMCs.

Expected Outputs

Output 1: Integrated feeding systems for livestock that optimize use of improved and indigenous fodders, and crop residues, and farm labor crop

1. Conclude the evaluation of *Lablab purpureus* for forage use
2. Conclude the evaluation of new accessions of *Stylosanthes guianensis* for anthracnose resistance

Output 3: Increased capacity for dissemination of potential technologies

1. Conduct training courses on farmer seed production systems for LLSP partner countries
2. Facilitate cross visits of researchers and farmer from other countries on forage seed production in Thailand
3. Assist with experiments on seed production for other countries (i.e. Vietnam)

Viet Nam

Objectives

1. Improve the sustainable livelihood of small farmers in the uplands through intensification of crop-livestock systems, using farmer participatory approaches to improve and deliver forage and feed technologies.
2. Improve delivery mechanisms in participating staff for the dissemination of these technologies

Project Outputs

Integrated feeding systems for livestock that optimize use of improved and indigenous fodders and crop residues

1. Improved forage species (Elephant grass, *Panicum maximum*).
2. Legumes species (herb, tree shrub legumes) - feed quality
3. Local fodders (types, quantity, quality)
4. Crop by product (processing, ration)

Improved methods to develop forage feed systems and extend them to new farmers optimizing the use of M&E for feedback to others in the community

1. Information and data need to M&E
2. Quantity and quality in M&E
3. Use results of M&E in development of forage, feed systems to new farmers and new sites(Central of VN)
4. Use M&E as a tool in planning activities of commune and district
5. Training and scaling up skill of staff on M&E

Increased capacity in DMCs, at different levels to expand the use of improved forage and feed systems and respond to local needs

1. Increase the capacity of researchers, development worker, and farmer extensionist on Forage agronomy, animal nutrition, and extension method base on participatory approach.
2. Training staff, farmers on seed production use expertise from Thailand

Evaluate development opportunities and market and logistic constraints for intensification of smallholder livestock systems across sites in the country

1. Study on market opportunities and constraints at each sites (cooperate with agro-enterprise project)
2. Provide the market information of livestock products to the stakeholders
3. Strengthen livestock production and deliver systems
4. Increase income of farmers from market information
5. Undertake socioeconomic study of livestock system their contribution to livelihoods

Improved regional interaction and linkages with national and donor funded development projects that ensure synergistic and multiplier effects

1. Exchange experience between the countries in the project
2. Linkage with other projects and programs in the country
3. Set up the communication systems

Partners

1. Government organizations:
   a. NIAH, TNUN
   b. Provincial DARD
   c. Extension offices in districts and communes
2. Development projects:
   a. National and provincial Dairy cattle project
   b. National and provincial Beef cattle project
   c. Improvement local cattle breed

Sites

1. Focus sites: Daklak and Tuyen Quang provinces
   a. Capacity of researchers and DWs to carry out the project activities
   b. Opportunities and potential to carry out the project activities
2. New sites: Scale out to new sites such as Binh Dinh province in central Viet Nam

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