CGPRT No. 7

ADOPTION OF SOYBEAN IN LUPAO, NUEVA ECIJA THE PHILIPPINES

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The CGPRT Centre

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UN/ESCAP CGPRT Centre
Regional Co-ordination Centre for
Research and Development of Coarse Grains,
Roots and Tuber crops
in the Humid Tropics of Asia and the Pacific

FOREWORD

The regional research project RAS/82/002 is funded by the UNDP, and is implemented by the FAO and the ESCAP/CGPRT Centre.

One of its important objectives is to identify and analyse socio-economic constraints to increased production and efficient distribution, and to formulate strategies to exploit economic, employment and nutritional potential of coarse grains and food legumes under varying farming systems.

In line with its mandate, the CGPRT Centre was requested to implement socio-economic studies in selected countries of Asia. Initiated in late 1984, country studies were conducted in 7 countries, namely, Bangladesh, India, Indonesia, Nepal, the Philippines, Sri Lanka and Thailand. Selection of crops was based on their importance to the individual country and on the priority set by the CGPRT Centre, namely, selected pulses for the southern Asia subregion and either maize or soybean for Southeast Asian countries.

The research report "Adoption of soybean in Lupao, Nueva Ecija, the Philippines" is the third country report in this series. It describes and analyses the performance of farmers participating in a package of technology programme.

The authors, Paciencia C. Manuel, Romeo R. Huelgas, and Leina H. Espanto show that soybean is in the stage of farm adaption and selection of the best cultivation method. The study shows that constraints lay in various fields: water management, including drainage and irrigation, pest management, and seed supply. This case study shows that soybean in an early stage of development as presently is the case in the Philippines, is a crop which until a suitable package has been found, requires a great effort from the farmer in order to minimize risk.

I am pleased to present this case study to the reader and I hope it will contribute to further studies tackling the problem of soybean production in the Philippines.

Director
CGPRT Centre

Shiro Okabe

SUMMARY AND RECOMMENDATIONS

In the framework of the RAS/82/002 project, a case study looking into constraints and cultivation practices was executed in Lupao, Nueva Ecija, the Philippines in 1986. The objective of the study was to identify and analyse constraints to adoption and production of soybean on the basis of one case study.

The utilization of soybean in the Philippines has primarily developed in the sector of animal feed: 70 to 90% of domestic production and imports is used for animal feed. Consequently, imports of soybean meal rose steeply from 136,000 tonnes of soybean meal in 1979 to 291,000 tonnes in 1983. Imports of soybean grain are relatively small: they reached a level of 30,000 tonnes in 1983. Domestic production constituted a meagre 3% (8,000 tonnes in 1983) of the total consumption of soybean meal and grain in 1983.

The role of soybean in human nutrition is extremely limited in the Philippines. The use of soybean as curd, sprouts or as the basis for sauces is virtually nil. Surprisingly, the use of roasted soybean enjoys some popularity as a coffee surrogate. This form of utilization may not be very substantial in the future.

In 1983 the Philippines Government launched a programme to develop soybean production, in order to offset rising soybean meal imports. The target was to be 130,000 hectares planted to soybean in 1986-1987 with a projected yield increase from 1.2 metric tonnes to 1.8 metric tonnes by 1986-1987. The programme aims at approximately 50% self-sufficiency in soybean in 1986-1987. In view of the average yield of selected soybean cultivars, which ranges from 1.6 to 3.0 tonnes per hectare, the projected yield increase seems technically possible. However, it needs to be noted that the projected area increase from 8,590 hectares in 1983 to 130,000 hectares in 1986-1987 may be difficult to realize, especially if yields are to increase significantly in the same period.

The factors affecting yield and adoption of soybean are primarily pest and disease management, and water management, while the availability of capital plays an important role in the socio-economic sphere. These conclusions are not surprising in view of the relatively high susceptibility of soybean to pests and the need for an adequate water supply (or drainage), while the investment costs are relatively high if risks are to be minimized to acceptable levels.

In Lupao, it was found that 34% of the sample farmers participating in the soybean programme achieved yields lower than 500 kg/ha of dry grain, while yields conforming to the national average of 1.2 tonnes per hectare were reached by 20% of the participants.

Several observations can be made regarding the willingness of farmers to participate. Keeping in mind the risky nature of soybean and the high required investments, it was surprising to note that in general farmers were quite willing to try soybean as a second crop. Farmers reduced risk by planting soybean in the dry spell after the first crop, which was mostly rice. It appears then that the findings of the case study in Lupao confirm the general finding that even small farmers (the average area planted to soybean was 0.57 hectares) are quite willing to take some risks, while the non-adopters observed keenly the results of the early adopters.

In the case of Lupao, it needs to be noted that the delivery of services by support agencies which supply chemicals and seed was not always timely, and this negatively affected the performance of 26% of sample farmers. Production function analysis showed that 40 to 50% of the variation in farm output was explained by the following variables: labour, operating capital, and irrigation.

It was observed that low yields are primarily caused by lack of water during vegetative growth and occurrence of pests and disease.

The case study in Lupao permits the conclusion that the present recommended package of technology needs further adaption to farm-level practices; in particular, careful assessment of he place of soybean in the cropping calendar is necessary. On the other hand, farmers definitely need to increase their know-how on soybean, which is understandable, since they may have grown soybean only for one or two years.

A background variable which may influence early adoption versus later adoption through increased capacity to carry risks may be ownership of the cultivated land. Also, cultivators having water directly available are more likely to be early adopters. It seems likely that nationwide adoption requires careful assessment of the place of soybean in the cropping calendar in view of rainfall and water availability through irrigation, while the speed of the adoption process will also be determined by the risk-carrying capacity of farmers and the efficacy of government or semi-government support services.

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ACRONYMS

ARBA	Agricultural Rural Bank Association
BAEX	Formerly, the Agricultural Credit Administration and the Agricultural Productivity Commission
BPI	Bureau of Plant Industry
CGPRT	Coarse grains, pulses, roots, and tubers
CLSU	Central Luzon State University
CLT	Certified Land Transferee
DANR	Department of Agriculture and Natural Resources; now the Ministries of Natural Resources and of Agriculture and Food (MAF)
ISA	Irrigators Service Association
MAF	Ministry of Agriculture and Food
NFA	National Food Authority
NFAC	National Food and Agriculture Council
PCARRD	Philippine Council for Agricultural Research and Development
POT	Package of technology
PTCRD	Philippine Training Center for Rural Development
SN	"Samahang Nayon", a labour organization in Lupao
SSMS	Soybean Subject Matter Specialist
UPLB	University of the Philippines of Los Banos.
USM	University of Southern Mindanao

PREFACE

The study on soybean adoption described in this report is part of "Phase I Studies of the Project RAS/82/002: Socio-Economics of CGPRT crops", a regional project funded by UN/ESCAP and co-ordinated by The CGPRT Centre in Bogor, Indonesia.

Numerous studies have already been conducted on major crops such as rice (both irrigated and rainfed), corn, cotton, and coconut. These studies identified production constraints and their effect on yields. For rice, the yield constraints were classified as those that affected the farmer's ability and willingness either to achieve the yield poten tial or finally to adopt the crop. The first category is related to the development of new technology, and the second is concerned with the realization of the production potential, given the existing technology and environment, and access to financial resources and other inputs.

Yield of soybean, as with any other crop, is influenced by culturally-biased management practices, the quantity of input, the level of technology, agro-climatic conditions, as well as socio-economic factors. As for methodology, a directory of 56 co-operators in the Philippine National Soybean Production Program was obtained from the PCARRD. From this list, 31 farmers were randomly selected for the study. Farm performance and socio-economic data were gathered through interviews. Since all soybean growers in the area participated in the programme, it was necessary to identify whether there existed any radiation effect on the introduction of the POT. An equal number of farmers who previously did not grow soybeans were randomly selected, and they were interviewed regarding their willingness to plant the crop.

Data gathered from the POT trial site co-operators explain physical factors influencing soybean yield. Information from non-soybean growers helped identify and analyse the factors influencing the adoption of the soybean POT.

Interviews were also conducted with extension agents, staff involved in the national soybean program, local officials, and input dealers. Additional information on farming facilities and condi-tions, infrastructures, and support services were obtained.

Inquiries were also made at CLSU, NFA and MAF with regard to the services extended by the technicians and on the loaning system provided by the program. Moreover, data on the prior performance of farmers under the respective agencies were also sought. Information on the prevailing market price of soybean in Lupao was gathered from the dealers.

The analytical procedure used in this study consisted of two parts:

1. Quantification and economic analysis of yield constraints, with focus on the factors that could explain the differences in yield among the farmer co-operators;

2. Analysis of the social and economic environment of the farmer, to determine the influence of social and economic aspects on area, production and yield of soybean.

Regression, cost and return, and tabular analyses were performed. T-and F-tests were used to test the validity and reliability of the coefficients obtained.

The authors wish to acknowledge the assistance of Miss Irene B. Escueta, research aide, in the collection and analysis of data.

1. Introduction

1.1 Background of soybean cropping

Soybean is a high protein legume, and can be used as food, animal feed, and as an industrial raw material. Oil is extracted and then used in the manufacture of many foods and industrial products. Soybean meal, left over after oil extraction, is a major source of protein in livestock feeds. Soybeans contain 40 percent protein, and are an important part of the diet in many Asian countries. They are consumed in a wide variety of food preparations.

However, in the Philippines, human consumption of soybeans is quite low. The bulk of soybean in the Philippines is used for animal feed (70-90 percent of total domestic utilization), and is usually supplied by soybean meal imports. In 1983, soybean production and soybean imports amounted to US$8.3 million (30,555 mt) and US$72.2 million respectively. The Philippines has one of the lowest soybean productions of countries in Asia. In 1981, it contributed only 0.08 percent to Asia's total production (Table 1). A promising increase in yield from 0.89 to 1.180 mt/ha took place in the period 1981-1985.

Table 1 Soybean production in selected countries of Asia, 1981-1985

Country	Area Harvested ('81 (000 ha.) '85		Yield ('81 (mt/ha) '85		Production ('81 (000 mt) '85	
China	7,613	7,376	1.05	1.426	8,016	10,519
Indonesia	732	960	0.89	0.917	650	825
Japan	144	134	1.46	1.783	210	238
Philippines	9	10	0.89	1.180	8	12
India	600	1,250	0.83	0.880	500	1,100
Thailand	143	198	0.84	1.492	120	296

Source: FAO Production Yearbook, 1985 (estimates).

The national soybean production programme started in 1969 when the Department of Agriculture and Natural Resources (DANR), now the Ministries of Natural Resources and of Agriculture and Food harnessed 900 hectares for soybean and sorghum planting to meet the requirements of the local livestock and poultry industries. Other government agencies, such as the Agricultural Credit Administration and the Agricultural Productivity Commission (now BAEX) provided support services.

Furthermore, the decade of the 1970s saw great development in the generation of technology for soybeans adaptable to Philippine condi tions. In spite of all these efforts to support the commodity, the soybean industry is still groping in the dark. Domestic soybean production has not been large enough to effect an import-free industry

(Tables 2 and 3).

Table 2 Soybean production in the Philippines, 1978-84.

Year	Area (ha)	Production (mt)	Yield (mt/ha)
1978	9,320	7,099	0.77
1979	8,400	8,033	0.96
1980	9,580	9,395	0.98
1981	10,410	10,057	0.97
1982	10,900	11,466	1.05
1983	8,590	8,104	0.94
1984	7,600	7,538	0.98

Source: BAEcon.

Table 3 Philippine soybean imports, 1978-83.

Year	Soybeans grain		Soybean Meal		Total Vol. (mt)
	Vol. (mt)	Value US$ (in millions)	Vol. (mt)	Value US$ (in millions)	
1978	22,090	6.2	44,227	9.4	66,317
1979	12,313	n.a	123,594	32.5	135,907
1980	24,882	8.9	214,788	57.7	239,610
1981	16,002	5.4	217,809	65.8	233,811
1982	31,277	8.8	343,000	n.a	374,277
1983	30,555	8.2	260,954	63.9	291,509

Source: NFA

Thus, in December 1983, the Philippine Council for Agricultural Research and Resource Development (PCARRD), together with UPLB, CLSU, MAF and other government agencies, launched the soybean Pilot Production Program. The program was to develop a viable soybean production scheme for Luzon and the Visayaqs, aimed at hastening self-sufficiency in soybean for local needs, for raw ingredients in feed formulas, and for food and industrial uses as well.

With the availability of the package of technology for soybeans that would increase yield, there is still the problem of slow acceptance and efficient use of this technology. Some farmers are simply not aware of this technology. The national average yield for soybeans is 0.98 metric tons (mt) per hectare, while experimental yields of 2.8 mt per hectare can be obtained (SJ-2and UPL Sy-2, Table 4). The yield gap may be attributed to various environmental factors, including agro-climatic, economic and social.

While the yield gap can be easily measured through yield differentials, the factors that contribute to the gap have to be identified and their influence in the yield gap analysed. The extent to which these factors inhibit yield increases, and their relationship to other factors, need to be assessed. An understanding needs to be developed of the limiting factors, and the development of efficient measures that would minimize or possibly remove contraints to higher yields, still has to be pursued. This study is related to the programme on soybean expansion in one new area, and hence the sample respondents consist of

inexperienced soybean farmers.

Table 4 Mean yields of selected soybean cultivars tested at various locations, 1982

Cultivars	Country of Origin	Yield (t/ha)		
		Los Banos	Tuguegarao	Davao
Dan's	U.S.	3.0	1.6	2.0
Improved Pelican	U.S.	3.0	2.8	2.5
Alano	U.S.	2.1	2.2	2.3
SJ-21	Thailand	2.4	1.6	2.5
Orba	Indonesia	2.8	1.8	2.5
ACC-2120	Taiwan	2.5	1.0	2.7
UF-VI (BP2)	Brazil	2.6	2.4	2.5
PB-1	India	3.4	2.6	2.2
L-114	Philippines	2.3	1.0	2.0
ULPSY-2	Philippines	2.4	2.6	2.4

1 This is referred to as CLSOY at the CLSU.
Source: R.H.C. Clements and R.A. Morris (1982).

1.2 Objectives of the study

The overall objective of the study is to identify and analyse the constraints to adoption of soybean and the package of technology that goes with it, in a selected area of the Philippines. The hypothesis is that the low yields among soybean farmer co-operators is due to their inability to adopt the recommended inputs more fully (e.g., HYV seeds, fertilizer and insecticides), unfavorable economic and physical conditions (e.g., credit availability, high cost and low returns, irrigation), and the lack of technical knowledge on soybean production.

The objectives of the study in detail are as follows:

1. To describe the current soybean production systems and their general characteristics;
2. To identify the constraints to adoption (of new crops and POT) and higher soybean yield, and to ascertain the reasons why farmers' actual yields are much lower than what is technically possible under controlled conditions;
3. To account for the contribution of physical and socio-economic factors toward soybean yield in the trial site;
4. To recommend policy measures that would minimize or remove the constraints to adoption and higher productivity of soybeans.

1.3 Soybean improvement programme

The National Soybean Production Program was launched by the Philippine government to increase the domestic production of soybean by utilizing the recommended package of technology, with the expecta-tion of decreasing imports and increasing the income levels of soybean farmers. The programme is pursuing a 3-year accelerated national produc-tion plan for soybean, with a targeted increase in area of 130,000 ha in 15 provinces during 1986-87. Yearly targets are as follows: 1984/85 -- 12,000 hectares; 1985/86 -- 60,000 hectares, and

1986/87 -- 13,000 hectares. Furthermore, as a result of improved technological prac-tices, yield levels are expected to increase from 1.3 mt/ha to 1.8 mt/ha. by 1986-87. The program projects the import substitution suffi-ciency level at 49.3 percent by 1986-87, starting from 4.0 percent in 1984-85 and 20.8 percent in 1985-86.

The soybean production areas were concentrated where the agro-nomic viability of soybean had been tested and proven economical. Lupao was one of the sites of soybean production in Nueva Ecija. The programme was started there during the dry season of 1983-84 and conti-nued through the dry season of 1984-85. It was supported with adequate manpower, composed of MAF production technicians, complemented by the technical manpower of participating private agencies.

The loans taken by soybean growers for the dry season of 1984-85 amounted to P2,500 per hectare, consisting of P750 for seeds (50 kg/ha at P15 per kg), P970 for fertilizer; and P780 for farm chemicals.

The planting time for the dry season of 1984-85 ranged from November - December to February - March.

Two approaches were employed to provide financial assistance to qualified farmers in the form of material inputs (See Illus. 1). The NFA provided this financial assistance. NFA utilized its existing warehouses to serve as distribution and procurement centres for input. MAF production technicians provided the necessary technical supervision to co-operators under this scheme. The NFA also provided postharvest facilities.

The other approach, end-user oriented, had PCARRD provide the budget to CLSU, and CLSU provided the material inputs to the farmers, with the assistance of the MAF production technicians for technical services.

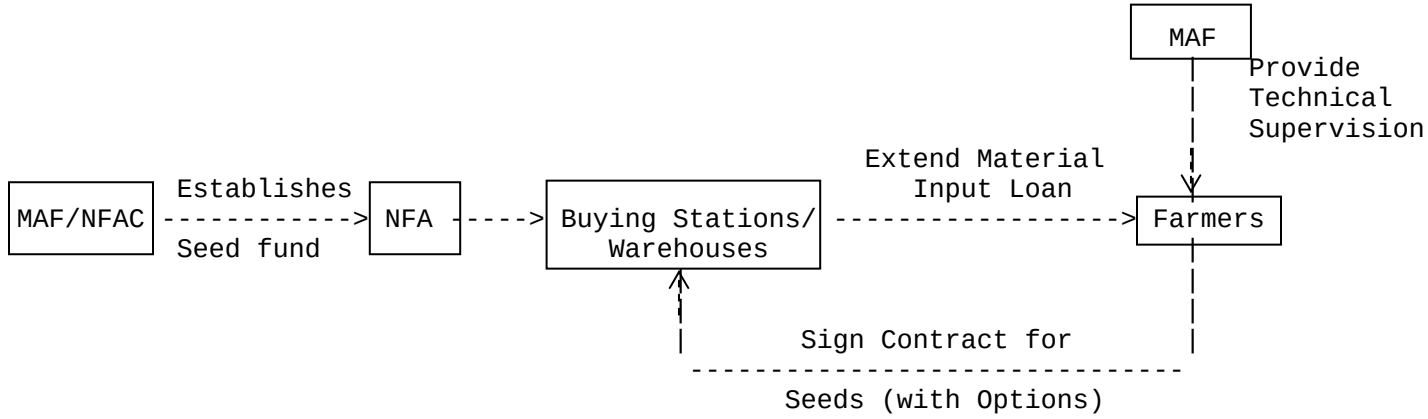
A three-way relationship among the farmers, the financing units providing production capital, and the markets for the produce will be introduced into the financing scheme. A uniform interest rate was applied to all farmers using production loans.

To strengthen the technical and managerial capabilities of the Soybean Subject Matter Specialist (SSMS) and farming leaders, various training programmes were conducted by the National Food and Agriculture Council (NFAC), the University of Southern Mindanao (USM), the Bureau of Plant Industry (BPI), and the Philippine Training Center for Rural Development (PTCRD).

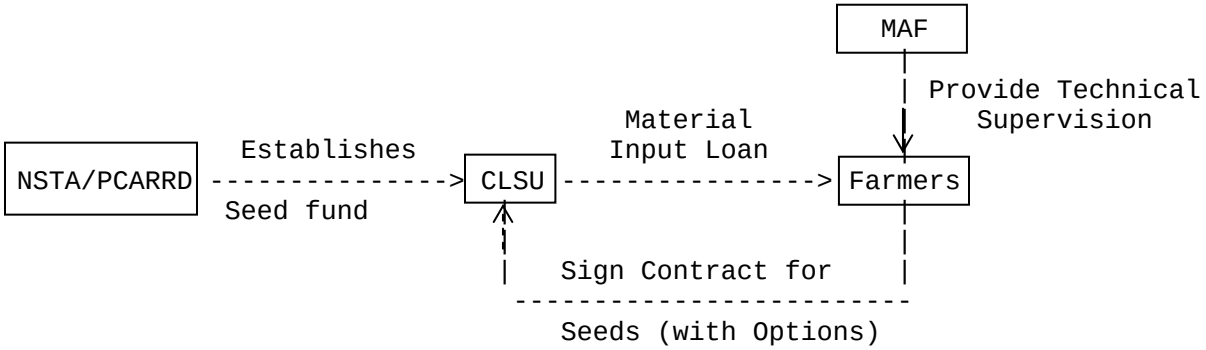
Soybean marketing is based on an agreement between the producers and buyers, using the prevailing price as the guideline to ensure farmers of at least minimum returns.

Illus. 1 The NFA Approach

A. The NFA Approach



B. The PCARRD-CLSU Approach



2. The Farmer and his Environment

2.1 Description of the study area

The province of Nueva Ecija is located in the northeastern section of the Central Luzon Region, bounded on the northwest by Pangasinan, Tarlac on the west, Nueva Vizcaya on the northeast, Pampanga on the southwest, and Bulacan and Queson on the southeast (Illus. 2, page 14). It has a total land area of 5,284 km2, and is flanked by mountains in its eastern section.

Lupao is one of the municipalities which was selected for the national soybean production programme launched by the government. It is located near the border of Pangasinan (on the border of Nueva Ecija), and is situated about 7 km from the city of San Jose. It has a total land area of 15,179 hectares, of which 63 percent is devoted to agriculture. Lupao is characterized by flat to sloping areas, with some mountainous regions in the northeastern part.

The wet season starts in May and ends in October, while the rest of the year is dry. The total population of Lupao is 28,205, with 4,156 households.

Rice is the main crop of Lupao. Most of the farms are rainfed (about 4,337 hectares), while other farms are irrigated. The total land area devoted to rice alone is about 5,650 hectares. Corn, another main crop of the town, covers only about 190 hectares. The average size of the Lupao farm is 2.10 hectares.

Different labour organizations exist in Lupao, such as the "Samahang Nayon" (SN), Irrigators Service Association (ISA), Agricultural Rural Bank Association (ARBA) and the "Kabatang Barangai". Most of the farmers join either SN or ARBA.

The trial sites for the soybean production programme were located in the villages of Tienzo, San Antonio Weste, San Antonio Este, San Pedro, San Isidro, Salvacion II, Cardero, Namulandayan, Parista, San Roque and Cabangaran. The farmers were encouraged to join the soybean programme through seminars held by government agencies.

2.2 The soybean farmers

2.2.1 General characteristics

The soybean farmers studied were, on the average, 47 years old, and had 23 years farming experience (Table 5). Since the programme on soybean trial farming was launched recently in Lupao, their experience in soybean farming amounted to only 15 months. The average level of education was slightly above primary, but three of them were bachelors of science in agriculture. Twenty-one farmers were PCARRD-CLSU funded, six were under the NFA, while four were under both the PCARRD-CLSU and the NFA. Among the farmers studied, four tenure types existed: owner-operators, sharing tenants, lease-holding tenants, and the Certified Land Transferees (CLT) (see Table 6). Fifteen of the thirty-one soybean farmers were lease holders.

Table 5 General characteristics of the sampled soybean farmers in Lupao.

CHARACTERISTICS	AVERAGE
Age (Year)	47.0
Years in school	8.2
Years in farming	23.0
Years in soybean farming	1.2
Household size (heads)	6.0

Table 6 Tenure status of the sampled soybean farms in Lupao.

TENTURE TYPE	SOYBEAN FARMERS	
	Number	Percent
Owner-operator	10	32
Sharing tenant	1	3
Lease tenant	18	58
CLT holder	2	7

84 percent of all farms were located in flat areas, while the rest were located on rolling and sloping areas (Table 7). Seventeen out of the thirty-one farms got their irrigation water from pumps, while only seven farms depended on rain. The average farm size was 3.23 hectares, while the area devoted to soybean farming averaged 0.57 hectares only (Tables 8 and 9).

Before lauching the soybean farming trials, the soil types in the study area were tested in order to determine whether they were suitable for soybeans. The most dominant soil types in the area were the sandy and sandy loam types, followed by clay and clay loam.

Table 7 Characteristics of sampled soybean farms

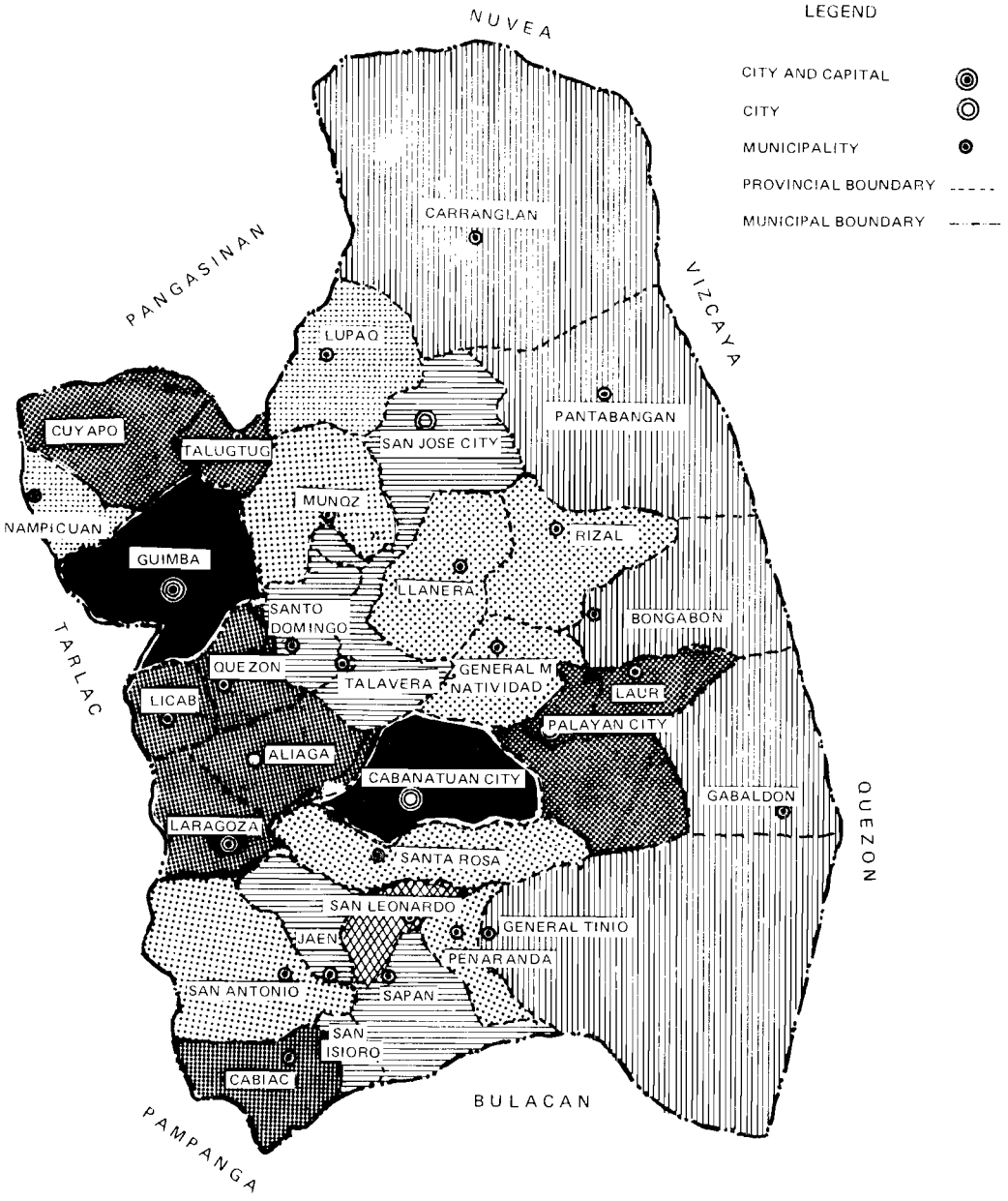
FARM CHARACTERISTICS	SOYBEAN FARMERS	
	Number	Percent
Topography		
Rolling	4	13
Flat	26	84
Sloping	1	3
Source_of_water		
Gravity	3	10
Pump	17	55
Rain	6	19
Spring, river or creek	5	16
Soil_type		
Sandy	9	29
Sandy loam	14	45
Clay	4	13
Clay loam	4	13
Road_class		
Concrete	2	6
Gravel and sand	12	39
Trail	17	55

Table 8 Average farm size in Lupao

FARM SIZE (ha)	SOYBEAN FARMERS	
	Number	Percent
0.5 - 1.9	7	42
2.0 - 3.9	14	45
4.0 - 5.9	7	23
6.0 - 7.9	2	7
8.0 and above	1	3
Average size = 3.23 ha.		

Table 9 Area planted to soybean on the sampled farms in Lupao

AREA PLANTED TO SOYBEANS (Ha)	Number	Percent
less than 0.5	13	42
0.5 - 0.8	10	32
0.81 - 2.0	8	26
Average size = 0.57 ha.		



Illus. 2 Map of Nueva Ecija showing the study area

2.2.2 Cropping patterns

Because soybean is a crop of relatively short duration, it fits well into cropping systems either as a cash crop preceding or following the main crop, or as an intercrop. In this study area, soybean was generally grown as a single crop immediately after rice (Illus. 3). However, where environmental conditions were well suited to soybean, they were grown as the main crop, sometimes twice yearly in some parts of the area. At present, UPL-SY2 and CLSOY (Sj-2) are registered varieties commonly grown in the study area.

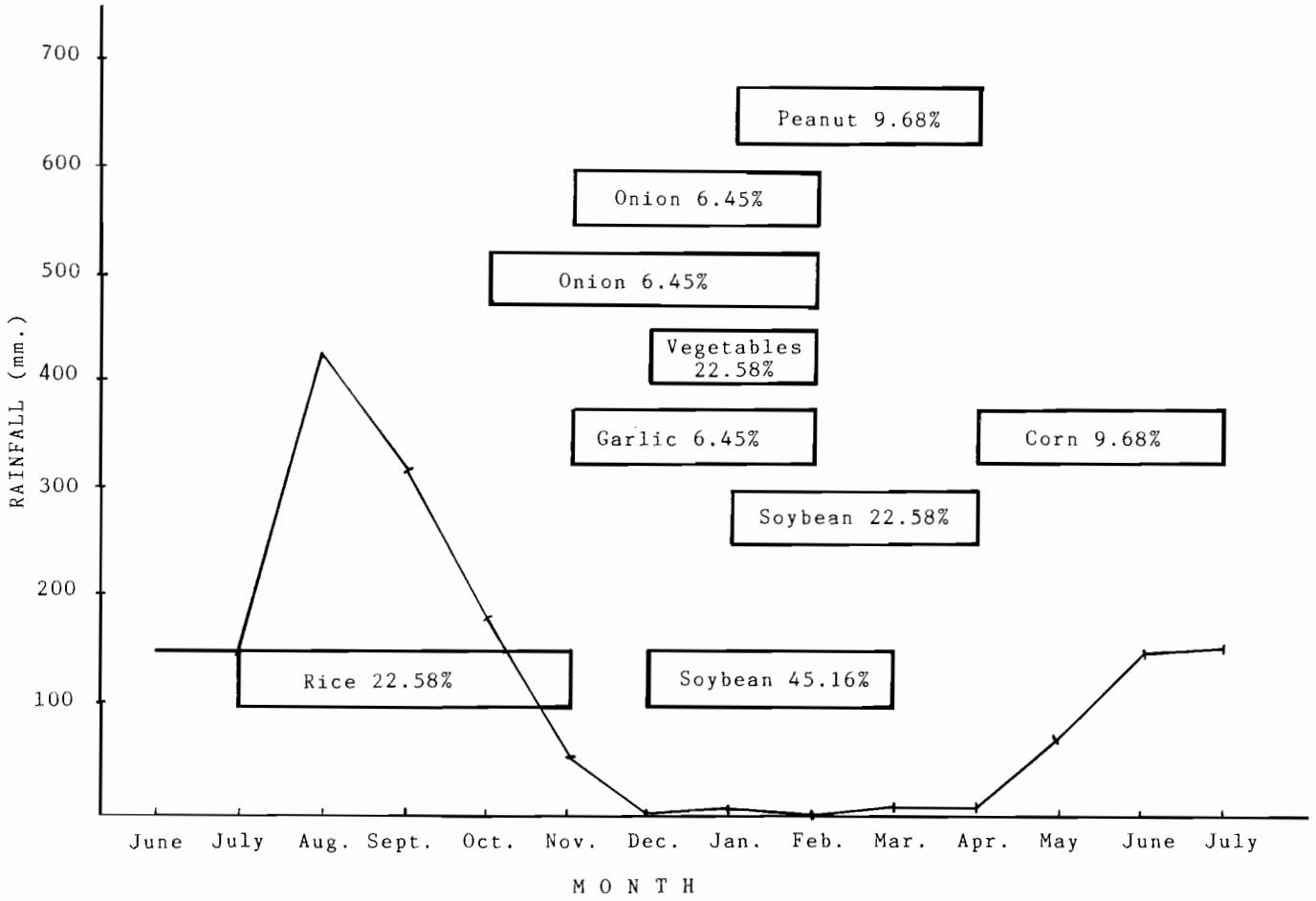
The planting of soybeans started in September 1984 under the PCARRD-CLSU funded programme, and then in December 1985 under the NFA funded programme (Table 10). On the average, the actual planting took place from November to January. Harvesting was done from February until March, or after three to four months.

Most of the farmers planted their soybean after the wet (rice) season (June to October), simultaneous with other crops, such as eggplant, tomato, squash, ampalaya, beans, corn, onion, garlic and peanut.

In the first year (1983-84) of the soybean production programme in Lupao, only 4 percent of the co-operators attained the targeted yield of 1.25 tons per hectare. However, 34 percent did not attain 500 kg/ha.

Table 10 Soybean cropping season for the sampled farms

SOYBEAN CROPPING SEASON	NUMBER OF FARMS	%
October - December 1984	1	3
November 1984 - January 1985	2	7
November 1984 - February 1985	5	16
December 1984 - February 1985	1	3
December 1984 - March 1985	14	45
January - April 1985	7	22
January - March 1985	1	3



Illus. 3. Cropping season and crop selection, Lupao, 1984-85
(% of sampled group indicated)

3. Farmer Evaluation of the POT

3.1 Soybean growers (participating farmers)

3.1.1 Farmer awareness and adoption of the POT

It proved interesting to determine what the farmers learned after adopting the given package of technology. Table 11 details the information and technology the farmers learned through soybean production.

Many of the soybean growers reported that they had learned a great deal about techniques in soybean farming. These include the use of fertilizers and chemicals, the right way and time of planting, water requirements, and care of the crop. Five out of the thirty-one farmers sampled reported that they studied so that they could generate profit from soybean.

In terms of adoption of the technology, only one of them reported that he did not adopt the POT, while the majority (64 percent) adopted it (Table 12). However, many others did not answer (32 percent).

Table 11 Information and technology from following the soybean programme

INFORMATION/TECHNOLOGY	SOYBEAN FARMERS	
	Number Reporting	Percent
Farming techniques [a/]	3	10
Farming technology; mulching is better than plowing	1	3
Farming techniques: soybean is more profitable if timely planted	1	3
Fertilizer application techniques; planting should be done in December	1	3
Effective fertilizer application	1	3
Use of inoculant and liquid fertilizer for soybeans	1	3
Use of fertilizers, chemicals, etc.	1	3
Soybean needs a lot of spraying	1	3
Chemicals, irrigation and care are needed	1	3
Correct way of planting soybean learned through seminars	3	10
Water requirements for soybean	4	13
Good profit; soybean is easy to produce	1	3
Soybean is more profitable than other crops	3	10
More profit than other crops during the dry season and during the flowering stage if sprayed properly	1	3
Nothing learned	3	10
No response	5	17

[a/] Farming techniques include furrowing, spraying and record keeping.

Table 12 Farmers adopting the POT

ADOPTION OF POT	SOYBEAN FARMERS	
	Number reporting	%
Adopted	20	65
Did not adopt	1	3
No response	10	32

3.1.2 Recommended farming practices

The farmers were asked whether or not they followed the recommended practices for soybean farming. Few farmers (29%) inoculated their seeds before planting, while the recommended system of plowing, harrowing, furrowing, spacing between hills and between rows, seeding rate, and the depth of planting was followed by most of the farmers (Table 13). Seeding rate and harrowing methods were the practices followed most. All these indicate that the farmers are willing to adopt the POT if provided with recommendations for farming practices. Moreover, according to them, soybean production is easy.

Table 13 Adoption of recommended farming practices in Lupao.

RECOMMENDED FARMING PRACTICE	SOYBEAN FARMERS			
	Adopted		Did Not Adopt	
	Number reporting	%	Number reporting	%
Frequency of plowings	26	84	5	16
Harrowing methods	28	90	3	9
Furrowing methods	27	87	4	13
Inoculation	9	29	22	71
Spacing beween hills and between rows	26	84	5	16
Seeding rate	28	90	3	10
Depth of planting	26	90	3	16

3.1.3 Recommended fertilizers and chemicals

Only two kinds of fertilizers were recommended for soybean production: complete fertilizer (14-14-14) and urea. Among the farmers sampled, eighty-seven percent answered that they knew only 14-14-14 as the recommended fertilizer, while 13 percent knew of both complete and urea (Table 14). This may indicate that soybean is a new crop to them, and thus they had no idea of what kind of fertilizer it required. Among the farmers who made use of these fertilizers, 97 percent applied complete fertilizer, while only one farmer applied both fertilizers to his soybean farm.

Recommended insecticides known and used by the farmers for soybean farming are listed in Table 15. Among them, Azodrin 202-R and Gusathion were the most popular insecticides. Some farmers, however, made use of other brands of insecticides (like Symbos, Folidol and Malathion) as supplements.

Table 14 Kinds of recommended fertilizers known and used by the sampled farmers.

FERTILIZER	FARMERS_WHO_KNEW Number	%	FARMERS_WHO_MADE_USE Number	%
complete 14-14-14	27	87	30	97
complete and urea	4	13	1	3

Table 15 Recommended insecticides known and used by the sampled farmers.

NAME OF INSECTICIDE	NO. OF SOYBEAN FARMERS: Farmers who knew	Farmers who made use
Azodrin 202-R	17	14
Hopcin	1	-
Lannate	12	-
Folidol	2	-
Thiodan	2	-
Gusation	9	8
Symbos	1	-
Parathion	1	-
Brodan	3	2
Sumucidin	2	-
Malathion	1	-

3.1.4 Extension services

The farmers were asked whether their funding agencies had extended to them the technical services they needed (Table 16).

Table 16 Number of farmers receiving services from funding agencies

FUNDING AGENCY	SOYBEAN FARMERS			
	Received Service		Did not receive Service	
	Number reporting	Percent	Number reporting	Percent
PCARRD-CLSU	13	42	1	3
NFA	2	7	4	13
Both PCRRD-CLSU and NFA	6	19	2	6
No response	-	-	3	10
TOTAL	21	68	10	32

Forty-two percent of all soybean farmers answered that they had received services from PCARRD-CLSU. Only one of them reported that he did not receive any technical assistance at all. On the other hand, only two farmers reported that they had received assistance from NFA, while four of them reported that they had not.

Moreover, farmers who received technical services reported that services extended were useful. However, a few of them reported that service could be improved.

3.1.5 Other uses of soybean

This section of the study aimed at determining the farmers' knowledge on other uses of soybeans aside from using them raw. According to the farmers, milled coffee derived from soybeans was the most popular alternative form of utilizing the crop (reported by 90%). Few farmers were aware that soybean can be processed into curd ("tokwa"), or served as viand for animal feed (refer to Table 17).

Table 17 Knowledge of uses of soybean

FORMS OF UTILIZATION	SOYBEAN FARMERS	
	Number reporting	Percentage of sample
Coffee	28	90
Soya milk	9	29
Soybean candy ("Polboron")	2	29
Soybean cheese ("Tokwa")	2	6
Curd ("Taho")	1	3
Viand	2	6
Animal feed	2	6

3.1.6 Farmer evaluation of the programme's services

a) Threshers

One part of the programme offered machines (tractors, threshers, and others) to farmers who could not afford to rent or otherwise obtain such machines. In the study area, the farmers needed and were provided with only threshers.

Forty-five percent of the respondents (14 farmers) were able to borrow threshers from the agencies (Table 18). Among them, 32 percent (10 farmers) answered that the threshers were good. Only one farmer reported that the threshers were delivered late.

On the other hand, seven farmers reported that there were no threshers available, which was why they were not able to borrow them. Four of these farmers were under the supervision of PCARRD-CLSU while two were NFA supervised.

b) Seeds, fertilizer, and insecticides

A high proportion of the respondent farmers (55 percent) reported that the delivery of supplies were good, although one farmer answered that the price of the insecticide was too high. Four farmers reported that the supplies they needed were indeed available. On the other hand, 26 percent reported that the services were not good because of the following reasons: inability to receive any services (one farmer), delayed delivery of insecticide and fertilizer (reported by two farmers), and insufficient supplies of the material inputs (reported by five farmers).

Table 18 Farmer evaluation of programme services

FARMERS EVALUATION	SOYBEAN FARMERS	
	Number Reporting	%
Avialability_of_threshers		
All available	1	3
Available	2	6
Good service	10	32
Good machines but delayed delivery	7	3
No available threshers	1	23
Did not borrow a thresher	7	3
No responsea/	9	30
Availability_of_seed,_fertilizers_and_chemicals		
Availableb/	4	13
Good services	15	48
"Good; through seeds from CLSU, I learned how to produce soybeans."	1	3
Good, but price of insecticide was too high	1	3
Delayed delivery of insecticide and fertilizers	2	6
Not good - services were not given	1	3
Insufficient supplies of:		
fertilizers	1	3
fertilizers and insecticide	2	6
seeds, fertilizer, and insecticide	2	6
No response	2	6

(continued ....)

Table 18 (continued)

FARMERS EVALUATION	SOYBEAN FARMERS	
	Number Reporting	%
Marketing_and_post-harvest_assistance		
Good services	13	42
Plenty of buyers	1	3
Good grading of seeds	1	3
"Okay, but I'd rather sell my produce at the highest price"	1	3
Services were available	1	3
Good agreement, they can market outside if price is higher	1	3
Not good - CLSU's promise to sell at a higher market price was not kept	1	3
None - no assistance received	4	13
No response	8	26
Other_extension_services		
Good services	6	19
Technical assistance was available	4	13
All problems were settled by the technicians	1	3
Technicians teach the correct way of spraying insecticides (good service)	1	3
Soil test was good	2	6
Only inputs were provided	1	3
Seminars provided good assistance	1	3
No response	11	35
None (no extension services provided)	4	13

a/ Includes those who were not able to borrow threshers and those who did not answer the quesion

b/ Includes responses like "always available" and "all available"

c) Marketing and Postharvest Assistance

These included the purchase of the soybean produce by the respec tive agencies at the price of P9.50 and P6.00 per kg,set by PCARRD-CLSU and NFA, respectively. Included in this service were the delivery of the produce from the farm to the procurement area, and the grading of the grain before sale.

A high proportion of the farmers (52 percent) reported that the services provided were good. One of them answered, however, that he could sell his produce to other market outlets instead of selling them to the agency. However, five farmers reported that the services were not good: CLSU's promise to pay them at a higher price was not kept, as reported one farmer, and no assistance was received--reported by four farmers.

d) Other Extension Services

These include the establishment of demonstration farms and infor mation campaigns led by technicians. Among the respondents, 48 percent reported that the extention services were good and readily available. Only four farmers reported that they did not receive any service.

3.1.7 Socio-economic profile and employment

As mentioned earlier, the average household size of the soybean farmers under study was six, and the average number of children was four. Many of the farmers have their wives and children helping them farm, since most of them depend on farming for their living.

Aside from farming, a few of the farmers were engaged in non-farm enterprises, such as selling sundries; one farmer was an MAF technician himself.

3.1.8 Membership in labour organizations

The organization of which most farmers were members was the "Samahang Nayon". Four farmers held high position. A few farmers were members of the ARBA, the Co-Threshers' Association and the Agricultural Farmers Association.

According to the majority of members, however, they did not benefit from their respective farm organizations. However, some of them responded that the "Samahang Nayon" helped provide the funds and inputs they needed for farming, and that loans were available through co-operative rural banks; they also claimed to learn some technical know-how about farming through their organizations.

3.2 Non-soybean growers (non-participating farmers)

3.2.1 General characteristics

This section of the study discusses the characteristics of farmers who did not grow soybeans, and their awareness and perception of the soybean trial farming being conducted in the study area.

The average age of non-soybean growers was 44 years (Table 19); but some (13%) were aged 60 or above (Table 20). Table 21 shows that the majority of the farmers (55%) finished from one to six years of schooling. Only three of them (10%) were able to finish college. On the average, these farmers had already been engaged in farming for 20 years. As with the soybean farmers, the dominant (77%) tenure status of the non-soybean growers was lease-tenant, (Table 23). The average farm size they were tilling was 2.54 hectares. (Table 24).

Table 19 General characteristics of non-soybean growers, Lupao.

CHARACTERISTIC	AVERAGE
Age (years)	44.0
Years in school	7.3
Years in farming	20.0

Table 20 Number of non-soybean growers by age

AGE RANGE	NON-GROWERS	
	Number reporting	Percent
30 - 39	10	33
40 - 49	11	37
50 - 59	5	17
60 and above	4	13

Table 21 Years in school of the non-soybean growers

NUMBER OF YEARS	NON-GROWERS	
	Number Reporting	Percent
1 - 6	16	55
7 - 10	10	34
11 - 14	3	10

Table 22 Years in farming of the non-soybean growers

YEARS IN FARMING	NON-GROWERS	
	Number reporting	Percent
3 - 9	5	17
10 - 19	10	33
20 - 29	7	23
30 - 39	4	13
40 and above	4	13

Table 23 Tenure status of the non-soybean growers

TENURE TYPE	NON-GROWERS	
	Number reporting	Percent
Owner-operator	4	13
Share-tenant	1	3
Leasee	23	77
CLT holder	2	7

Table 24 Farm size of non-soybean growers

FARM SIZE (Ha)	NON-GROWERS	
	Number reporting	Percent
0.5 - 1.9	10	32
2.0 - 3.9[a]	15	48
4.0 - 5.9	5	16
6.0 - 7.9	1	3

[a]Average size: 2.54 ha.

Table 25 Awareness of farming trials

AWARENESS	NON-GROWERS	
	Number	Percent
Aware	23	74
Not aware	8	26

Table 26 Average distance from the nearest soybean trial

LOCATION	AVERAGE DISTANCE (km)
Farm	1.05
House	1.20

3.2.2 Knowledge of the programme

(Discussion of Tables 27, 28 and 29)

Some of the information farmers reported learning from the soybean trials was that soybean production requires irrigation (answered by five farmers), that it could increase farm yield (10 percent), that it is more profitable than other crops (10 percent), and that there are good benefits and modern technology for producing soybeans (Table 27). However, one farmer answered that peanut is a better crop than soybean, since the latter requires larger amounts of fertilizer and insecticide. Eight farmers (26 percent) reported that they were not aware of the trials.

The reasons given by the non-growers for not planting soybeans are listed in Table 28. Among these, were the lack of irrigation (or other water source), that their farmland was suited for rice cropping only, no knowledge about soybean growing, or the POT and what government agency to consult. Some of their responses indicated a the capability to grow the crop but lack of information about the POT, white others indicated an inability to plant due to factors outside their control, such as lack of financial support, bad health, or the unsuita-bility of the land for soybean. This implies that there were still a number of non-soybean growers who were willing to plant the crop if they were given the information, technology and assistance they needed.

This could also be supported by the information listed in Table 29. Out of the 31 non-soybean growers, a majority of them reported that they intend to plant soybean the next cropping season. According to four of these farmers, soybean growing was easy to engage in. Six responses indicated that the farmers realized that soybean production generates higher income. However, a majority of them answered that they will try only under the conditions listed in Table 29. The highest proportion of these farmers reasoned that they will try if a higher price for soybean were offered.

On the other hand, thirteen farmers reported their unwillingness to plant soybean. Most of their reasons indicated an inability to plant due to lack of water for irrigation, lack of space on their farms (as the majority had answered), lack of time or other resources. Two farmers reported that growing soybean would provide less profit than crops like peanut.

Table 27 Information gathered from trials by non-soybean growers

INFORMATION	NON-SOYBEAN GROWERS	
	Number Reporting	Percent
Soybean production needs irrigation/ Water is important	4	13
Soybean needs irrigation and proper way of applying insecticide	1	3
It could increase farm yield	3	10
Good benefits	1	3
More profits than other crops	3	10
Yield from soybean seems good	1	3
Peanut is better than soybean; soybean requires high amounts of fertilizer and insecticide	1	3
Technology from soybean production	2	6
None (did not learn anything)	7	23
No response[a]	8	26

[a/] Includes farmers who answered that they were not aware of the soybean trial farming in Lupao.

Table 28 Reasons for not planting soybean

REASON	NON-SOYBEAN GROWERS	
	Number Reporting	Percent
Lack of irrigation	5	16
Lack of pump	1	3
No irrigation system on their farm	1	3
Farm suitable for rice only (water-flooded farm)	3	10
Farmland is already planted with other crops	1	3
No knowledge about soybean growing	1	3
Lack of financial support	2	6
Difficult to engage	1	3
Bad health	1	3
New farmer (does not know anything about soybean farming)	2	7
No knowledge regarding the soybean program (POT)	2	7
No knowledge of any government agency that lends money	1	3
No seeds available	1	3
No response a/	9	29

a/ Includes farmers who did not answer the question.

Table 29 Reasons for (not) planting the next season

REASON	NON-SOYBEAN GROWERS	
	Number Reporting	Percent
Farmers_who_intend_to_plant	18	58
Easy to plant soybean	2	6
Easy to plant and more profitable	2	6
To increase income	3	10
Easier to earn money from soybean	1	3
Soybeans more useful	1	3
Heard from other farmers of high price offered for soybean	3	10
Will try, but presently poor health	1	3
Will try if it will give good yields	1	3
Will try a few seeds	1	3
Will try if the government lends them seeds, fertilizer and insecticide	1	3
Will plant only in November	1	3
Will plant only if there is an irrigation system available	1	3

(continued ....)

Table 29 (continued)

REASON	NON-SOYBEAN GROWERS	
	Number Reporting	Percent
Farmers_who_do_not_intend_to_plant	13	42
Farm is already planted with other crops	1	3
Lack of carabao and water	1	3
Lack of area (on the farm)	3	10
Lack of irrigation/water	3	10
No knowledge/prefers rice and peanut	1	3
Soil is not fertile	2	6
Higher earnings from vegetables	1	3
Low yield	1	3

3.3 Resources used by participating farmers

3.3.1 Labour utilization

The major source of labour in soybean farming was the operator's own hands. Family and hired or exchange labourers were also employed, but to a lesser extent. The total man-day and man-animal-day requirements for all 31 farms was 42.1 per hectare (Table 30). This included all preharvest to harvest to postharvest operations, and covered about 58 percent of the total labour requirement.

Among the labour operations in soybean production, the most labour-intensive operations were land preparation (clearing the field, plowing and harrowing, requiring 19.6 man-days or 26.9% of all labour) and harvesting (8.6 man-days or 11.8%). Thorough land preparation is especially needed particularly in order to convert the riceland into favourable land for growing soybean, for root development and for better water retention and weed control (National Soybean Production Program, 1984). Har-vesting, on the other hand, also required much manual labor for the cutting of stems (using a scythe).

Based on the prevailing wage rates in Lupao (Table 31), the study found that plowing and harrowing contributed to the high cost of labour for soybeans (at 17.1% and 14.3% respectively). The total labour cost per hectare for all operations was P1,448.05. Among the four labour sources, the operator's labour accounted for the highest cost at P852.65 per hectare or 58.9 percent of the total labour cost.

Table 30 Labour requirements (in man-days per ha) for the sample soybean farms.

OPERATION	SOURCE				TOTAL	PERCENT
	Operator	Family	Hired	Exchange		
Pre-harvest						
Clearing	3.9	0.4	3.6	0.3	8.2	11.25
Plowing[a]	3.4	0.4	2.4	-	6.2	8.51
Harrowing[a]	3.4	0.3	1.5	-	5.2	7.14
Mulching	0.1	-	0.1	-	0.2	0.27
Furrowing[a]	1.8	0.4	3.1	-	5.3	7.27
Inoculating	0.4	-	-	-	0.4	0.55
Planting	2.8	1.3	1.6	0.1	5.8	7.96
Off-barring[a]	2.1	0.1	0.1	0.3	2.6	3.57
Hilling-up[a]	2.2	0.2	0.1	-	2.5	3.43
Fertilizing	2.0	0.3	0.1	-	2.4	3.29
Weeding	1.3	0.3	-	-	1.6	2.20
Spraying	4.8	0.8	-	-	5.6	7.68
Irrigating	4.5	-	-	-	4.5	6.18
Harvest/Postharvest						
Harvesting	3.2	3.0	2.2	0.2	8.6	11.80
Threshing						
Manual	0.8	1.0	0.7	-	2.5	3.43
Animal-drawn[a]	2.2	1.8	0.1	-	4.1	5.63
Drying	1.8	0.02	0.08	-	1.9	2.61
Storing	0.4	3.4	-	-	3.8	5.22
Grading	0.1	0.03	-	-	0.13	0.18
Packaging	0.4	0.1	0.01	-	0.51	0.70
Hauling	0.5	0.3	0.02	-	0.82	1.12
TOTAL	42.1	14.15	15.71	0.9	72.86	100.00
Percent	57.8	19.4	21.6	1.2	100	

[a]Expressed in MAD (man-animal-days).

Table 31 Labour cost (in pesos per ha) for sample soybean farms.

OPERATION	SOURCE			TOTAL	PERCENT
	Operator	Family	Hired		
Preharvest					
Clearing	78.00	8.00	72.00	158.00	10.91
Plowing	136.00	16.00	96.00	248.00	17.13
Harrowing	136.00	12.00	60.00	208.00	14.36
Mulching	2.00	-	2.00	4.00	0.28
Furrowing	27.00	6.00	46.50	79.50	5.49
Inoculating	6.00	-	-	6.00	0.41
Planting	42.00	19.50	24.00	85.50	5.90
Off-barring	42.00	2.00	2.00	46.00	3.18
Hilling-up	44.00	4.00	2.00	50.00	3.45

(continued....)

Table 31 (continued)

OPERATION	SOURCE			TOTAL	PERCENT
	Operator	Family	Hired		
Fertilizing	30.00	4.50	1.50	36.00	2.49
Weeding	19.50	4.50	-	24.00	1.66
Spraying	72.00	12.00	-	84.00	5.80
Irrigating	67.50	-	-	67.50	4.66
Subtotal	702.00	88.50	306.00	1,096.00	75.72
Harvest/postharvest					
Harvesting	48.00	45.00	33.00	126.00	8.70
Threshing					
Manual	12.00	15.00	10.50	37.50	2.59
Animal-drawn	44.00	36.00	2.00	82.00	5.66
Drying	27.00	0.30	1.20	28.50	1.97
Storing	6.00	51.00	-	57.00	3.94
Grading	0.15	0.45	-	0.60	0.40
Packaging	6.00	1.50	0.15	7.65	0.53
Hauling	7.50	4.50	0.30	12.30	0.85
Subtotal	150.65	153.75	47.15	251.55	24.28
TOTAL	852.65	242.25	353.15	1,448.05	100.00
PERCENT	58.88	16.73	24.39	100.00	-

Wage_rates:
Clearing, off-barring, hilling-up, threshing (animal - drawn)= P20/MAD.
Plowing and Harrowing = P40/MAD
Furrowing, mulching, inoculating, planting, fertilizing to hauling = P15/MD

3.3.2 Material inputs

The package of technology provided by the soybean production programme contained loans in the form of seed, fertilizer and insec ticide. An allotment of P2,500 per hectare's worth of material input with an interest rate of 5 percent for the entire cropping season of four months was given to the farmers. This section deals with the amount of material inputs the farmers were able to utilize.

a) **Seeds.** A seeding rate of 50kg per hectare of recommended seed varieties (UPL Sy-2 and BP Sy-2 from the program) was expected on the trial farms. However, the actual seeding rate used was only 43.5kg per hectare or 25kg per farm (Table 32). The programme failed to utilize its maximum potential seeding rate.

The total amount of seed used was 722.5kg, valued at P10,080.00, or P572.80 per hectare and P325.16 per farm. The value of the seed was P10.00 to P15.00 per kg (Table 33).

b) Fertilizer. Two kinds of fertilizer, namely 14-14-14 and urea, were used by the farmers. Prices per bag of fertilizer are shown in (Table 34). In this study, the farmers were able to utilize an average of 3.6 bags per hectare of complete fertilizer and 0.3 bags per hectare of urea, totalling 3.9 bags per hectare (Table 35). Average cost of fertilizer was P815.37 per hectare or P463.18 per farm.

c) Insecticide. The chemicals that the programme provided were a variety of chemicals in the insecticides (Table 36). The total cost of all insecticides used by the farmers (both loaned and purchased) was P9,836.30 or P558.56 per hectare and P317.30 per farm. Because of the additional supply of insecticide, the farmers' cash expenditures also increased.

d) Inoculant. Inoculants were provided at P5.00 per pack (100 grams). In this study, most of the soybean farmers did not apply inoculants; thus, only a few spent money on this. About 17 packs of inoculant were utilized, with a total cost of P80.00 or P4.54 per hectare and P2.58 per farm.

Table 32 Seeding rate (kg/ha) on the sample farms

RESPONDENT NO.	SEEDING RATE (kg/ha)	RESPONDENT NO.	SEEDING RATE (kg/ha)
01	40.0	17	50.0
02	40.0	18	40.0
03	50.0	19	40.0
04	75.5	20	40.0
05	0	21	60.0
06	-	22	80.0
07	15.1	23	40.0
08	64.5	24	48.0
09	40.0	25	50.0
10	33.3	26	84.0
11	40.0	27	40.0
12	40.0	28	40.0
13	0	29	40.0
14	40.0	30	40.0
15	-	31	50.0
16	40.0		

Average seeding rate = 43.5 Kg/ha.

Table 33 Amount and cost of seeds for the sample

ITEM	TOTAL	PER HECTARE	PER FARM
Amount (kg)	722.50	43.50	25.00
Value (P)	10,080.00	572.80	325.16

Table 34 Inputs loaned by the Soybean Pilot Project.

Kind	Quantity	Unit Price (P)	Value (P)
Seeds	695	10.00	6,950.00*
Inoculant	14 packets	5.00	70.00*
Fertilizer			
14-14-14	39 bags	253.00	9.867.00
Urea	1 bag	275.00	275.00
Insecticide			
Gusathion	17 qrt.	190.00	3,230.00
Azodrin	4 qrt.	135.00	540.00
Sumucidin	4 qrt.	158.00	632.00
Hopcin	2 qrt.	121.00	242.00
Thioxin	1 qrt.	120.00	120.00
Lannate	9 qrt.	135.00	1.215.00
Brodan	1 qrt.	145.00	145.00
Thiodan	2 qrt.	133.00	266.00
Lithox	1 qrt.	120.00	120.00
Parathion	1 qrt.	120.00	120.00
TOTAL AMOUNT OF LOAN			23,792.00
LOAN PER HECTARE			1,950.87

* Not subject to 5% interest

Table 35 Amounts of fertilizer used on sample farms

TYPE OF FERTILIZER	SOURCE OF LOAN: PCARRD-CLSU	NFA	BOTH PCARRD-CLSU AND NFA	ALL SOURCES
	no._of_bags[a]			
14-14-14	4.6	2.4	2.0	3.6
Urea	0.3	-	0.3	0.6
BOTH KINDS	4.9	2.4	2.3	3.9

[a] 1 bag = 50 kgm.

3.4 Production and disposition

The average production of soybean was 529.8kg per hectare or 300kg per farm (Table 36). This is low yield performance, implying that a single farmer was able to produce 0.30 m.t. only, with an average farm size of 0.57 hectares.

However, looking at the performance of individual farms, average production of one ton/ha and higher was reached by high-yielding farms (yields ranging from 0.8 to 1.8 tons/ha) (Table 37). These farms include about 26 percent of the sample. This indicates that high soybean production, given the proper management and POT, is still possible in this area. On the other hand, low-yielding farms (yields ranging from 0 to 0.3 ton/ha) included about 35 percent of the sample.

The bulk of the produce was sold to either the funding agencies or to other market outlets where prices were more favourable. 281.1kg of soybean on the average were sold per farm (Table 38). Some were utilized for home consumption (16.6kg), some were paid to creditors (2.7kg), while the remaining produce was given away (0.5kg).

3.5 Marketing

The total revenue from soybean sales was P82,122.62 or P2,649.10 per farm (Table 38). Prices varied, as seen in Table 39, for the retail price of the soybean; the most prevalent price for soybean was P9.50 and P10.00 per kg. The lowest price received was P6.00 per kg, which was offered by the NFA. Prices ranging from P10.00 to P15.00 per/kg were offered by private markets and dealers to whom the farmers found it favourable to sell; 79 percent of the soybean farmers reported selling their produce to outlets other than PCARRD-CLSU and NFA (see Table 40).

Table 36 Production and disposition of soybean

ITEM	TOTAL	PER HECTARE	PER FARM
		kilograms	
Quantity sold	8,715.3	494.9	281.1
Home use	514.9	29.2	16.6
Given away	15.0	0.8	0.5
Payment to creditor	84.0	4.8	2.7
TOTAL	9,329.2	529.8	300.9

Table 37 Soybean yields in Lupao

RESPONDENT No.	FARM SIZE (ha)	YIELD (tons)	
		Per Hectare	Per farm
1	0.53	1.80	0.90
2	0.62	1.40	0.90
3	0.50	1.40	0.70
4	0.18	1.20	0.20
5	0.40	1.10	0.40
6	0.25	1.10	0.80
7	1.00	1.00	1.00
8	1.88	0.80	1.50
9	0.25	0.61	0.10
10	0.25	0.60	0.10
11	0.50	0.50	0.20
12	1.00	0.50	0.50
13	0.25	0.50	0.10
14	0.25	0.50	0.10
15	0.25	0.50	0.10
16	0.25	0.44	0.10
17	0.50	0.44	0.20
18	0.50	0.40	0.20

(continued....)

Table 37 (continued)

RESPONDENT No.	FARM SIZE (ha)	YIELD (tons)	
		Per Hectare	Per farm
19	0.25	0.40	0.20
20	1.00	0.40	0.40
21	0.20	0.30	0.10
22	0.25	0.27	0.10
23	0.25	0.20	0.10
24	1.00	0.20	0.02
25	0.30	0.20	0.04
26	1.00	0.20	0.02
27	1.00	0.10	0.10
28	0.50	0.10	0.05
29	1.00	0.07	0.10
30	1.20	0.05	0.10
31	0.50	0.00	0.00
AVERAGE	0.57	0.55	0.30

Table 38 Volume and value of soybean sales in Lupao

ITEM	TOTAL	PER HECTARE	PER FARM
Quantity sold (kg)	8,715.30	494.9	281.10
Average price (P/kg)[a]	9.42	-	-
Total value (P)	82,122.62	4,663.40	2,649.10

[a] Price computed from total revenue

Table 39 Selling prices for soybean in Lupao

PRICE OF SOYBEAN (P/kg)	NUMBER OF FARMS
6.00	1
8.50	2
8.75	1
8.00 - 9.00	1
9.00	3
9.50	14
10.00	4
12.00	2
14.00	1
15.00	2
TOTAL	31

Table 40 Soybean markets in Lupao

MARKET	NUMBER REPORTING	PERCENT
Private markets, dealers	22	79
PCARRD-CLSU	5	18
Both PCARRD-CLSU and NFA	1	3

3.6 Credit and farm financing

As mentioned earlier, there were two sources of loans, namely the PCARRD-CLSU and the NFA. As seen in Table 41, the highest proportion of the soybean farmers acquired their material input loans from PCARRD-CLSU (64%), while only eight farmers (26%) acquired their loans from NFA. Three farmers, however, obtained loans from both funding agencies.

3.6.1 Sufficiency of loans

A majority of the farmers who borrowed from PCARRD-CLSU and NFA reported that the amount they borrowed for soybean production was sufficient (Table 42). Among these farmers, 10 farmers, or 53 percent, borrowed from PCARRD-CLSU. On the other hand, 16 percent of all farmers reporting said that credit was insufficient; three of these were funded by the NFA. The other co-operators (12%) did not give any answer.

From both financing sources, the actual amount of loans averaged P2,000 per hectare for each farmer. This is equivalent to about P1,136 per farm.

3.6.2 Willingness to borrow again

There are more farmers who are willing to borrow again (29%) than those who are not willing (16%) (Table 43). A high number of these farmers who are still willing to borrow again are from PCARRD-CLSU or joint PCAARD-CLSU/NFA funding. However, a majority of the respondents (55%) gave no answer.

Table 41 Source of loans for the sample farms

SOURCE	NUMBER OF FARMS	PERCENT
PCARRD-CLSU	20	65
NFA	8	26
Both PCARRD-CLSU and NFA	3	10

Table 42 Credit sufficiency in Lupao

CREDIT SUFFICIENCY	SOURCE OF LOANS			ALL SOURCES	PERCENT
	PCARRD-CLSU	NFA	BOTH PCARRD CLSU AND NFA		
	Numbering_reporting				
Sufficient	10	3	1	14	45
Not sufficient	1	3	1	5	16
No response	9	1	2	12	39
TOTAL	20	7	4	31	100.00

Table 43 Number of farmers willing to borrow again

WILLINGNESS	SOURCE OF LOANS			ALL SOURCES	PERCENT
	PCARRD-CLSU	NFA	BOTH PCARRD CLSU AND NFA		
	Number reporting				
Willing	4	3	2	9	29
Not willing	3	2	-	5	16
No response	13	3	1	17	55
TOTAL	20	8	3	31	100.00

4. Economic Evaluation of The POT Trials

Cost and Return Analysis

To evaluate the economic advantage of the package of technology, cost and return analysis was done for all the respondents (co-operators under PCARRD-CLSU and NFA). This section deals with the profitability of soybean production. Profit or loss was computed by deducting the total expense from the total income, as shown in Tables 44 and 45.

4.1. Income. The income of the co-operators from the sale of soybean is shown in Table 44. The total cash income amounted to P4,663.40 per hectare or P2,649.12 per farm. Non-cash income included soybean for home use, given away, or paid to creditors. Total income amounted to P4,994.58 per hectare, or P2,649.12 per farm.

4.2 Expenses. In this study, expenses were classified as cash or non-cash. Cash expenses included seed, fertilizer, insecticide and inoculant (loaned from the agencies), hired labour, hired animals and machines (threshers), pump rental, fuel and oil for irrigation, food, and other expenses. On the average, the total cash expense for each farm was P2,775.22 per hectare, or P1,576.69 per farm. Pumps for irrigation were either owned or rented. Rental fees ranged from P6.00 to P19.00 per hour depending on the agreement. However, the farmers provided their own fuel and oil for operation. Of these cash costs, the amount loaned for material inputs was P1,950.87 per hectare or P1,108.22 per farm (excluding loan interest), almost P825 per hectare.

On the other hand, non-cash expenses included unpaid family labour, depreciation, opportunity cost of the equipment used in the farm, payment to creditors, interest on loans, and other items paid in kind. The interest rate on capital for opportunity costs was 20 per cent per year or 5 percent for four months (one soybean cropping period). Operator and family labour were valued at P40/MAD, and P15 to P29/MD for different labour operations, which are the actual wage rates in the study area. The depreciation cost, P536.19 per hectare, was computed using the straight line method. Total non-cash expenses were, on the average, P2,645.90 per hectare or P1,466.63 per farm. Total expenses (cash and non-cash) amounted to P5,421 per hectare, or P3,04312 per farm (Table 44).

Among the items listed under expenses, operator and family labour contributed to the high cost of production of soybeans (20.2% of the total cost).

Table 44 Production costs and returns

ITEM	TOTAL	PER HECTARE	PER FARM	PERCENT
Yield (kg)	9,329.20	529.80	-	-
Farm size (ha)	17.61	-	-	-
RECEIPTS_(Pesos)				
Cash receipts				
Sales from soybean	82,122.62	4,663.40	2,649.12	93.37
Non-cash receipts				
Home use	4,891.55	277.40	157.79	5.56
Given away	142.50	8.09	4.60	0.16
Paid to creditor	798.00	45.32	25.74	0.91
TOTAL RECEIPTS	87,954.67	4,994.58	188.13	100.00
COSTS_(Pesos)				
Cash Costs				
Loan from POT:				
Seed	10,080.00	572.40	325.16	10.56
Fertilizer	14,358.75	815.37	463.18	15.04
Chemicals (Insecticides)	9,836.30	558.56	317.30	10.30
Inoculant	80.00	4.54	2.58	0.08
Hired labour	5,615.00	318.85	181.13	5.88
Hired animals	645.00	36.63	20.18	0.68
Hired machines	837.90	47.58	27.03	0.88
Pump rental	1,232.75	70.00	39.77	1.29
Fuel and oil (irrigation)	5,603.50	318.20	180.76	5.87
Food and other expenses	588.00	33.39	18.97	0.62
Total Cash Cost	48,877.20	2,775.32	1,576.69	51.20
Non-cash_costs				
Unpaid operator's labour	15,258.90	852.65	492.22	15.73
Family labour	2,887.65	242.25	93.15	4.47
Depreciation	9,442.31	536.19	304.59	9.89
Opportunity cost of capital[a]	15,804.54	597.48	509.82	16.55
Interest on loan[b]	1,238.12	70.31	39.94	1.29
Paid to creditor	798.00	45.32	25.74	0.84
Others paid in kind	30.00	1.70	0.97	0.03
Total Non-Cash Cost	45,459.42	2,645.90	1,466.43	48.80
TOTAL COST	94,336.62	5,421.42	3,043.12	100.00
Cost per kg.	10.11	-	-	-
RETURNS ABOVE CASH COST	33,245.42	1,887.88	1,072.43	-
NET RETURNS LOSS	(6,381.95)	(426.84)	(205.82)	

[a]Interest of 20% per year or 5% for the cropping period.

[b]Loan interest at 5% for the cropping period (four months).

Table 45 Cost and returns per hectare

LABOUR COSTS[b]	MAN-DAYS	MAN-ANIMAL DAYS	P/HA	P/ FARM
Clearing	8.20	-	158.00	89.75
Plowing (2-3x), animal	-	6.2	248.00	140.88
Harrowing (2-3x), animal	-	5.2	208.00	118.16
Mulching	0.20	-	4.00	2.27
Furrowing, animal	-	5.3	79.50	45.16
Inoculating	0.40	-	6.00	3.40
Planting	5.80	-	85.50	48.57
Off-barring	2.60	-	46.00	26.13
Hilling-up	2.50	-	50.00	28.40
Fertilizing	2.40	-	36.00	20.45
Weeding	1.60	-	24.00	13.63
Spraying	5.60	-	84.00	47.72
Irrigating	4.50	-	67.50	38.34
Harvesting	8.60	-	126.00	71.58
Threshing				
Manual	2.50	-	37.50	21.30
Animal-drawn	-	4.1	82.00	46.58
Drying	1.90	-	28.50	16.19
Storing	3.80	-	57.00	32.38
Grading	0.13	-	0.60	0.34
Packaging	0.51	-	7.65	4.34
Hauling	0.82	-	12.30	6.99
Subtotal	52.06	20.8	1,448.05	822.58
Seeds, 40 kg/ha, P10/kg	-	-	572.40	325.16
Fertilizer[c]				
14-14-14, 63 bags	-	-	710.17	403.42
Urea, 4 bags	-	-	105.21	59.77
Chemicals (insecticide)	-	-	558.56	317.30
Inoculant, 17 packs, P5/pack	-	-	4.54	2.58
Subtotal			1,950.87	1,108.22
TOTAL VARIABLE COST			3,398.92	1,930.80
Gross returns at 0.5 ton/ha (cash income)			4,663.40	2,649.11
NET RETURNS			1,264.48	718.31

[a]Excludes all fixed costs such as depreciation, opportunity cost of capital and land rent, and farmer's own and family labour.

[b]Wage rate: P20/MD for clearing the field, off-barring, hilling-up, and threshing (animal), P40/MAD for plowing and furrowing, P15/MD for other labour operations

[c]14-14-14 and Urea are priced at P253.00/bag and P275.00/bag, respectively.

The impact of soybean production in Lupao could be reckoned by its profitability. This study revealed that the returns on top of cash cost was P1.887.88 per hectare, or P1,072.43 per farm. When non-cash expenses were considered, the net income per hectare was negative.

Of the total farm expenses, 48.8 percent were non-cash. The bulk of the non-cash items were charged for operator and family labour and opportunity cost of capital, giving rise to negative returns. This means that soybean production is quite labour intensive. However, for family labour which might otherwise be unemployed, the negative figure does not mean that soybean production is a losing proposition, since the cash costs were more than adequately covered by the cash income. Moreover, total variable costs (which include the farmers' labour and his expenses on material inputs) were also covered by the cash income (Table 45).

A cost and returns analysis for other crops produced during the same cropping season was not included in the analysis; instead, the data that were gathered included gross returns and expenses figures only.

In its second phase, the study will present a wider scope of analysis on this aspect of the study -- a study which will be conducted in provinces of the Philippines where a larger population engages in soybean farming and marketing.

5. Constraints To Soybean Production

This part of the report deals with the analysis of constraints to adoption of soybean and to higher yield. The analysis is based on data gathered from the farmer co-operators of the PCARRD-CLSU and NFA programme. Physical constraints as well as socio-economic factors were identified.

To identify the physical factors influencing soybean yields, a multiple regression analysis was run using the production and input data of the recommended package of technology.

On the average, the yields of the farmer respondents were lower than that of the yields obtained in the nearest experimental station. On the average, yields were only 0.6 tons per hectare as compared with experimental yields of 2.8 t/ha of the same variety, a yield gap of 2.4 tons per hectares.

The findings of a study on constraints to higher corn yields showed increased yields were realized when all recommended inputs were used simultaneously. However, yield increases attributed to these recommended inputs varied between areas, and were highly influenced by soil and climate.

5.1 Production function estimates

In general, farmers, including soybean farmers, are faced with problems of low productivity and rising costs of production. This would either prevent them from adopting soybean, to drop out from the production programme, or to shift to other crops.

Hence, it is important to identify the limiting factors or constraints to higher yield of soybean at the farm level, and to determine possible solutions to these constraints, and consequently improve the quality of life of the farmer; this would justify the government's continuous support to the national soybean production programme.

Production function analysis identified the different inputs that significantly influence yield. The inclusion of some socio-economic variables in the production function further clarified the constraints to higher soybean yield. The standardized regression function showed the relative contribution of the quantity of inputs and the socio-economic factors. Input coefficients obtained from production function analysis also provided insight into the optimum level of input.

While cost and returns analysis measures the success and failure of a farm business, an estimation of the production function identifies inputs that influence product yield and shows the efficiency of the inputs. As a tool for analysis, this would give answers to questions such as which constraints inhibit productivity and profitability of an agricultural production system.

To measure constraints to increased yield, two regression equations were used:

$Y_1 = f (X_1, X_2, ..., X_n, Z_1, Z_2, Z_3, ..., Z_n, U)$, and

$Y_2 = f (X_1, X_2, ..., X_n, Z_1, Z_2, Z_3, ..., Z_n, U$

where:

Y_1 = gross value of yield of soybean in pesos per farm

Y_2 = total production of soybean in kg. per farm

X's = physical factors where:

X_1 = farm size in hectares

X_2 = total labour in man-days per farm

X_3 = operating capital in pesos per farm

X_4 = irrigation (dummy variable 1 with pump and 0 without pump)

X_5 = fertilizer expenditures in pesos per farm

X_6 = chemicals in pesos per farm, and

Z's = socio-economic variable, where:

Z_1 = age of farmer

Z_2 = experience in farming

X_3 = educational level, and

X_4 = evaluation of extension services.

The Cobb-Douglas production function was used in the following form:

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + ... + b_6 \ln X_6 +$$

$$+ b_7 \ln Z_1 ..... + b_{10} \ln Z_4$$

The production function for gross value of production was estimated using individual farm data (Table 46). In the first and second regression equation, the estimate contained 3 quantitative variables and one dummy variable, only one of which was significant. The third and fourth regression equation contain 4 and 5 quantitative variables respectively and one dummy variable, 2 of which were significant.

The R2 in the first, second, third and fourth production functions were 0.400 and 0.410 and 0.48 and 0.48 respectively. This means that 40 percent, 41 percent, 48 percent and 48 percent of the variation in the per farm output respectively were explained by the variables included.

The operating capital was the only significant factor affecting soybean yield. The bulk of operating capital was the value of insec ticide and fertilizer. In the second and third regression equation, the dummy variable on pump irrigation was significant. The value of insecticide was also significant in the third production function. This is to be expected because the amounts of supplementary pump irri gation and insecticide used are very critical as inputs in soybean production. When the farmers were asked why they got very low yields on their farm, the majority of them responded that it was due to lack of water during a critical growing stage and the occurrence of pests and disease. This means that if all the other inputs in soybean pro duction remain at the same level, a ten percent increase in insecticide used would increase gross value of output by 10.85 percent and 9.95 percent (equations III and IV) respectively.

The presence of one irrigation pump either owned or rented will surely increase the gross value of production of soybean by 9.16 percent and 9.21 percent (equations II and IV) respectively.

Another production function for soybeans was estimated using per farm data. This time, the total production per farm was considered as the dependent variable, and the same independent variables as in the

previous regression equation were used. Only two independent variables were found to significantly influence the total production per farm: irrigation and the value of insecticide per farm.

Table 46 Regression coefficients of soybean production using gross value of output per farm as dependent variables.

VARIABLES	REGRESSION COEFFICIENTS			
	I	II	III	IV
Constants (a)	-0.2195	1.8612	2.5118	2.3674
X_1 farm size	0.0530	0.1758	0.3074	0.2767
	(0.3199)	(0.2965)	(0.3408)	(0.2643)
X_2 total labor	-0.0618	-0.0244	-0.0135	-0.0149
	(0.0318)	(0.0274)	(0.0422)	(0.0255)
X_3 operating capital	1.1278	-	0.0241	-
	-	-	(0.8300)	-
X_4 irrigation	0.0451	0.0916	0.0894	0.0921
(dummy)	(0.0640)	(0.0642)	(0.0701)	(0.0002)
X_5 fertilizer and	-	0.9257	-	-
insecticide	-	(0.3015)	-	-
X_6 insecticide	-	-	1.0854	0.9948
	-	-	(0.5948)	(0.2688)
X_7 fertilizer	-	-	-0.1362	-
			(0.3928)	-
Coefficient of Determination R^2	0.4003	0.4106	0.4792	0.4792
Std. Error of Y	0.8580	0.8506	0.8342	0.7936
n	28	28	28	28

Table 47 Regression coefficients of soybean production using total production per farm as dependent variable.

VARIABLES	REGRESSION COEFFICIENT
Constants (a)	6.5207
X_1 Farm size	0.3242
	(0.3259)
X_2 Total labour	-0.4204
	(0.4433)
X_3 Operating capital	-0.3226
	(0.6687)
X_4 Irrigation	0.1439
	(0.0788)
X_5 Fertilizer	0.2381
	(0.5812)
X_6 Insecticide	0.9727
	(0.5188)
X_7 Age	-0.5867
	(0.9015)
X_8 Years in School	-0.0316
	(0.0659)
X_9 Years in farming	-0.0911
	(0.849)
X_{10} Extension services	0.0107
	(0.0519)
Coefficient of determination R^2	62.64%

Table 48 Marginal physical product and marginal value product, (28 soybean farms).

	REGRESSION			
	I	II	III	IV
	Marginal_Physical_Product			
Farm size	0.5376	1.7832	3.1181	2.8067
Operating capital	1.1737	-	0.8638	-
Insecticide	-	-	1.4643	-
Fertilizer	-	-	0.1718	-
	Marginal_Value_Product			
Farm size	5.0415	16.7225	29.2409	26.3207
Operating capital	11.0067	-	8.1005	-
Insecticide	-	-	13.7319	-
Fertilizer	-	-	1.6111	-

Computed Price of Soybean = P9.3778

Table 49 Soybean prices in the Philippines, 1976-83 (P/kg)

Year	Wholesale	Retail
1976	2.67	4.63
1977	2.93	4.99
1978	3.24	5.57
1979	3.05	5.99
1980	3.74	5.98
1981	4.90	6.19
1982	4.45	6.17
1983	4.83	6.86

Source: Bureau of Agricultural Economics, Philippines

The R^2 (in Table 47) is 63 percent, meaning that 63 percent of the variation in the per farm production was explained by the variables included.

The marginal physical product and marginal value product were also derived from the four regression equations (Table 48).

The values of the marginal value product were computed by multi plying the marginal physical product values with the computed price (P9.3778) of each equation. A unit increase in the use of the inputs will bring about a corresponding increase in the value of production. From Equation III, a unit increase in capital will bring about P8.00 increase in the product value, the bulk of which is contributed by additional operating capital for insecticide. An additional increase in the use of insecticide will bring about an increase in the value product equal to P13.73.

The computed price of soybean was P9.38 per kg. This was much higher than the prevailing retail price of soybean in the country (Table 49), since the soybean produced in Lupao were sold for seed purposes only.

5.2 Yield constraints -- according to the farmers

This section discusses the factors which, according to the farmers, contributed to their low yield performance in soybean production; the suggestions they offered are discussed. In Table 50, these factors are classified as physical and agro-climatic, negligent farm management, or negligent funding agency support.

The highest contributing factors to low soybean yield were infes tation by pests and disease and lack of rain or water for irrigation (as reported by 19% of the respondents for each factor). The soybean crop during the first three weeks of its growth until the flowering stage is highly susceptible to pod borers. This might be brought about by too much rain, according to one farmer. The farmers also suggested that soybean be given proper amounts of water and be planted as early as November or December so that they could use the water from their pumps.

Some other factors could be classified as farmer negligence in management of their farms: lack of proper spraying, crop management, and knowledge of common problems because of not attending the seminars.

Some other factors constraining high soybean yield were the negligence of the funding agencies to efficiencly render their services to the farmers (26%). According to three farmers, due to delayed planting (as scheduled by the programme), the crops were not able to grow in the most suitable season (November to December), when rainfall is minimal and flowers are more likely to bloom. Moreover, the delay in the delivery of chemical supplies also hindered the farmers spraying on time, when pest and disease infestation was most prevalent.

Table 50 Factors constraining soybean yield and solutions suggested by the farmers

FACTOR	SUGGESTED SOLUTION	SOURCE OF LOAN			TOTAL NUMBER REPORTING	PERCENT
		PCARRD CLSU	NFA	PCARRD-NFA		
		Number_Reporting				
A. Physical_and_agro-climatic						
1. Too much rain causing pod borer infestation; infestation of pests and disease	1. Proper irrigation; planting during the wet season. (November)	2	4	-	6	19
2. Lack of water for irrigation/ lack of rain	2. Assistance/support from the government (particularly the National Irrigation Authority)	6	1	-	7	23
3. Too much wind which destroyed the flowers	3. Early planting (November to December)	-	1	-	1	3
Sub-total		8	6	0	14	
B. Farmer_negligence						
1. Lack of proper spraying	1. Proper farming techniques	1	-	-	1	3
2. Poor crop management/ delayed spraying	2. Irrigation within 7-10 days especially when pods are growing.	2	-	1	3	10
3. Lack of experience because farmer wasn't able to attend seminar.	3. Attend seminars because soybeans need a lot of pest control and irrigation	1	-	-	1	3
4. Did not follow the POT	4. (No suggested solution)	1	-	-	1	3
Sub-total		5	0	1	6	
C. Funding_agencies_negligence						
1. Planting was out of season	1. (No suggested solution)	1	-	-	1	3
2. Late planting	2. Planting from November to December (at the same time inputs and irrigation are provided).	3	1	-	4	13
3. Delayed delivery of insecticide	3. Funding agency must insure chemicals delivered on time.	1	1	-	2	6
4. Inadeqate supply of insecticide	4. Sufficient amount of chemicals	1	-	-	1	3
5. Lack of proper management from the agency	5. (No suggested solution)					
Sub-total		6	2	0	8	
No response		1	-	2	3	10
TOTAL		20	8	3	31	

6. Conclusions, Recommendations

This study attempts to assess the contribution of physical and socio-economic factors affecting soybean yield and to evaluate the economic performance of the farms that participated in the national soybean pilot production programme in Lupao, Nueva Ecija.

Preliminary findings of this study implied an interrelatedness of factors that constrained soybean yield. The physical factors were soybean variety, fertilizer, irrigation, insects and weeds, and cultural practices; the socio-economic factors were the availability of credit, distance from input service, farm size, and education.

As discussed earlier, among the physical variables, insecticide (chemical) and the presence of pump irrigation were found to be signi ficant factors explaining variation in soybean yield. Farm size was found to be insignificant. The extent of extension services, utiliza tion of research information, and market and other support services were independent of farm size.

Credit availability was recognized as a positive factor in a farmer's decision to adopt the package of technology for soybean, and this was the concept behind the financing program extended to farmers. However, loans in the form of material input should be delivered in time for use by the farmers, and repayment schemes should be carefully constructed.

Establishment of demonstration farms should be carried out to continuously re-evaluate the agronomic performance of the varieties grown in areas identified as suitable for soybeans.

Adverse climatic conditions, particularly drought and the occurrence of pests and disease, are common the causes of low yield. To avoid crop failures, complete knowledge of pests, disease control management, and proper times for planting may prove to be helpful.

In general, the available package of technology for soybean did not perform well during the cropping calender considered in this study. It is in this direction that scientists and researchers should continue to search for innovation, particularly for varieties whose performance is acceptable and adaptable to the farm environment. Proper dissemina tion of relevant findings is essential.

Technical assistance, supported by governmental policy, should be strengthened to increase communication between applied research extension workers and the farmers. Extension workers must also improve their rapport with farmers in order to gain their confidence and pave the way for the adoption of yield-increasing inputs. More frequent visits and closer supervision would stimulate discussion, and facilitate solving problems associated with the introduction of new technology.

Socio-economic evaluation of the package of technology introduced should always be one component in any given programme for increased production, because demonstration of both increased productivity and profitability of any production system will surely convince most of our

farmers to adopt a new technology. This would include the determination of cost-reducing cultural practices and other cost-saving strategies.

The impact as well as efficiency in the allocation of farm resources, including pump irrigation, the adoption of seed and fertilizer technology, cropping intensity, crop income (net revenue) and the level of input used need to be assessed in greater depth.

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