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Local Soybean Economies and Government Policies in Thailand and Indonesia

Pattana Jierwiriyapant
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J.W. Taco Bottema

The CGPRT Centre

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Foreword

The present collection of studies brought together in this volume is rather unique. The Centre has engaged for some time in identifying competitive advantage and comparative advantage among CGPRT Crops. Usually such studies have been done at national and aggregate level. In the present studies, implemented by Dr. Pattana A. Jierwiriyapant from Chiang Mai University of Thailand, Dr. Hermanto, Mr. Armen Zulham, and Ms. Suhartini from the Centre for Agro-Socioeconomic Research (CASER) in Bogor, Indonesia, attention is given to local developments affecting soybean production including an assessment of impact of government policies.

In addition, the work of Dr. Roche and Dr. Hutabarat, and their team provides a valuable contribution by presenting an analysis of agriculture census data stratified by agro-ecological zones in Java.

We are very grateful for the dedication with which the researchers have tackled the studies and we are confident that with these empirical studies the discussion regarding the impact of government policies can be focused more sharply.

We would like to express our gratitude for the support of the Commission of European Communities which made these studies and a workshop possible.

The work also constitutes an example of efficient collaboration between the CASER and the CGPRT Centre.

Effendi Pasandaran
Director
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Seiji Shindo
Director
CGPRT Centre

Summary and Introduction

In recent years a spontaneous process of agricultural diversification has taken place in Asia. In some countries, such as Indonesia and Thailand, limited price and trade intervention has been applied in the food crop sub-sector.

International trade is becoming increasingly important in national agricultural policy, and international food grain markets are becoming more global in nature.

This implies that national policy, as well as the agro-economic condition of certain commodities in interaction, determines the degree of direct competition between local producers and the world commodity markets.

A recent approach which establishes a conceptual and empirical framework, and enables comparison of government policy impact differentials, is the policy analysis matrix (PAM) as developed by Pearson and Monke. PAM has found substantial recognition because it employs rigorous categories in its application. It has not always been recognized that rigorous empirical work is essential in using this approach.

In order to address more sharply the major policy questions related to food crop agriculture, several studies were commissioned by the CGPRT Centre which is presented in this volume.

These studies focus on local soybean economies. Production and price data are collected at farm and village level while competing crops are also identified at local level. The studies were executed in Thailand in the Chiang Mai valley, which is a major soybean producing province. In Chiang Mai research was implemented in the Sanpathong area. In Indonesia villages were selected in two different agricultural zones: a relatively well-developed area with irrigation, on alluvial fertile soil (Jember) and in a relatively marginal area without irrigation, and hilly, limestone based soil (Blitar).

Interesting findings resulted. Soybean production in the Jember district of East Java is more profitable than soybean production in Chiang Mai village. This unexpected phenomenon is brought about by the relatively high mobility of the rural labor market. In Chiang Mai rapidly rising demand for unskilled labor in the urban construction industry has led to increasing rural wages. In the marginal area of Blitar, East Java, farmers apply substantially more fertilizer than in the Jember area. This finding is inconsistent with the common view that farmers in marginal areas minimize risks through minimizing farm expenditures. The large difference in fertilizer use between Jember and Blitar may party be attributed to the exceptionally low fertilizer use in Jember, which is apparently possible because soybean is usually grown after irrigated rice, which is given heavy doses of fertilizer. The popularity of soybean as a first crop in Jember is increasing, as is contract farming. In Jember, from a benefit cost point of view soybean is in direct competition with rice, which can be considered as an important finding which needs to be explored further. Both in Jember and Blitar soybean cultivation experienced significant growth over the last 10 years.

In Chiang Mai valley, as in the case of Jember, irrigation is well developed and soybean cultivation expanded consistently from 1980 onwards. It is now usually grown as a secondary crop after rice. However, while in Jember soybean competes with rice and in Blitar with maize, in Chiang Mai the formation of the rural economy is reflected by the new competitors for soybean: horticultural crops such as onion and garlic. In Chiang Mai by the late 1980s the mobility of the rural labor market surged, induced by the demand in construction which followed an increase in prices of soybean produce in the mid 1980s. The constrained rural labor market resulted in higher labor costs. Partly as a consequence, both at provincial and national level some price intervention has taken place on joint request of farmers and local officials.

In East Java which is characterized by very high population density in the fertile areas such a process in the rural labor market is not yet visible. However, in the marginal area of Blitar the labor market is also constrained because of the significance of seasonal labor migration. Labor needs for soybean in Blitar were met by the household as in Chiang Mai valley. In Jember in contrast almost 90% of labor was hired.

The findings of Jierwiriyapant and Hermanto underline that government policies, both in Thailand and Indonesia, have different impacts on rural households, which depend on the size and proportion of resources allocated to specific commodities. The fact that both in Chiang Mai valley as well as in East Java shifts in crop orientation and crop proportions have come about over the last 10 years in a continuing process, clearly shows that government policy has not had an immobilizing effect on the allocation of farm resources. This finding is not only of empirical importance in the unfortunately often rhetorical discussions regarding trade policy and agricultural protection, it also points clearly to the fact that one cannot analyze agricultural development in terms of a technology path of a given commodity only. Through time the switch from one crop to another may in fact constitute a major determinant of development.

In this volume the trail-blazing work of Roche et.al. is presented. The work is of special significance and interest because it points at a time and cost efficient way of analyzing available data sets in Indonesia. These capture a large variety of agroecological and climatological zones, in addition to seasonal variation. Input and output data as generated by Roche facilitate stratified analysis of secondary crop agriculture in Indonesia. The multitude of analysis these data facilitate and their use as a national monitoring system of agricultural performance in food crop over time, are major advances.

In this volume no specific attempts are made to expand concepts and classifications in the PAM. PAM is conducted in conjunction with a clear view of agricultural development through time. The important element in the PAM is the inclusion of farm technology.

There could also be debate regarding the question of whether social prices need to include or reflect processes of environmental change in those situations where crop expansion policy, with factor and product market price intervention, have led to a process of agro-economical degradation. In our view these issues, which are of great importance, do not really belong to the PAM approach per-se. The role of PAM is merely to structure and simplify policy analysis along empirical lines. The observation that shifts in crop orientation are connected with long-term issues of agro-economical and ecological importance requires an essentially different multi-disciplinary longitudinal approach.

J.W. Taco Bottema

Part I

Soybean and Competing Crops in Chiang Mai Province, Thailand: An Application of The Policy Analysis Matrix

Pattana Jierwriyapant, and
Prayogo U. Hadi

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Abstract

This study constitutes one of the exercises using primary data from a farm survey to construct a policy analysis matrix. The policy analysis matrix (PAM) approach developed by Pearson and Monke (1987) was used to analyze comparative advantage of soybean and competing crops in Chiang Mai province. The result of this study indicates that soybean production in Chiang Mai province is socially profitable, but privately unprofitable. The negative private profit indicates that the return for labor for soybean farmers is less than market wage rates. Onion and garlic production are both socially and privately profitable. The domestic resource cost ratio (D.R.C.) coefficients indicate that the production systems of garlic and onion in Chiang Mai province are efficient. However, the production of soybean seed is efficient only under an export regime which presupposes high quality seed.

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1

Introduction

Purpose and Approach

Crop production in Thailand has expanded steadily during the past two decades. The major source of growth comes from the expansion of cultivated areas. Total land area for agricultural crops had increased from 33 percent of total land in 1977 to 37 percent in 1984. Part of this expansion is at the cost of the forest area which declined from 34 percent in 1977 to 29 percent of total land in 1984 (Royal Forest Department). Another source of growth comes from the increased production of secondary crops in the dry season in irrigated areas. From 1980 through 1989 the irrigated area in Thailand has increased by 70 percent (Department of Royal Irrigation). However, water shortage is still a major problem for dry season crops.

In the past decade, there has been significant change in agricultural patterns due to the rapid growth of the economy. There are three major factors that affect the cost of production of agricultural products. The first is the increasing labor movement .from the agricultural sector into the industrial sector due to higher wage rates. The second is the rising price of agricultural land in rural areas due to the increasing demand on land for real estate and other industrial sectors. The third is an insufficient supply of water for agricultural areas in the dry season.

Given that resources such as land, labor, water and capital have become more costly and scarce, a study of comparative advantage for crops that compete for these resources has to take into account factor shifts. Since the application of improved technology can have a substantial impact on comparative advantage, research should be aimed at those systems or crops where further efficiency and improvements are possible.

There are some earlier studies measuring the impacts of policy interventions on efficiency and comparative advantage using the policy analysis matrix (PAM) Altemeier and Gijsbers, 1988 and Thailand Development Research Institute, 1989). These earlier studies merely looked at comparative advantage of one crop in different production areas across the country. However, it is also important to look at comparative advantage of crops competing for the same resources within a given area. In this study the PAM approach is used to determine whether it yields useful results in analyzing policy effects of competing crops within a given area.

Despite the increase in production of soybean in the past decades, Thailand is still a net importer of soybean meal. This is because of the fast growing demand for soybean meal in the animal feed industry. Therefore, soybean in Thailand has been selected as one of the commodities to be covered in the study. The comparative advantage analysis of soybean and competing crops in Thailand is useful to study the possible implications and effects in the diversification process of agriculture. Chiang May Province, being an important soybean production area, was selected for the study.

In addition, the knowledge of factors which determine the production of soybean is important to obtain policy measures so as to direct soybean production quantity. By improving the use and/or the price of inputs and the price of output through government intervention, soybean production and farmers' income could be improved. Therefore, the present study also attempts to identify factors affecting soybean production in Chiang Mai province

This introduction is followed by five chapters. Chapter 2 provides a review of production, demand, utilization and government policies of soybean in Thailand/Chiang Mai. In chapter 3, cropping systems and cultivation practices for soybean, garlic and onion in Chiang Mai province are presented and discussed. Chapter 4 presents the concepts and methodology of comparative advantage and the application of policy analysis matrix (PAM) in Chiang Mai province. Empirical analysis of the policy analysis matrices is presented in chapter 5, followed by the conclusions of the study.

2

Soybean: Production, Utilization and Policies

Soybean Production in Thailand/Chiang Mai Province.

In Thailand, soybean is grown in a variety of locations, cropping patterns, land types, and seasons. The total area for soybean cultivation in Thailand has increased from 0.36 million rai* in 1971/72 to approximately 2.67 million rais in 1989/90 (Table 1). This area accounted for 9 percent of the total area planted to secondary crops. Table 1 also shows that total production of soybean in Thailand increased from 54,000 tons or 151 kg/rai, to 213 kg/rai or 568,000 tons, from 1971/72 to 1989/90. The major production area for soybean in Asia is China, which produces approximately 70 percent of the total production in Asia (Table 2), followed by India and Indonesia (Table 2). Soybean is imported from the US and Brazil.

Table 1. Planted Area, Production, Average Yield and Farm Price of Soybean in Thailand, 1971/72 - 1990/91.

Year	Planted Area (1,000 rais)	Production (1,000 tons)	Average Yield (kg/rai)	Farm Price (Baht/kg)	Production Cost' (Baht/rai)
1971/72	359	54	151	2.52	N/A
1972/73	525	72	138	2.51	N/A
1973/74	766	104	136	3.41	N/A
1974/75	823	110	134	3.99	N/A
1975/76	736	114	154	4.16	N/A
1976/77	635	114	179	4.70	N/A
1977/78	958	96	118	5.61	N/A
1978/79	1,010	159	175	5.39	N/A
1979/80	679	102	163	5.26	N/A
1980/81	788	100	152	5.78	N/A
1981/82	797	132	168	6.81	N/A
1982/83	778	113	180	5.12	N/A
1983/84	1,008	179	184	6.07	N/A
1984/85	1,253	246	204	6.00	965
1985/86	1,524	309	206	6.09	933
1986/87	1,799	356	202	6.15	1,077
1987/88	2,260	338	178	8.01	981
1988/89	2,508	517	206	8.46	1,067
1989/90	2,669	568	213	7.33	1,105
1990/91**	3,054	578	189	N/A	N/A

Source: Office of Agricultural Economics, Thailand
*Production costs of Soybean in Northern Thailand
**Projected
Rai = 0.16 ha
US$ = 25 Bht 1990

* 1 rai = 0.395 acre or 0.16 hectare.

Table 2. Soybean Production From Various Countries in Asia and Asia Total, 1981-88.

Year	China	India	Indonesia	Thailand (1,000 tons)	Vietnam	Asia Total
1981	9,341	467	687	132	56	11,631
1982	9,042	491	521	113	100	11,292
1983	9,769	614	568	179	107	12,283
1984	9,705	934	743	246	110	12,792
1985	10,519	1,100	825	309	120	14,046
1986	11,629	891	1,227	356	94	15,446
1987	12,198	980	1,161	338	90	16,094
1988	10,918	1,350	1,260	517	100	15,465

Soybean Production in Three Major Countries and World Total, 1981-88

Year	U.S.A.	Brazil (1,000 tons)	Argentina	World Total
1981	54,436	15,007	3,770	88,478
1982	59,611	12,838	4,150	92,277
1983	44,519	14,582	4,000	79,450
1984	50,645	15,541	7,000	90,242
1985	57,114	18,278	6,500	101,135
1986	52,802	13,330	7,100	94,354
1987	52,330	16,979	7,000	100,167
1988	41,876	18,055	9,830	92,359

Source: F.A.0. Production Yearbook

The dominant production area for soybean in Thailand is located in the Northern region which produces 74 percent of total production (see map in Figure A-1). There are two major production systems of soybean in Thailand; the wet season soybean which accounts for 70 percent of national production and the dry season soybean which accounts for 30 percent of national production. The dry season soybean is grown mostly in Chiang Mai province which comprises 15 percent of the total soybean production areas. The major area for wet season soybean is in Sukhothai province which accounts for 27 percent of total area. There is substantial trade in seed among the different production systems. In this study, the Sanpathong area in Chiang Mai province is purposely selected as the study area for studying comparative advantage of production of dry season crops.

Chiang Mai province may be considered as rich agricultural land compared to other parts of Northern Thailand. In 1989, about 1.5 million rais in Chiang Mai were under agriculture. However, only 394,000 rais were irrigated. In Chiang Mai the area is used for paddy (746, 190 rais), other field crops, (such as soybean, garlic, onion etc. (375,729 rais)), vegetables, tree crops (196, 885 rais), (Chiang Mai Provincial Agricultural Office): 1979/80-1990/91.

In the common cropping system in Chiang Mai, rice is planted in the wet season followed by soybean, garlic, onion, groundnut, dry season rice or vegetables. Triple cropping is practiced in those areas where irrigation is available in the dry season. However, due to droughts in the past few years, triple cropping has become more difficult. This also affects production of dry season rice.

Since 1976, dry season rice in Chiang Mai has been largely replaced by soybean. which requires less water. In the 1989/90 season only 40,416 rais was under dry season rice, while 208,668 rais was under dry season soybean (Table 3).

Table 3. Planted Area For Dry Season Economic Crops in Chiang Mai Province, Thailand, 1979/80 -1990/91

Year	Planted Area (rai)			
	Dry Season Soybean	Garlic	Onion	Dry Season Rice
1979/80	167,763	N/A	N/A	40,434
1980/81	113,321	N/A	N/A	20,277
1981/82	113,144	58,585	N/A	28,928
1982/83	193,254	59,651	8,563	28,572
1983/84	125,925	67,093	8,461	42,350
1984/85	164,408	56,688	10,826	38,889
1985/86	204,512	51,586	9,009	35,977
1986/87	228,226	52,821	10,101	32,636
1987/88	220,609	71,130	11,826	65,861
1988/89	254,746	70,503	14,632	42,307
1989/90	208,668	49,201	13,407	40,416
1990/91·	176,847	45,878	14,707	N/A

Sources: Office of Agricultural Economics, Thailand.
Chiang Mai Provincial Agricultural Office.
*Preliminary Survey

Table 4. Planted Area, Production, Average Yield and Farm Price of Dry Season Soybean in Chiang Mai Province, Thailand 1978/79-1990/91.

Year	Planted Area (rais)	Production (tons)	Average Yield (kg./rai)	Farm Price* (Baht/kg)
1978/79	129,441	26,665	206	5.68
1979/80	167.763	23,990	143	6.74
1980/81	113,321	15,662	138	6.59
1981/82	113,114	19,384	171	6.21
1982/83	193,254	40,390	209	6.77
1983/84	125,925	23,926	190	7.45
1984/85	164,408	29,393	179	7.50
1985/86	204,512	43,548	212	6.65
1986/87	228,226	49,448	216	6.84
1987/88	220,609	49,793	255	8.03
1988/89	208,668	42,777	205	9.76
1990/91**	176,847	40,498	229	N/A

Sources: Office of Agricultural Economics, Thailand.
Chiang Mai Provincial Agricultural Office.
* Preliminary Survey
** Projected

In 1990 about one-third of the area in Chiang Mai was occupied by the rice soybean cropping system. Chiang Mai is known for its good quality soybean, even though soybean does not give particularly high yields or high returns per rai, though yields rank among the highest in Thailand. Producing soybean requires low inputs c: both labor and capital compared to other dry season crops. Another factor is that the rice-soybean system enjoys more price stability than other systems of cash crops in the dry season. The average price of soybean in Chiang Mai has increased from 5.68 Baht/kg. in 1978/79 to 9.76 Baht/kg. in 1989/90 (Table 4). Soybean production in Chiang Mai, however, has increased about 51 percent in the past eleven years from 26,665 tons in the 1978/79 season to 54,133 tons in the 1988/89 season, and then decreased to 42,777 tons in the 1989/90 season (Table 4).

In the 1989/90 season the production share of dry season soybean in Chiang Mai reached 75 percent of the total production in Chiang Mai which is eleven percent of national production (Table 4, 5). In addition, the research and development efforts to increase soybean production had been given high priority. One of the aims of a successful program is to transfer soybean production technology to increase farm yield. Thus, efforts to promote soybean production should focus on the systems that are efficient producers of the crop. Efficiency considerations suggest that agricultural diversification should focus on crops that can be efficiently produced, in other words, have a comparative advantage. Technological factors, input use and management are key factors in the competition of crops for farm resources and land

Table 5. Planted Area, Production, Average Yield and Farm Price of Total (Wet and Dry Season) Soybean in Chiang Mai Province, Thailand, 1977/78-1989/90

Year	Planted Area* (rais)	Production (tons)	Average Yield (kg./rai)	Farm Price (Baht/kg)
1977/78	118,780	15,508	131	5.61
1978/79	154,688	29,700	192	5.39
1979/80	137,379	27,338	199	5.26
1980/81	183,722	26,224	143	5.78
1981/82	152,750	23,524	154	6.81
1982/83	118,709	20,062	426	5.12
1983/84	241,058	46,473	209	6.07
1984/85	238,537	45,518	194	6.00
1985/86	232,520	48,978	214	6.09
1986/87	246,725	50,597	206	6.15
1987/88	244,325	50,311	213	8.01
1988/89	253,939	58,450	236	8.46
1989/90	275,957	57,042	207	7.33

Sources: Office of Agricultural Economics, Thailand.
* Average of 80 Percent of total planted area in Chiang Mai is for dry season soybean and average of 20 percent is for wet season soybean.

Demand and Utilization of Soybean.

Although production of soybean has been increasing rapidly, the annual production of soybean only accounts for approximately 60 percent of the domestic demand (Office of Agricultural Economics).

Demand for soybean and soybean products can be divided into four major categories; soybean seed, soybean oil, soybean meal and soy food products. Table 6 shows the demand for soybean in four major categories from 1975 to 1989. It is clearly shown that the major use of domestically produced soybean is in the oil and meal industry. Demand for soybean in the oil and meal industry had increased from 62,240 tons or 46 percent in 1975 to 427,000 tons or 64 percent in 1989 (Table 6). In the past decade, demand for soybean meal in the animal feed industry has increased dramatically due to a rapid expansion of the livestock and shrimp sectors

The next major use of soybean is for direct consumption in the form of soybean curd, soy-sauce, soymilk, etc. Since soybean is well recognized as a source of protein, its consumption has increased from 20,370 tons in 1975 to 139,707 tons in 1989. Another use of soybean is for seed. Since 1975, utilization of soybean for seed has accounted for about 5-6 percent of total production per annum (Table 6).

Table 6. Demand and Utilization of Soybean in Thailand, 1975-1989

Year	Utilization and Demand for				Total Production (ton)
	Export	Seed	Direct Consumption (ton)	Crushing For Oil & meal	
1975	24,060	7,384	20,370	62,240	133,950
1976	8,130	6,351	27,740	71,430	113,650
1977	11,510	9,575	6,918	69,300	100,300
1978	8,100	10,104	70,820	80,720	169,740
1979	9,710	6,793	17,790	67,860	102,150
1980	3,400	7,882	9,740	94,300	115,320
1981	2,530	7,970	42,440	78,600	131,540
1982	1,300	7,778	19,680	87,860	116,620
1983	1,040	10,084	100,150	67,860	179,130
1984	990	12,526	116,610	116,430	246,560
1985	2,3500	15,243	117,490	174,340	309,410
1986	1,9500	17,390	98,307	238,840	350,310
1987	16	22,604	64,375	250,750	338,000
1988	4	25,078	155,437	367,500	517,000
1989	-	31,300	139,707	427,000	672,000

Source: Office of Agricultural Economics, Thailand.
Department of Customs, Thailand

Since 1977, total demand for soybean oil, in Thailand has increased steadily with a growth rate of 17 percent per annum. Thus, Thailand has to import a certain amount of soybean oil to meet this deficit. However, the data from the Office of Agricultural Economics (OAE) indicated that Thailand has reached a level of self-sufficiency in vegetable oil (including soybean oil) since 1985

In contrast, there is a tremendous increase in domestic demand for soybean-meal which cannot be met by domestic supply. Table 7 shows that from 1977/78 to 1989/90 total demand for soybean meal in Thailand has increased from 167,520 tons to 599,270 tons, a 252 percent increase.

Demand for soybean meal in the feed sector has risen relatively fast causing imports to increase from 112,080 tons in 1977/78 to 240,320 tons in the 1983/84 season and then decrease to 184,080 tons in 1989/90 (Table 7). In 1990, the import of soybean meal in terms of volume accounted for 69 percent of total imports of animal feed ingredients, and amounted to 340,814 tons (The Department of Customs). During the same period domestic production of soybean meal increased from 55,430 tons to 405,190 tons (Table 7). This increased demand for soybean meal caused expansion of oil crushing facilities, with consequently more meal production for animal feed and oil as a side product.

Table 7. Total Demand for Soybean Meal in Thailand from 1977/78 through 1989/90.

Year	Domestic Production	Import (1,000 tons)	Total Demand
1977/78	55.43	112.08	167.52
1978/79	64.53	38.86	103.39
1979/80	54.19	131.85	186.04
1980/81	74.44	138.59	213.03
1981/82	62.33	188.89	251.03
1982/83	70.29	200.89	271.18
1983/84	53.94	240.32	294.26
1984/85	93.14	223.13	316.27
1985/86	134.62	229.16	363.78
1986/87	183.91	225.28	409.19
1987/88	193.08	232.18	425.26
1988/89	300.38	177.17	477.55
1989/90	405.19	184.08	599.27

Source: Department of Customs, Bangkok, Thailand. Office of Agricultural Economics, Thailand

Given the situation mentioned above, increased production of soybean to be used as raw material for soybean meal in the oil and meal industry would result in excess supply of soybean oil. It is important to consider modem technology for producing soybean meal without extracting oil. This modern crushing technology is known as extrusion. The machine presses the whole soybean into meal without extracting the oil as a side product. Therefore, the need to market excess oil is not present. The extra fat in soybean meal produced this way also benefits the feed mix, as no extra fat needs to be added. One of the problems of this process is the need to extract or destroy trypsine inhibitors from the meal. However, this problem can be solved by heating during the pressing process. Extrusion is an expensive technology, but it should be considered for use in Thailand.

Government Policies

In Thailand, government intervention in the agricultural sector is a common phenomenon. Government policies for agricultural products in Thailand take into account many factors such as; domestic demand for the product, demand for export, prices, limitation of natural resources and income distribution of the farmers. The objectives of government intervention are to improve the efficiency of resource use, income distribution, production and to maintain stability of prices. However, policies for each specific crop are different.

Given that Thailand is self-sufficient in rice production and a net exporter of rice, reduction of rice production in the dry season should not hurt the economy. Therefore, one of the government policies in the past decade is to promote dry season soybean and to discourage farmers from growing dry season rice. There are two reasons for this policy; one is the increasing domestic demand for soybean (soybean meal) and another is the need for efficient use of irrigation water since dry season rice requires considerable amounts of irrigation water which is scarce. Shifts in Government intervention and pricing policies for soybean in Thailand in the past decade will be described in more detail.

Since 1982, the Thai government has set floor prices for soybean between 6-8 Baht/kg depending on the grade, domestic demand and supply, and world prices. The 1984/85 season world price of soybean meal was very low and therefore the government imposed a quota policy to control imports of soybean meal. A ratio of import: domestic purchase was made effective. The ratios of, 2:1, 4:3, 1:1, were used in 1984/85, 1985/86, and 1986/87, respectively (Thitisap, 1991). These ratios changed from time to time depending on the market situation. In 1990, the government lifted the quota system for soybean meal and imposed a surcharge for the amount of soybean meal imported. The surcharge rate in March, May, June and July of 1990 was 1,585, 1,975 and 1,472 Baht/ton, respectively (Department of Customs).

The Government has followed an expensive but fairly effective policy with the objective of strengthening the seed supply. In 1984 the government made available 1 kg of good quality soybean seed for 1 kg of soybean from the farmers. In 1986 the quantity was increased to 10 kg, while the farmer had to purchase Rhizobium. After 1986 the Ministery of Agriculture and Co-operative seed Multiplication and Distribution Services made available 1 kg of seed for 10 Bht/kg. The Seed Multiplication and Distribution Services used contract farmers to obtain the desired seed targets.

In 1992 the Government lowered the price of seed again to 2 Bht/kg in an attempt to continue the soybean expansion drive. This price is well below market price which is approximately 15 Bht/kg.

In the case of Chang Mai in 1990 an ad hoc price correction took place when it appeared that a number of farmers had received 7 Bht/kg while the floor price was set at 9 Bht/kg. Retroactive payment through the private sector took place, which absorbed approximately 50% of the additional payment.

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Cultivation Practices and Cropping Systems in Chiang Mai

Cropping System

Rice is a major crop in the wet season in Chiang Mai province; it is harvested in November. Following the rice harvest, major crops grown in the dry-season-irrigated area between November and April are soybean, onion, garlic, dry season rice, and vegetables. Cropping patterns in Chiang Mai province can be grouped in four major, groups; rice-soybean-fallow, rice-garlic-fallow, rice-onion-fallow, and rice-rice-fallow. In .he 1960s rice-rice-fallow was a common cropping pattern in Chiang Mai. This was due to the introduction of several new varieties of rice and the improvement of irrigation systems. However, recent production data show that the importance of dry season rice has steadily declined and the pattern of rice-soybean-fallow become more common in the mid 1970s. In the 1980s, the Thai government discouraged the growth of dry season rice for several reasons such as the domestic surplus of rice, low prices in world markets and scarcity of irrigation water. Recent surveys indicate that currently the dominant cropping system in Chiang Mai is rice-soybean-fallow. In 1989/90 planted areas were; soybean (208,668 rai); garlic (49,201 rai) onion (13,407 rai), and rice (40,416 rai) in the dry season in Chiang Mai (Table 3). These crops are competing for the same resources such as land, labor, capital and water in the same area. The focus of, his study is to look at the patterns in comparative advantage of soybean and other competing crops in the dry season.

Soybean Cultivation practice

Dry season soybean in Chiang Mai province is planted immediately after harvesting the rice in December. The major soybean areas in Chiang Mai province are Sanpathong, Hang-dong, Mae-Rim and Mae-Tang districts (see map in Figure A-2). These areas are located along the Mae-Tang irrigation canal. There are three common methods to prepare land for soybean. In the first, rice straw is cut and soybean seeds are planted directly into the stubble. In the second the fields are burned after t he ground has been uniformly covered by the rice straw. The farmer dibbles holes with a wooden stick, then soybean seeds are sown and covered with ashes. In the last method, the land is ploughed and the seed planted in raised beds. This last method is not commonly used due to the high cost of ploughing. It is used in water-logged areas.

Especially in areas with newly constructed roads and houses waterlogging often occurs. In soil saturated condition weeding is difficult and can dislodge young plants. As the watertable goes down substantial weed growth occurs.

For the first and second methods, farmers have to make ditches around the plot for irrigation and drainage to minimize water-logging in the field. Roughly 30 percent of the farmers apply pre-emptive weed control in the first method. In the other two methods weeding is not practiced. Sixty percent of the farmers apply chemical weed control after heavy growth. Only 5 percent of the farmers use manual labor for weeding.

Seventy percent of farmers broadcast chemical fertilizers once or twice and spray pesticides when there are problems. Sickle cutting is the most common harvesting method for soybean in Chiang Mai province. The cut vines are left in the field to dry, then collected and made into bundles for threshing. Threshing machines have been very popular in this area for the past two decades. The cost of threshing the soybean is approximately 0.50 Baht/kg. Crop care for soybean in Chiang Mai is thus minimal in term of labor use. (Priebprom et al., 1991).

Based on the survey data in Sanpathong and Hang-Dong districts, one can conclude that the three most serious problems in soybean production are late season water shortage, low prices, and insect damage (especially aphids). Other problems are the low percentage of seed germination, weeds, the high cost of labor and factors of production (i.e., fertilizers and pesticides). The greatest risk that soybean farmers face yearly is the scarcity of irrigation water at the end of the season. Critical water shortage in February is a common problem in years when the wet season ends early. It was reported that the result of water shortage can cause up to 80 percent loss in yield, especially for fields that are located some distance from the source of irrigation water (Siriratchaneekorn, 1986).

Table A-1 and Table A-2 shows the amount of labor used in each activity, inputs used, unit prices, costs, production and profit. The total amount of labor used in soybean production in Chiang Mai province is 19.34 man-day/rai. These included 8.45 days of family labor, 9.23 days hired labor, and 1.66 days exchanged labor, (Table A-3). Wage rates for male and female labor range from 50 Baht/day to 100 Baht/day depending on the activities (Table A-4). The land rental system for soybean in Chiang Mai province is usually 1:2 or 1:3 share-cropping of rice yield, after deducting input costs for rice in the wet season, or it is paid as a fixed cost. The data also indicate that the total cost of soybean production in Chiang Mai province is 2,211.64 Baht/rai, and the average yield is 289 kg./rai. Table A-5 also shows a comparison of production costs of soybean in Chiang Mai province in 1989 from four different sources.

Marketing of soybean

There are several reasons for soybean farmers to sell their product immediately after threshing. Firstly, it is convenient because they do not have to transport the product at their own expense. Secondly, they have no storage room for the product and thirdly, the urgent need for cash to pay their debts. Figure 1 shows that the marketing channels of soybean in Chiang Mai province operate at three levels; local level, provincial level, and national level. About 60 percent of soybean is sold to local traders. These traders usually act as produce collectors and resell the product to provincial wholesalers or oil extracting plants in Chiang Mai province. Thirty-eight percent of soybean from the farm is sold directly to provincial wholesalers. Provincial wholesalers usually do most of the grading and storing of soybean, seeking profits from price movements. At provincial markets, 50 percent of soybean is sold to oil extracting plants in Chiang Mai, 8 percent to small processors for soyfood and 40 percent to Bangkok markets. There is a large oil extracting plant in Chiang Mai province which buys most of the soybean from local traders and provincial wholesalers. Provincial prices of soybean are usually set by reported ex-factory gate prices in Bangkok.

Thus, the wholesale price of soybean in Chiang Mai province is based on this price after subtracting transportation and handling costs. Clearly the Bangkok wholesale price is also influenced by government restrictions on imports of soybean meal. In addition, the government also sets floor and ceiling prices for soybean each year. Monthly average wholesale prices of soybean in Chiang Mai province from 1984 to 1989 are shown in Table 8. In Chiang Mai it can be concluded that provincial price formation occurs in close interaction with Bangkok wholesale prices. One can therefore speak of an integrated national soybean market

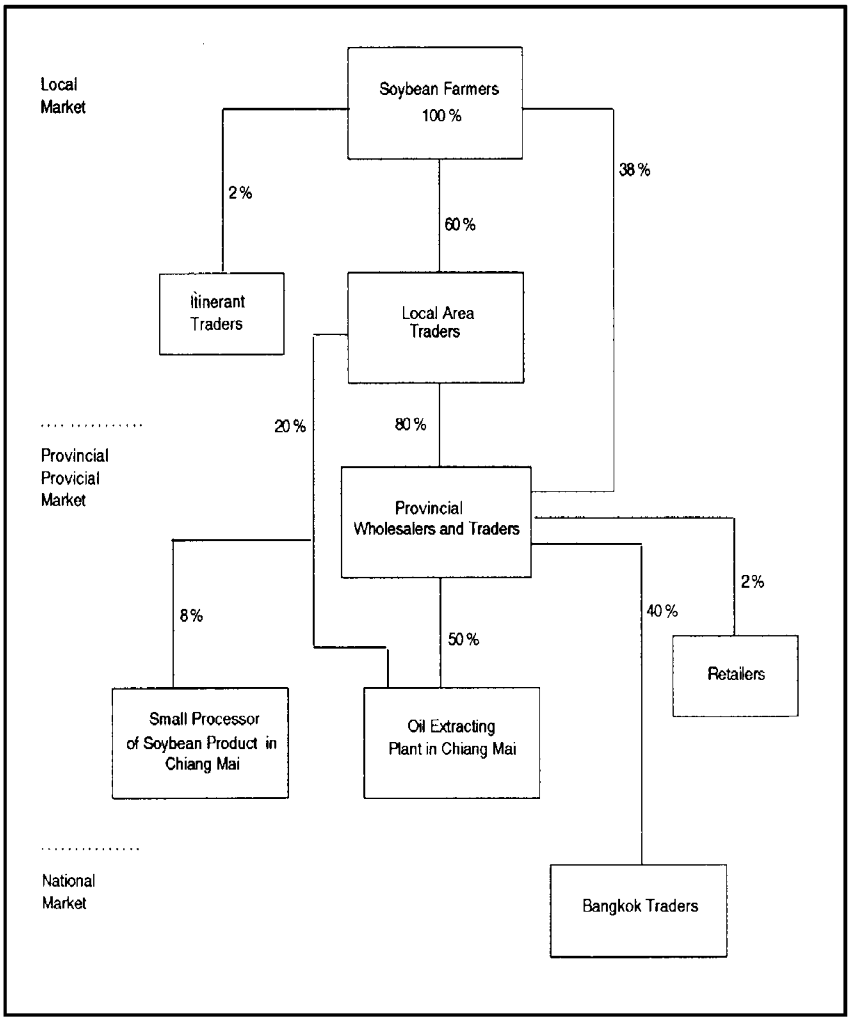

Figure 1. Marketing Channels of Soybean in Chiang Mai Province, Thailand, 1990. Chiang Mai Provincial Agricultural Office. Survey Information. in Sanpathong Area. Chiang Mai Province, 1991.

Table 8. Monthly Average Wholesale Prices of Soybean in Chiang Mai Province from 1984-89

Year Month	1984	1985	1986	1987	1988	1989
			(Baht/kg.)			
January	8.00	6.97	6.46	7.38	10.75	9.63
Febuary	7.60	6.60	6.81	6.93	10.30	9.50
March	7.10	6.38	7.60	7.00	10.12	9.45
April	7.25	6.60	6.66	7.28	9.24	9.91
May	7.75	6.71	7.03	8.79	9.12	9.62
June	8.50	6.77	7.26	7.98	8.69	9.75
July	8.60	6.90	7.12	8.31	9.10	9.75
August	8.40	6.90	6.81	8.33	9.55	8.00
September	6.80	6.25	6.11	8.43	8.87	8.25
October	6.50	6.00	6.25	8.50	9.75	7.40
November	6.75	6.81	6.76	9.90	9.75	7.45
December	7.00	6.50	6.73	10.06	10.25	7.75
Average	7.52	6.62	6.80	8.24	9.62	8.87

Source: Chiang Mai Provincial Agricultural Office

Table 9. Planted Area, Production, Average Yield and Farm Price of Garlic in Chiang Mai Province, Thailand, 1981/82-1990-91

Year	Planted Area (rais)	Production (tons)	Average Yield (kg/rai)	Farm Price (Baht/kg)
1981/82	58,585	37,963	648	7.68
1982/83	59,651	34,657	581	12.36
1983/84	67,093	33,211	495	14.94
1984/85	56,688	36,166	638	8.83
1985/86	51,586	34,269	664	9.67
1986/87	52,821	26,727	506	9.40
1987/88	71,130	37,485	530	18.20
1989/90	49,201	33,475	680	11.18
1990/91*	45,878	33,399	728	N/A

Source: Office of Agricultural Economics, Thailand. Chiang Mai Provincial Agricultural Office.
* Preliminary Survey

Garlic Cultivation Practice

In 1988/89 the national production area of garlic was 233,400 rai with the total yield of 134,000 tons or 1,719 Kg./rai (Table A-6, and Office of Agricultural Economics). Note that garlic can be stored and sold at dry weight prices where the ratio for wet: dry weight of garlic is 3:1. The dominant areas for garlic production in Thailand are Chiang Mai, Lampoon and Srisaket provinces. Chiang Mai province produces about 30 percent of the total production of Thailand. Table 9 shows that the planted area for garlic in Chiang Mai province had increased from 58,585 rais in the 1981/82 season to 71,130 rai in the 1987/88 season and decreased to 49,201 rai in the 1989/90 season. In the period 1981-1990, production of garlic fluctuated between 26,727 tons and 37.9673 tons. It seems highly likely that the recent trend in area reduction is accompanied by expanded productivity from the mid 1980s to 1991.

Approximately 84 percent of garlic is planted in November and December. Harvesting time falls usually in March and April. Because garlic is a labor intensive crop the planted area for each family is usually small. In Chiang Mai province, 65.8 percent of garlic farmers cultivated on land less than 2 rai, 34.1 percent cultivated on land between 2 to 10 rai and only 0.1 percent on land of more than 10 rai. Sixty-five percent of garlic farmers owned their land, while 35 percent rented the land.

To cultivate garlic, farmers in Chiang Mai province plough their land once or twice and then make raised beds. Planting is done manually, and the beds are then covered with rice straw for weed control and to maintain moisture in the ground. Chemical fertilizers (usually 13-13-21 and 16-20-0) are broadcast 3 times during the season. A mixed method of chemical and manual weed control is commonly used by garlic farmers in Chiang Mai province. All of the farmers apply early weed control once at the beginning of the growing season. In addition, 90 percent of the farmers practice manual weeding once or twice while 10 percent do not do manual weeding. Watering is one of the major activities for garlic farmers. Garlic needs to be watered approximately 12 to 15 times during the whole season or every 10 days. Harvesting, drying, and bundling are all done manually.

Based on the data in 1991, the total cost of garlic production in Chiang Mai province is 1'0,738 Baht/rai (Table A 7) with an average yield of 2,751 Kg./rai. Total labor used in cultivation of garlic is 66.15 man day/rai. Most of the labor used in land preparation, planting, spraying insecticide and harvesting was hired labor or contracted labor. All other activities such as applying fertilizer, weeding, and irrigation were done by family labor. Table A-7 also shows the amount of labor used in each activity, the amount of inputs, unit price, cost, and profit. Some major problems for garlic farmers in Chiang Mai province are diseases (leaf curl and yellow leaf), unstable prices and weeds.

Marketing of Garlic

The Marketing channels for garlic in Chiang Mai province are shown in Figure 2. Based on the information from garlic farmers and provincial traders, marketing of garlic can be divided into three levels; local, provincial, and regional. Since the major utilization of garlic is for home consumption, demand for garlic in Chiang Mai and nearby provinces in the northern region can absorb all of the garlic produced in Chiang Mai. Garlic can be marketed in both forms, fresh and dry. Prices of garlic from 1981/82 through 1989/90 are shown in Table 9. It appears that area movements tend to correlate with prices, which underlines the price responsiveness of garlic.

Figure 2 shows that approximately 70 percent of garlic is sold locally. Local traders usually collect garlic from small farmers, transport it to town and sell to provincial traders. Farmers who own a truck normally sell their product directly to provincial traders. Only about five percent of garlic produced in Chiang Mai province is sold to itinerant traders at the farm. There are 5-6 major garlic traders in Chiang Mai province. These traders own large storage facilities and resell 90 percent of the garlic to provincial wholesalers and another 10 percent to Bangkok traders throughout the year. The provincial wholesalers distribute 20 percent to retailers in Chiang Mai province, 70 percent to traders from other provinces and another 10 percent to Bangkok traders. Compared to the soybean market, the garlic market seems to be more regional in nature, with competition at provincial wholesale level.

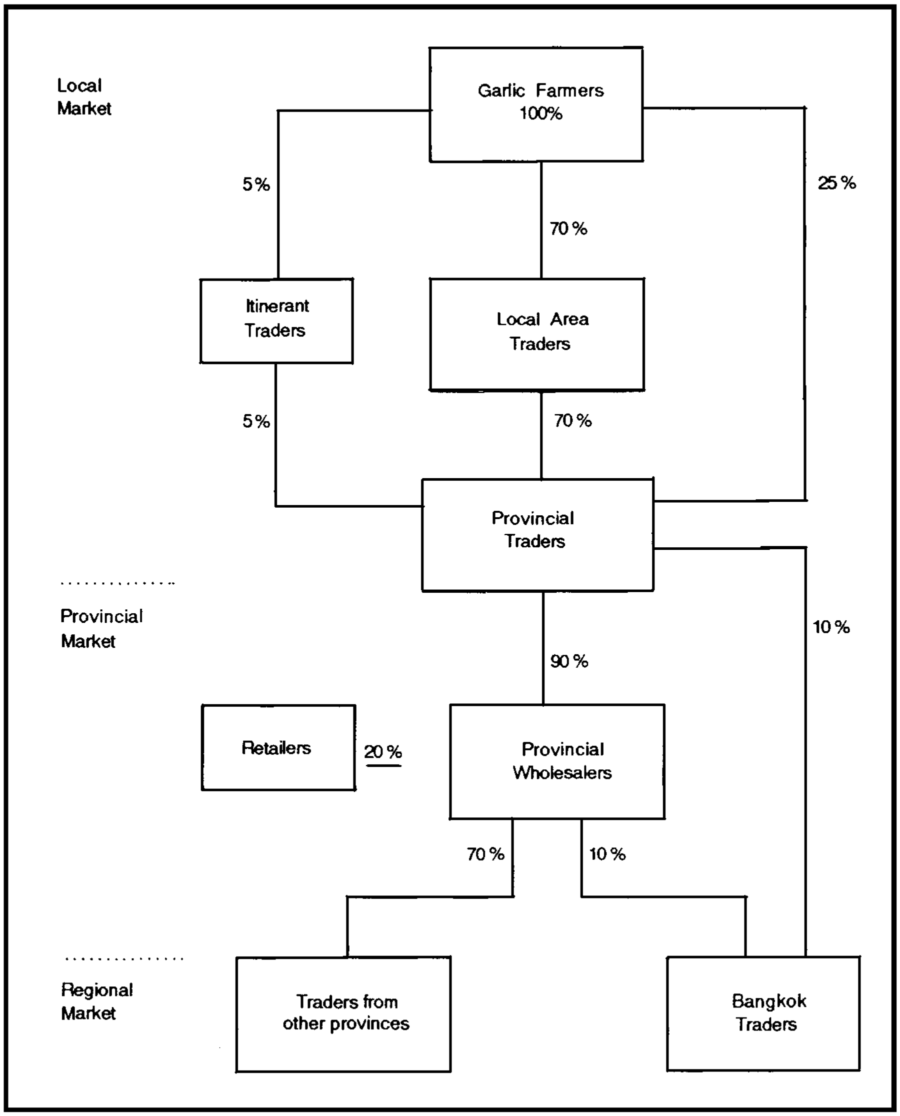

Figure 2. Marketing Channels of Garlic in Chiang Mai Province, Thailand, 1990.
Sources: Chiang Mai Provincial Agricultural Office.
Survey Information, in Sanpathong Area, Chiang Mai Province, 1991

Onion Cultivation Practices

In 1989 production of onion in Chiang Mai province accounted for 93 percent of national production. Total planted area for onion in Thailand had increased from 9,700 rais in 1983/84 to 14,400 rais in the 1989/90 seasons (Table A-6). The dominant area for onion production is in Chiang Mai province. In the 1982/83 season, production of onion in Chiang Mai province accounted for more than 90 percent of national production (OAE). Planted area for onion in Chiang Mai province increased from 8,563 rais in the 1982/83 season to 13,407 rais in the 1989/90 season (Table 10). Even though the planted area for onion has been increasing over the years, average yield per rai has been decreasing and, therefore, production of onion is not increasing in the same proportion as the increase in planted area. Average farm prices have also been decreasing over the years from 7.36 Baht/Kg. in the 1983/84 season to 3.49 Baht/Kg. in the 1989/90 season (Table 10).

Table 10. Planted Area, Production, Average Yield and Farm Price of Onion in Chiang Mai Province, Thailand, 1982/83-1990/91.

Year	Planted Area (rais)	Production (tons)	Average Yield (kg/rai)	Farm Price (Baht/kg)
1982/83	8,563	39,036	4,559	N/A
1983/84	8,461	31,257	3,694	7.36
1984/85	10,826	40,167	3,710	9.24
1985/86	8,009	34,356	3,813	6.33
1986/87	10,101	27,737	2,770	3.30
1987/88	11,826	40,336	3,411	4.55
1988/89	14,632	41,337	2,825	3.54
1989/90	13,407	37,895	2,827	3.49
1990/91*	14,707	43,161	2,935	N/A

Source: Office of Agricultural Economics, Thailand.
Chiang Mai Provincial Agricultural Office.
* Preliminary Survey

There are two planting periods for onion in Chiang Mai province. The first crop is planted in November and harvested in February. This is usually planted in the highland area. The second crop which is normally planted in the lowlands in December after the rice harvest is harvested in March. The cultivated area for each farmer or family in Chiang Mai province ranges from 1 to 6 rai. For land preparation, farmers plough the land once or twice, add limestone to the soil, and make beds. Cultivation practice for onion begins with germinating seeds in the beds for about 1.5 months. Then, seedlings are transplanted to the growing beds and covered with rice straw. Crop care such as weeding, pest control, fertilizer and watering are the same as for garlic. However, harvesting is slightly different. Farmers usually harvest onion from the field and transport it to their houses. Subsequently, cleaning, grading and bagging are done before marketing the product.

Based on the data for 1991, the total cost of onion production in Chiang Mai province is 10,121.66 Baht/rai with an average yield of 3,384.5 Kg/rai (Table A-9 and Table A-10). Total labor used in cultivation of onion is 87.89 man -day/rai. Most of the labor used in land preparing, transplanting and harvesting is hired labor or contracted labor. Activities such as planting, applying fertilizer, weeding and watering are done with family labor. Some major problems for onion farmers are low prices, insects and diseases such as leaf spot and rot.

Marketing of Onion

There are two major markets for onion grown in Chiang Mai province; domestic market and export. Most of the onion farmers in Chiang Mai province belong to a cooperative. The cooperative would normally have a contract with exporting companies. About 65 percent of onion is sold to cooperatives and another 35 percent to local area traders. Marketing channels for onion are shown in Figure 3. Wholesale area prices determine farm gate prices; usually farmers are price takers. The exporting companies normally guarantee prices for onion of different grades (A,B,C and D). Farmers usually sell their product to either local area traders or cooperatives. The cooperative then resells the onion of exported quality to the exporting companies and the rest to provincial wholesalers. Japan is a major market for exported onion. Provincial wholesalers distribute the product to retailers in Chiang Mai, traders from Bangkok and other provinces.

Note: For comparison; planted area, production, average yield, farm prices of dry season rice in Chiang Mai province are shown in Table A-11 and marketing channels are shown in Figure A-3.

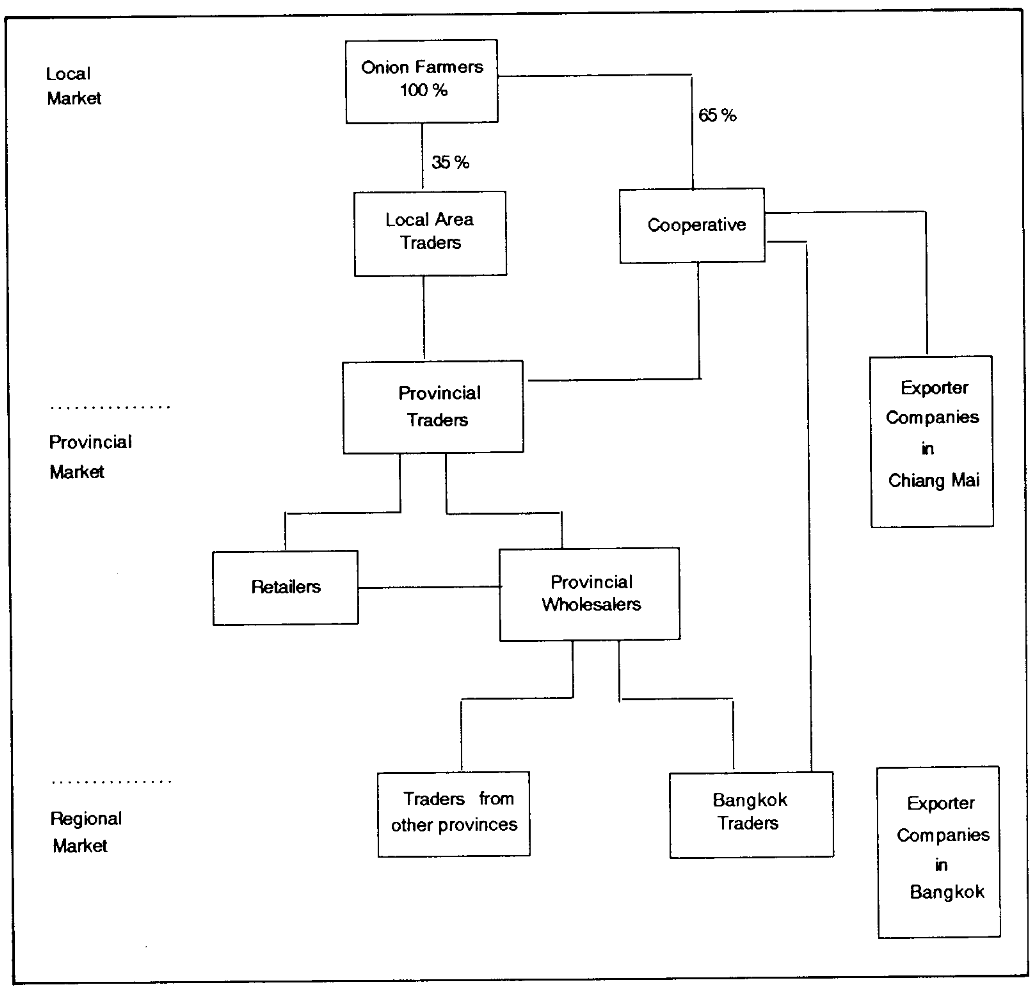

Figure 3. Marketing Channels of Onion in Chiang Mai Province, Thailand, 1990.
Sources: Chiang Mai Provincial Agricultural Office.
Survey Information, in Sanpathong Area, Chiang Mai Province, 1991.

Competion Among Crops

In identifying competing crops for soybean, one needs to take into consideration crops that compete for the same resources in the same area during the same period. Data from Table A-11, show that between 1980 and 1989 the ratio of planted area for dry season soybean and dry season rice in Chiang Mai province is approximately 5:1 with a growth rate of 9 percent per annum. From 1982/83 through 1989/90 the planted area for onion increased from 8,563 rais to 13,407 rais while the planted area for garlic fluctuated between 49,201 and 71,130 rais. However, one can see that there is an almost constant proportion of land allocation for these crops through time. This phenomenon indicates that area allocation across commodities takes place. It is significant that of the four important competing crops, dry rice, soybean, garlic and onion each have specific and different markets and price formation mechanisms. The soybean and the rice market supplies both provincial and national markets. In contrast the garlic market is primarily provincial/regional. The onion market is largely national.

Thus it is clear that competition for resources among crops is induced by price developments of different markets belonging to the various commodities. There is also an element of complimentarily with regard to the labor calendar, for example, farmers often grow as much garlic as the family can handle, i.e., 1-2 rais, and the rest of the area is then planted to soybean.

The profitability of each of the dry season crops in Chiang Mai province is very different. Stable proportions of land allocations to crops with very different profitability usually indicate:

a) differences in price risks and usually different processes of price formation, and
b) a shortage or constraint in capital or land and a high cost for labor.

However, the issue of crop competition remains largely under-researched. There are two major areas of research on competition among crops. One is to look at the competitiveness of the same crop in different areas, for example competitiveness of soybean grown in Chiang Mai, Sukhothai and Loey provinces. This includes a look at policy effects on one crop in different areas. Another is to look at the competitiveness of different crops in a given area. That is, to look at the policy effects in one area on different crops. The first type of research is useful for commodity-specific regional or national planning whereas the second type of research is useful for improving the efficiency of use of scarce resources. In addition, one could analyze comparative advantage of one product in the same area but at various market levels, based on empirical verification of competition.

It should be noted that the policy analysis matrix (PAM) method has mostly been used to identify policy effects on one crop in different areas. This study however, is an exercise in using the PAM to analyze policy effects in one area on different crops. Looking at comparative advantage necessitates a wider discussion and view than just looking at the policy effects.

Data to determine competing crops for soybean were obtained in a survey. Randomly selected farmers in the Sanpathong and Hang-Dong area were asked to list alternative crops that they could grow instead of soybean considering only the physical conditions. The majority of them listed garlic and onion. Very few listed dry season rice and vegetables. In addition, the data from the interviews also show that 80 % of farmers who had been growing soybean for more than 20 years had no answer to what would be their alternative crops despite the low return of soybean. Besides physical constraints this may also reflect capital and labor shortages

The popularity of soybean is simply explained, Soybean prices are relatively stable over time, and soybean requires less labor and capital input than many other crops such as garlic, onion, tobacco, and vegetables. However, due to the economic boom in Chang Mai in the past five years, farmers also face scarce and more expensive labor in the farm sector since there are many off-farm employment opportunities. The major characteristics of soybean, garlic and onion are shown in Table 11.

About 80 percent of soybean farmers indicated in their interview that they have no idea of what should be grown instead of soybean if the crop is no longer competitive. However, they pointed out that they would take into consideration the crops recommended by the extension agent or the government who give a security for market and price. This indicates that the price of the products also plays an important role in the farmers' decisions. Thus, potentially competing crops for soybean in Chiang Mai area are garlic and onion, and fallow. Two major factors that make farmers leave the land fallow are a high cost of production and water shortage, making it risky and often unprofitable for food crop cultivation.

Table 11. Major Characteristics of Dry Season Crops in Chiang Mai Province, Thailand, 1990.

Characteristic	Soybean	Garlic	Onion
Labour intensity (man-day/rai)	19.34	66.15	86.89
Cost of production (Baht/rai)	2,211.64	10,783.04	10,121.66
Net profit (Baht/rai)	421.06	9,085.25	10,328.69
Benefit/cost ratio	-0.19	0.85	1.02

Source: Survey data in Sanpathong area, Chiang Mai Province, 1991.

Price and Area Interaction

Prajogo U. Hadi

Introduction

This analysis assesses the effects of price on farmers' dry-season soybean planting decisions in the Chiang Mai province, Thailand. It includes the price of four commodities grown during the dry season: soybean, garlic, onion and rice. Dry-season soybean is hypothesized to compete with these commodities for scarce farmers' agricultural resources, especially land.

In the following section, simple response models are developed. Results, discussions and conclusions are presented in the subsequent section

Empirical Models and Estimation Procedures

Models adopted here are those of the Nerlovian type. Initially, lagged area planted was included as a variable in the models. However, it was eventually excluded from the models due primarily to its non-significance. The models, then, are specified (in a logarithmic form) as follows

(1) $A_{it} = \alpha_i + A_{it} = \alpha_i + \Sigma \beta_k P_{kt}$

(2) $A_{it} = \alpha_i + A_{it} = \alpha_i + \Sigma \beta_k P_{kt-1}$

where A_{it} = area planted of commodity i at time t

P_{kt} = relative prices of commodity i to commodity j at time t

P_{kt-1} = relative prices of commodity i to commodity j at time t – 1

These models assume that farmers are rational actors who combine commodities so as to maximize income from given resources. This implies that farmers take relative prices of the competing commodities into account in planting decisions. Relative price variables have to be included as regressors in the models. Models for each commodity should have three relative price variables.

Results and Discussions

Results of estimation using both types of model (1) and (2) show that model of type (1) gives a reasonably higher predictive power (higher adjusted squared R). Furthermore, the area of dry-season soybean is significantly affected by the relative prices of soybean to onion only. The area of other commodities is not affected by the relative prices of these commodities to dry-season soybean. Thus, only the empirical dry-season-area response with respect to the relative prices of dry-season soybean to onion is presented here in a logarithmic form.

Model (1) : $A_{sy}(_t) = 12.075 + 0.431P(_t)$; Adj. $R^2 = 0.899$
(488.86)*** (8.10)***

Model (2) : $A_{sy}(_t) = 12.204 + 0.167P(_{t-1})$; Adj. $R^2 = 0.115$
(128.45)*** (0.80)

(Number in parentheses is the t-ratio where *** and ** stand for the 1% and 5% significance level respectively)

where $A_{sy}(_t)$ = area planted of dry-season soybean at time t
$P(_t)$ = price of dry-season soybean deflated by the price of onion at time t
$P(_{t-1})$ = price of dry-season soybean deflated by the price of onion at time t - 1

These results reveal two important things. Firstly, the dry-season soybean farmers consider current relative prices instead of last-year relative prices. This would be true, if farmers watch the current price of these commodities in the markets (say at the wholesale or retail levels)* and choose commodities and plant them in the same year with an expectation that current relative prices will also prevail in the next harvesting season. This explanation seems reasonable in view of the fact that we consider here dry-season soybean.

Secondly, the dry-season soybean farmers consider only the relative prices of dry season soybean to onion only. This would imply that onion is the only competing crop for dry-season soybean in the study area.

In conclusion, the dry-season soybean area in the Chiang Mai province is positively affected by the current relative prices of dry-season soybean to onion only, though with a rather low elasticity. Almost 90 percent of the variation in the dry-season soybean area was determined by the variation of relative prices. The implication would be that a faster increase in soybean price relative to onion price could lead to expanded production of dry-season soybean. It is worth noting here that the use of average monthly price data for one season prior to planting time could result in more reasonable parameter estimates. Inter and intra seasonal interaction between dry-season soybean and onion could be rather stronger than yearly interaction. (See table A-25).

Production Function Analysis of Soybean in Chiang Mai
Data, Hypotheses and Methodology

In an attempt to estimate the production function of soybean in Chiang Mai province, the present study assumes that under a competitive market, farmers received the same price for their output and pay the same price for their inputs. That is, there are no output and input price variability's among farmers. Variability's in the cost of inputs could be viewed as representational of variability's in the quantity of inputs used. If this assumption is acceptable, then production function can be estimated directly using production models and not indirectly from profit function models.

In this study the available data set will be divided into two sub-data sets. The first sub-set includes those in which profits are positive. while the second sub-set involves those in which profits are negative. The number of observations is 28 and 64 respectively

The variables included in the model include labor, capital and land. Labor use may be specified as; cutting straw, burning, ditching, planting, applying fertilizer, weeding, spraying, irrigating, harvesting and threshing. Although harvesting and threshing activities do not affect standing soybean production (fresh in shell) they could affect the final quantity of soybean-grain produce. The increased labor used for these activities could represent more appropriate harvesting and threshing practices (e.g., due to more careful handling). Material may be specified into seeds, fertilizers and chemicals. Farm-size (land) is hypothesized to affect soybean yield negatively.

In addition to these variables, dummy variables are included in the model. It is hypothesized that the effects of these factors on soybean production in the case of profit-making farmers (i.e., farmers with positive profits) differ from those in the case of non-profit-making farmers (i.e., farmers with negative profits).

The Cobb-Douglas (CD) model is employed to estimate the empirical production function. Estimations took place in three steps. First, estimation of the CD function for the profit-making farmers; second, estimation of the function for the non-profit-making farmers; and finally, estimation of the function for both sub-data sets jointly with the inclusion of dummy variables.

The CD production function for the first two estimations and the last estimation are represented as follows:

$$(1)\quad \ln Y = \ln A + \alpha_1 \ln L_1 + \alpha_2 \ln L_2 + \alpha_3 \ln L_3 + \alpha_4 \ln L_4 + \alpha_5 \ln L_5 + \alpha_6 \ln L_6 + \alpha_7 \ln L_7\ \alpha_8 \ln L_8 + \alpha_9 \ln L_9\ \alpha_{10} \ln L_{10} + ß_1 \ln S + ß_2 \ln F + ß_3 \ln C + \delta_1 \ln Z$$

$$(2)\quad \ln Y = \ln A + \alpha_1 \ln L_1 + \alpha_2 \ln L_2 + \alpha_3 \ln L_3 + \alpha_4 \ln L_4 + \alpha_5 \ln L_5 + \alpha_6 \ln L_6 + \alpha_7 \ln L_7 + \alpha_8 \ln L_8 + \alpha_9 \ln L_9\ \alpha_{10} \ln L_{10} + ß_1 \ln S + ß_2 \ln F + ß_3 \ln C + \delta_1 \ln Z + \sigma \boldsymbol{D} + \alpha_{11} D \ln L_1 + \alpha_{12} D \ln L_2 + \alpha_{13} D \ln L_3 + \alpha_{14} D \ln L_4 + \alpha_{15} D \ln L_5 + \alpha_{16} D \ln L_6 + \alpha_{17} D \ln L_7 + \alpha_{18} D \ln L_8 + \alpha_{19} D \ln L_9 + \alpha_{20} D \ln L_{10} + ß_4 D \ln S + ß_5 D \ln F + ß_6 D \ln C + \delta_2 D \ln Z$$

where :

Y : Yield (kg/rai)

A : Intercept

L_1 : labor for cutting straw (baht/rai)

L_2 : labor for burning (baht/rai)

L_3 : labor for ditching (baht/rai)

L_4 : labor for planting (baht/rai)

L_5 : labor for fertilizing (baht/rai)

L_6 : labor for weeding (baht/rai)

L_7 : labor for spraying (baht/rai)

L_8 : labor for irrigating (baht/rai)

L_9 : labor for harvesting (baht/rai)

L_{10} : Labor for threshing (baht/rai)

S : Seed cost (baht/rai)
F : Fertilizer cost (baht/rai)
C : Chemical cost (baht/rai)
Z : Land (rai)
D : Dummy variable (1 for profit-making farmers and 0 for non-profit-making farmers)
A_i : Parameter estimate for labor in activity i(%)
$ß_i$. Parameter estimate for material i (%)
σ : Parameter estimate for dummy variable
δ : Parameter estimate for land (%)
ln : Log natural

The Profit-Making Example:

Results of statistical estimations are presented in Table A22 for profit-making farmers, Table A23 for non-profit-making farmers, and Table A24 for the whole data using dummy variables. The results may be interpreted as follows.

First, almost 70 percent of yield variation is determined by the model and only 30 percent is affected by factors outside the model. Second, yield is significantly affected only by the use of labor for threshing and the use of fertilizers and chemicals. The significant effect of both fertilizers and chemicals is as expected, while the effect of labor for threshing is not. On the other hand, the use of labor for spraying has no significant effect, which is not as expected. Finally, farm size has no significant effect on yield. In other words, small or large farms have no effect on yield.

The Non-Profit-Making Example:

First, about 74 percent of yield variation is determined by the model and only 26 percent is affected by factors outside the model. Second, yield is significantly affected only by the use of labor for applying fertilizer and for threshing activities. The no significant effects of labor for spraying and the use of fertilizers and chemicals are not as expected. Finally, as in the case of profit-making farmers, farm-size has no significant effect on yield. The negative profits could be attributed to the non-significant effect of the use of fertilizers and chemicals.

General:

The identification of factors affecting soybean yield regardless of whether or not farmers are profit makers, is aimed at testing the hypothesis that profit-making and non-profit-making farmers had no differences in yield and factor effects on yield.

It is found that almost 75 percent of yield variations have been explained by the model. Moreover, all the parameter estimates of dummy variables are not significantly different from zero at the 90 percent, i.e., the hypothesis is accepted. This implies that there is no difference in both yield (non-significant o) and effects of the factor' included in the model (non-significant value of the remaining dummy parameters, between profit-making farmers and non-profit-making farmers.

The average values of each cost component, yield, output price, total revenue and profit per rai are presented in Table A-21 It can be seen from this table that profit making farms had different features from non-profit-making farms in terms of costs, yield, output price, revenues and profits.

In terms of production costs, almost all the cost components, except labor for weeding and threshing, in the non-profit-making farm example have higher values than those in the profit-making farm example. The total costs in the first case are 18.5 percent higher than in the second case. On the other hand, the non-profit-making farms obtain a lower yield, i.e., 15.6 percent, and output price, i.e., 8.1 percent, than those of profit-making farms.

These lead to a vast difference in profits received by the two farmer groups. While the profit-making farmers receive profits of 304 Baht/rai, the non-profit-making farmers lose 739.6 Baht/rai, on average. However, in both cases, farmers still suffer from losses which account for 423.6 Baht/rai.

Based on the empirical estimation of production function one can conclude that, out of the 92 samples, only 28 samples or 30.4 percent are profit makers while the others are non-profit makers. The use of labor for threshing and the use of fertilizers and chemicals significantly affect soybean yield for the profit-making example. The positive sign of parameters of labor for threshing and chemicals suggest that an increase in the use of labor for threshing and the use of chemicals are necessary to increase soybean yield. The negative sign for fertilizer parameters, on the other hand, suggests a fertilizer reduction. However, for the non-profit-making example, only the use of labor for applying fertilizer and threshing has significant effects on yield with a positive sign. This suggests that the increase in the use of labor for both applying fertilizer and threshing is necessary to increase soybean yield. The results from both cases indicate that only the use of labor for applying fertilizer and threshing have significant positive effects on yield. This suggests the need for increasing labor use in applying fertilizer and threshing activities in general.

Finally, the costs of production in the case of non-profit-making farms are much higher than those in the case of profit-making farms. The reversed situation prevails for yield and output price.

Overall suggestions are that even though only a few factors have significant effects on yield, the signs of all the factors included in the model deserve consideration. The positive sign suggests the need for increasing the use of the corresponding factors while the negative sign suggests reductions in the corresponding factors so as to increase yield, hence revenues and profits. Factors which have positive signs include labor use for the application of fertilizer, irrigating and threshing and the use of chemicals, whereas those having negative signs involve the use of labor for cutting straw, burning, ditching, planting, weeding, harvesting and the use of seeds. In addition, reduction in the cost of rent and other costs for labor and material for the non-profit making farms, is necessary to create a profit from their soybean production

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4

Comparative Advantage

Concepts and Methodology

The concept of comparative advantage is of a respectable age. Ricardo had already applied the concept to trade among countries, illustrated by the classic example of trade between Portugal and England. The concept has grown in use in the past decennial and is, among others, now also applied to institutions. In agriculture the concept assumes a rather multi-disciplinary and technical nature, primarily based on productivities, inputs, costs and prices.

In 1987, Pearson and Monke developed the policy analysis matrix (PAM) approach to be used as a tool in analyzing comparative advantage. The PAM is essentially the application of cost-benefit analysis as developed for firms. As such, the various ratios, domestic resource cost ratio (DRC) and the private resource cost ratio (PRC) are indicative of efficiency for government and private firms (or farmers) at a given time. It should be noted that the PAM approach is static in nature because development through time cannot be captured in a single ratio. Yet, the approach is very useful in making the cost and returns of government intervention in the factor and output market explicit.

Comparative advantage analysis incorporates two economic approaches; social cost-benefit analysis and trade theory. The social cost-benefit analysis indicates that a crop or production system has a comparative advantage if it produces outputs more efficiently than crops or enterprises that compete for the same resources (i.e., land, labour, water, and capital). From the trade theory perspective, comparative advantage implies that a crop is efficient if it can compete on international markets given the elimination of subsidies and distorting policies (Altemeier and Gijsbers, 1988).

The notion that comparative advantage reflects a higher efficiency would also apply to many areas of agriculture. In other words, the concepts of comparative advantage and efficiency have many meanings and dimensions, depending on their context, such as; agronomic factors, potential diversity in use, and substitutability with other crops. Comparative advantage of production systems is commonly measured with the domestic resource cost analysis (DRC).

The methodology proposed for analysis of comparative advantage of soybean and competing crops in this study is that which is presented in Figure 4. and definitions of variables are presented in Table 12. The PAM incorporates two basic identities, private profitability and social profitability. The first identity states that private profitability (D), equals revenues (A) minus the sum of the costs of tradable inputs (B) and domestic factors (C) expressed in private prices. The private profitability determines whether a given production system is competitive, i.e., can survive in the market, given actual prices paid and received by producers and consumers. The second identity states that social profitability (H) equals revenues in social prices (E) minus the sum of the costs of tradable inputs (F) and domestic factors (G), expressed in social prices. The social prices are those prices that reflect scarcity values, in other words, social prices eliminate the effects of policy and market distortions. Therefore, the social profitability determines whether the system is competitive or not when there are no policy distortions and market imperfections. Details of the PAM approach can be found in Pearson and Monke (1987).

	Revenues	Costs		Profits
		Tradable inputs	Domestic factors	
Private prices	A	B	C	D1
Social price	E	F	G	H2
Policy effects	13	J4	KS	L6

1. Private profits, D = A- B- C
2. Social profits, H= T- F- G
3. Output transfers, I = A- E
4. Input transfers, J = B- F
5. Factor transfers, K= C- G
6. Net transfers, L = D- H also L = I- J- K

Figure 4. Policy Analysis Matrix
Source: Pearson and Monke (1987)

Table 12. Definitions of Variables for Policy Analysis Matrix

Variable[a]	Definition
A	Revenue
B	Summation of the cost of tradable inputs
C	Domestic factor cost for private prices
E	Output price (Revenue in social price)
F	c.i.f. or f.o.b. prices (Summation of the cost of tradable inputs)
G	Domestic factor cost for social prices
D = A-B-C	Private profits
H = E-F-G	Social profits
I = A-E	Output transfers
J = B-F	Input transfers
K = C-G	Factor transfers
L= D-H = I-J-K	Net transfers
DRC = G/(E-F)	Domestic resource cost ratio
	If D.R.C. < 1 implies that value added is greater than domestic factor cost, therefore, system is efficient
PCR = C/(A-B)	Private cost ratio

[a] Variables A to L are in Figure 4

Application of Policy Analysis Matrix (PAM) in Chiang Mai Province.

As mentioned earlier, the method can be applied to cover one commodity in different areas, which would identify policy impacts and transfers in different areas. In this case, the results are helpful in evaluating and formulating regional planning. This PAM approach can also be used to depict policy effects on different crops in one area. In addition, the PAM approach can also be applied to analyse policy effects of various crops in various regions. However, it should be appreciated that empirically verified differences in ratios pertaining to various crops in various regions do not prescribe policy steps or adjustments by necessity. The application of the policy analysis matrix approach in Chiang Mai province is to determine the policy effects on different crops in one area. That is, to look at competing activities of major crops such as soybean, garlic, onion, and rice in the dry season.

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Comparative Advantage of Soybean in Chiang Mai Province

Data

A preliminary survey was conducted in order to select the study area and determine competing crops to soybean. Sanpathong, Mae-Wang and Hong-Dong districts are the major soybean producing areas in Chiang Mai province and were selected as the area of study. Garlic and onion were included as competing crops for soybean. Data on private prices, production costs, and cultivation practices were obtained from primary surveys. Additional information on socio-economic and marketing channels of these crops was obtained from interviewing the extension agents, government officials and the manager of an oil extracting factory in Chiang Mai province. National average, farm gate and wholesale (Bangkok) prices of soybean in 1990 were obtained from the Office of Agricultural Economics and presented in Table A-12. Data on c.i.f. and f.o.b. prices of soybean meal and onion presented in Table A-13 and A-14 were provided by the Department of Customs in Bangkok.

Technical Coefficients

Technical coefficients for soybean, garlic, and onion production were estimated from cross sectional survey data in Chiang Mai province. These technical coefficients included the amount and cost of labor used for each cultivation activity in the 1989/90 season. In addition, the amount and prices of input and output of soybean, garlic and onion are reported in Table A-1, A-7 and A-9, respectively. Technical coefficients on social prices are presented in Table A-2, A-8 and A-10.

Private Prices

Private prices are referred to as market prices or financial prices. These prices can be obtained from a primary farm survey or derived from secondary data. The private prices used in conducting a policy analysis matrix are very important, because the PAM results are adversely affected by the omission of cost or revenue items. Therefore, particular attention must be given to ensure that the budgets reflect a complete set of inputs and output activities. In most cases, the formal records of input use, particularly with regard to individual crops, are not available. The output records are usually reported and can be found as secondary data.

However, conducting primary farm surveys is expensive and time-consuming. It also places heavy demands on skilled man-power for monitoring and evaluating the surveyed data. This considerable amount of work plus the constraints of time and financial support for research usually make primary farm surveys more difficult. Therefore, most economists rely on secondary data as a major source of information

Prices for all marketed inputs such as seed, fertilizer, chemicals, and hired labor are easily determined. The difficulty lies in prices of no marketed input such as family labor. The problem is that instead of receiving a wage payment, a family laborer shares in the net income of the farm. Each family member receives an implicit wage equal to the value of individual consumption and savings divided by the time devoted to the farm activity. In evaluating labor, the market wages should be applied to all labor inputs (Pearson and Monke, 1987). This approach allows the profitability calculation to indicate whether family members are earning at least the market rate of return to their labors. One of the implications of this approach is that if family labor does not earn the market wage (private profit is negative), at least some producers could do better financially by leaving their own farms and seeking employment as hired laborers (Pearson and Monke, 1987). Ideally, implicit wages would reflect the private marginal products and divergences of the sort described above which can be used to explain the differences between private and social cost of labor. In this case, market wages are used because family labor wages cannot be empirically observed. The market wages used in this study also reflect differences of skill, labor, sex, and age.

Social Prices

Social prices are referred to as shadow prices, economic prices, or accounting prices. Social prices of commodities and domestic factors are all related to world market commodity prices. These social prices represent the `efficiency' prices and do not incorporate non-efficiency objectives (Pearson and Monke, 1987). Comparisons of private and social costs and returns in the PAM thus provide an indication of the efficiency costs (or benefits) of particular policies. These efficiency measures are then compared to non-efficiency effects to assess the ultimate merits of existing or changed policies.

In order to find the appropriate social prices for all goods, one would have to identify the goods and services as importable, exportable, or non-tradable. This classification refers to the hypothetical status of the goods or services by assuming that there is no distorting policy effect. One begins by observing whether the item is actually imported, exported, or non-tradable. In order to calculate social price for the products, one needs to know a c.i.f. import price if the product is importable, an f.o.b. export price if the product is exportable, or a decomposition of the item into its component of tradable and factor costs if the product is non-tradable. The data on c.i.f. and f.o.b. prices may be obtained from the country's international trade statistics, Department of Customs or other sources.

Implicit world prices may be found by dividing total values by quantities traded (of imports or exports). Other possible sources of direct world price can be derived from industry, government agencies, or international organizations. These c.i.f. and f.o.b. prices must be adjusted to allow for any international transport and insurance cost differences between the listed port and the relevant country port. In the case where trade distortion such as quota or tariff exists, domestic price may be driven up higher than usual, therefore, c.i.f. or f.o.b. prices in nearby countries must be obtained.

For an importable output (a domestic item that competes with imports), the c.i.f. value records internal marketing costs required to move imports from the port to the internal wholesale market. The same principle applies to exportable products. The social value of exportable products at an internal wholesale market can be obtained by subtracting the transportation costs required to move the product from the wholesale market to the port from the f.o.b. export price at the nearest port. One can develop a complete set of social output values for the PAM by applying the comparable location principle to each activity in the system. A set of social prices for soybean, onion and garlic in Chiang Mai province is presented in Table A-15.

Results and Discussion.

The policy analysis matrix of soybean, garlic, and onion is presented in Table A-16 through A-20. The first row of the accounting matrix contains private prices of revenue, cost, and profit. Private profits indicate the degree of competitiveness of the crop. From observation, farmers will pursue activities continuously only if they make private profits. The second row of the accounting matrix contains social prices of revenue, cost and profit. The term social refers to valuations that attempt to measure comparative advantage or efficiency in the agricultural production system.

The PAM of soybean were analyzed at various regimes, i.e., export regime o; soybean seed, import regime of soybean meal and import regime of soybean seed and are presented in Table A-16, A-17 and A-18. It is shown that in 1990 soybean growers in Chiang Mai province ended up with a negative net profit of 421 Baht/rai. This is not at all unusual, but rather reflects the typical structure of small scale farming in Asia as a whole. The fact that there is no entrepreneurial reward does not mean that growers have no return for their labor. It is of interest to note that family income derived from labor in own or rented farms yields a lower return per day than the average market wage rate of 65 Baht per day. This is indicative of relative shortage of labor in the agricultural sector and the incapacity of smaller farmers to pay the going wage rates for hired labor. One of the possible factors that contribute to the negative private profit of soybean in this past year may be the high cost of water pumping due to the drought at the end of the growing season.

It should be noted that in the PAM approach only the average is used. The surveyed data from this study indicate that both cost and yield of soybean in Chiang Mai province are normally distributed (Figure 8 and 11). A scatter gram in Figure [5] shows that the yield and production cost distribution of soybean in Chiang Mai province is very compact. The statistical result indicates significant increase in the relationship between yield and production cost. That is, by increasing cost of production farmers could possibly increase soybean yield. In addition, if one looks in depth at the distribution of yield and production costs, it becomes clear that high yielder would in fact enjoy a positive farm profit. Small-scale agriculture is normally profitable except in extremely bad years.

The result from Table A-16 indicates that soybean grown under an export regime is socially profitable. The positive social profit indicates that the system operates efficiently, and Chiang Mai province has a comparative advantage in producing soybean using present technology. The privately unprofitable (negative D1) and socially profitable (positive H2) in Table A-16 is, as explained, a common phenomenon However, the results from the PAM table indicate that soybean is socially unprofitable under import regimes of soybean meal and soybean seed (Table A-17 and A-18).

The yield and cost distribution of garlic and onion are presented in Figure 9, 12, 10, and 13, respectively. The scatter grams in Figure 6 and Figure 7 indicate: positive relationship between yield and production cost of both garlic and onion. In other words, higher production costs for garlic and onion would result in higher yield. The analyses of the PAM for onion and garlic are presented in Table A-19 and A-20. These results indicate that garlic and onion are both socially and privately profitable. It is also shown that private profit for onion is higher than that of garlic while social profitability of onion is lower. These positive private and social profits imply that production of garlic and onion in Chiang Mai province is efficient. However, one should also look at the policy interventions of these crops and rewards for factors in other sectors.

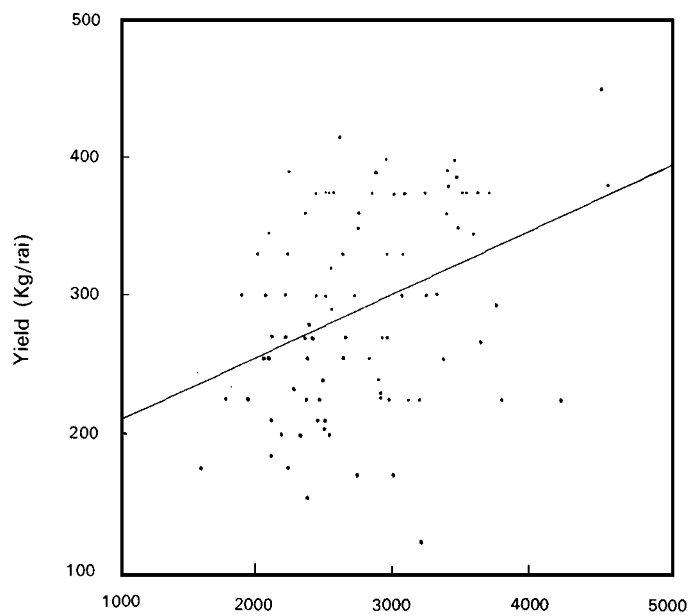


Figure 5. Yield/Production-Cost Distribution of Soybean in Chiang Mai Province, Thailsmd, 1990

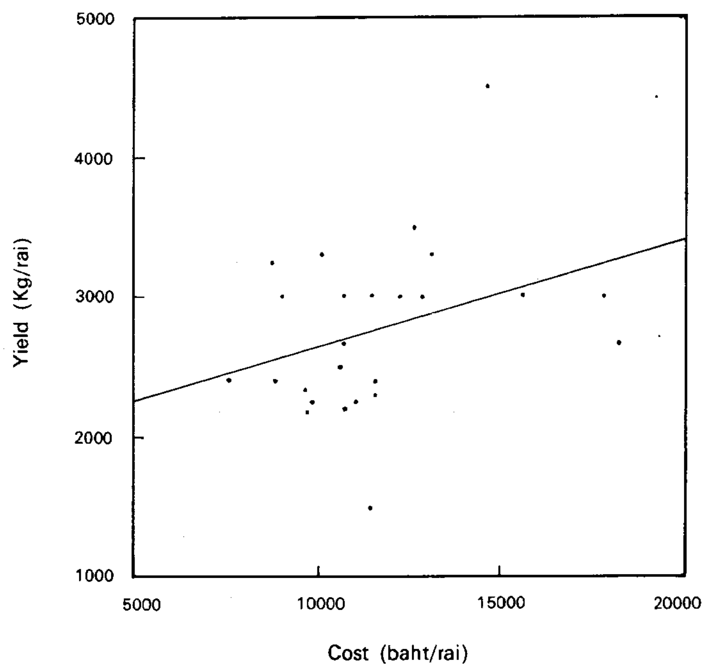
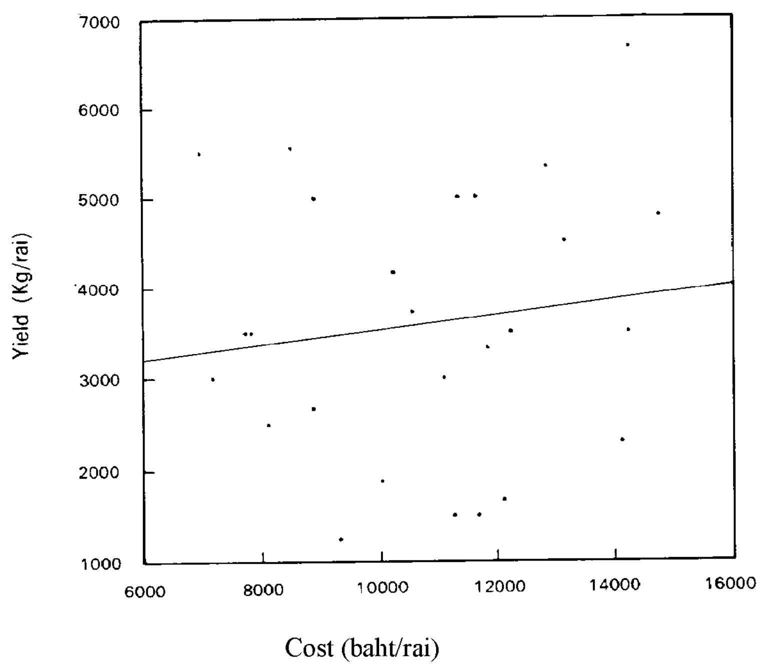


Figure 6. Yield/Production-Cost Distribution of Garlic in Chiang Mai Province, Thailand, 1990



F tgure 7. Yield/Production-Cost Distribution of Onion in Chiang Mai Province, Thailand, 1990.

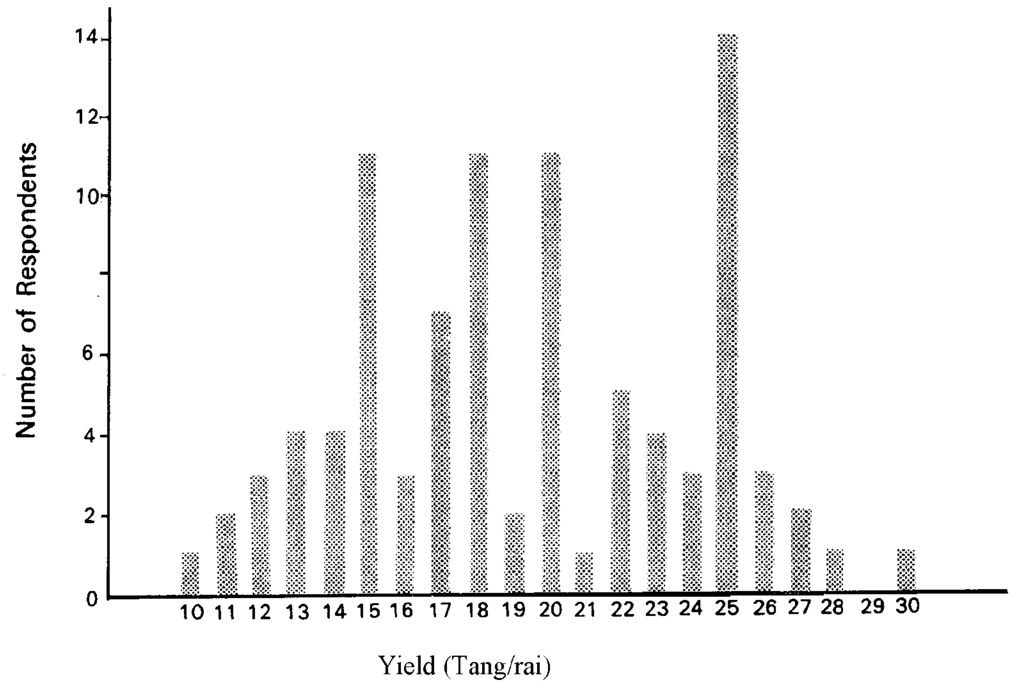


Figure 8. Soybean Yield Distribution in Chiang Mai Province, Thailand, 1990.

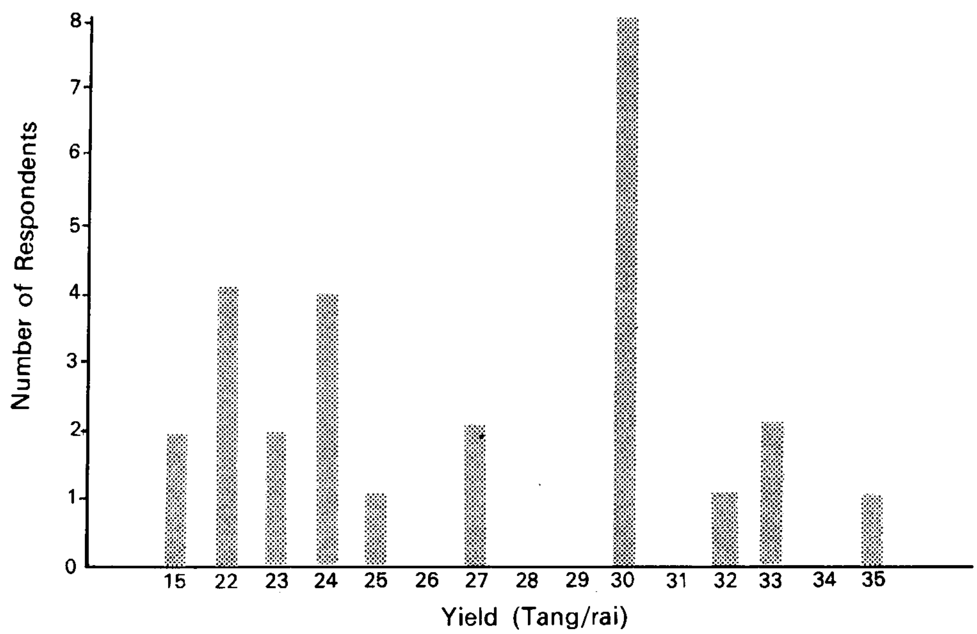


Figure 9. Garlic Yield Distribution in Chiang Mai Province, Thailand, 1990

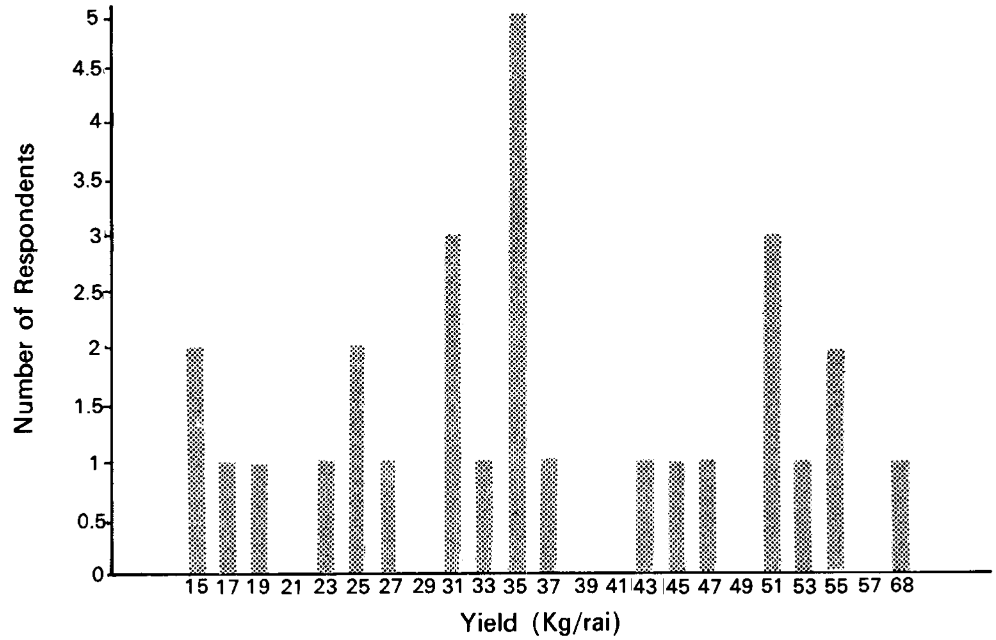


Figure 10. Onion Yield Distribution in Chiang Mai Province, Thailand, 1990

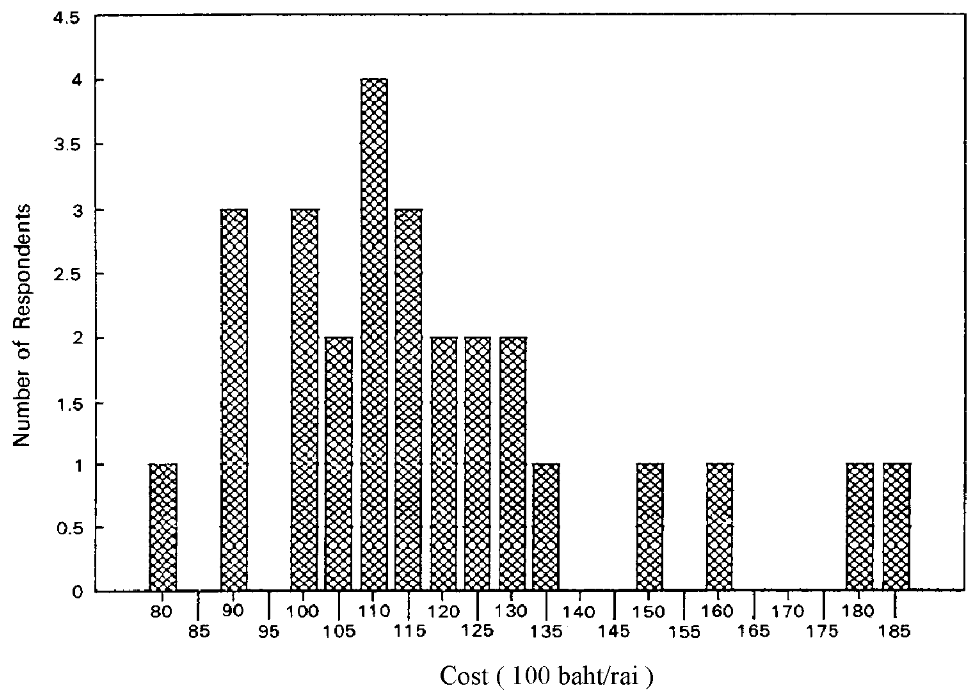


Figure 11. Soybean Cost Distribution in Chiang Mai Province, Thailand, 1990

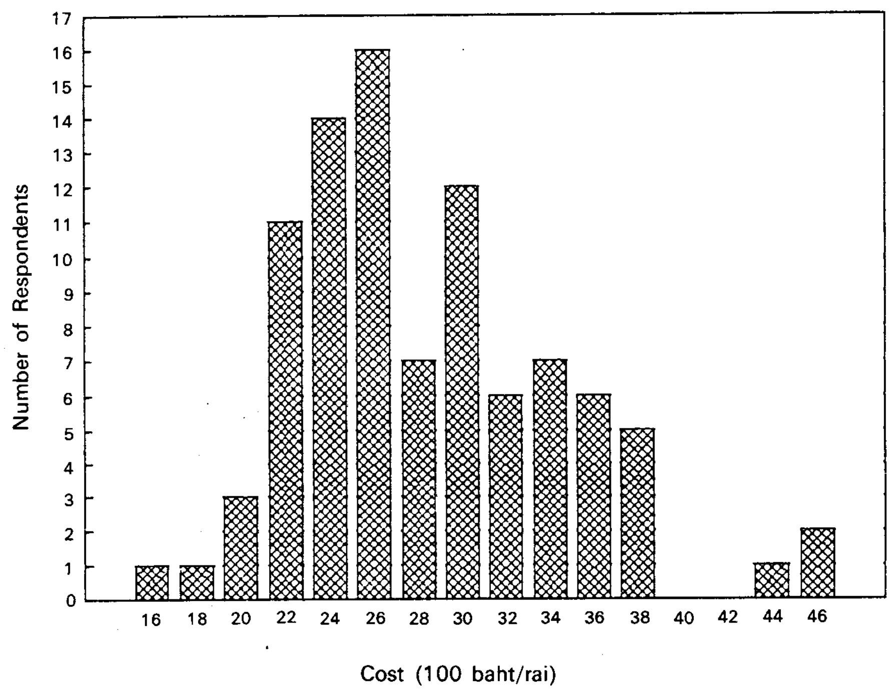


Figure 12. Garlic Cost Distribution in Chiang Mai Province, Thailand, 1990.

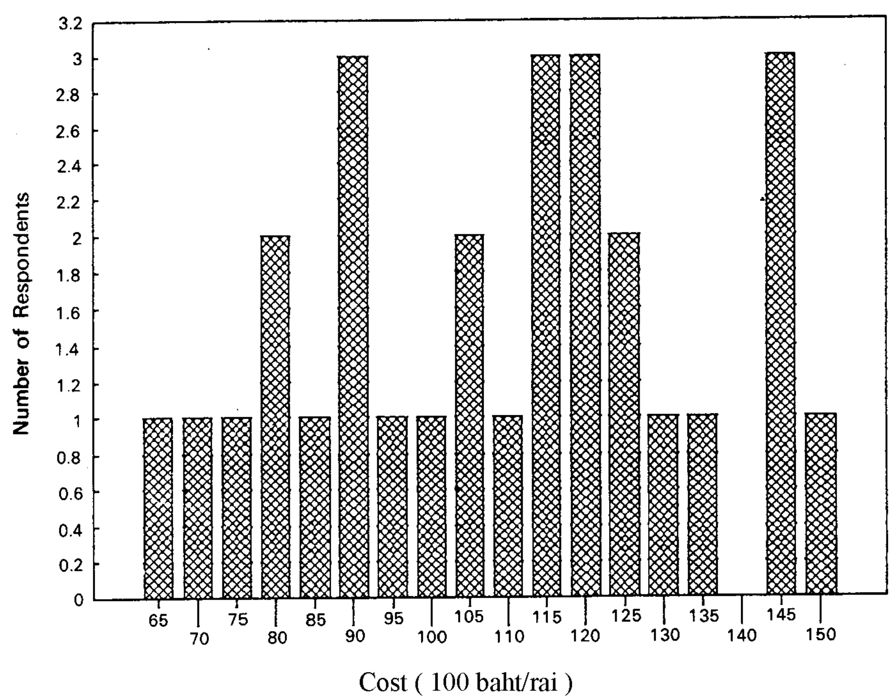


Figure 13. Onion Cost Distibution in Chiang Mai Province, Thailand, 1990.

The values of the domestic resource cost ratio (D.R.C.), private cost ratio (P.C.R.), net policy transfer (N.P.T.), benefit/cost ratio and nominal protection coefficient on output (N.P.C.O.) of soybean under different regimes, garlic and onion in Chiang Mai province are presented in Table 13. The D.R.C. and P.C.R. indicate the efficiency of social and private profitability. The D.R.C is defined as G/(E-F) which serves as a proxy measure for social profits. Clearly, D.R.C. only indicates that in any operation, to get a profit, gross revenue minus capital inputs should be exceeded by labor cost. Therefore, the system is efficient if the domestic resource cost ratio (D.R.C.) is less than 1. By comparing D.R.C. of these three crops, one can conclude that production of garlic and onion under export regime, and soybean grown under an export regime, are efficient.

Table 13. Values of Domestic Resource Cost (D.R.C.), Private Cost Ratio (P.C.R.) Net Policy Transfer (N.P.T.), Benefit. Cost ratio and Nominal Protection Coefficient on Output (N.P.C.O.) of Various Crops in Chiang Mai Province, 1990.

Crop. (Regime)	D.R.C.	P.C.R.	N.P.T.	B/C ratio	N.P.C.O.
Soybean (export)	0.79	1.27	170.71	-.19	0.67
Soybean (meal import)	1.49	1.27	-293.45	-	1.08
Soybean (seed import)	1.19	1.27	-73.58	-	0.92
Onion (export)	0.45	0.40	2,294.02	1.02	1.19
Garlic	0.37	0.30	61.65	0.85	1.0

A private cost ratio (P.C.R.) is defined as the ratio of domestic factor costs (C) to value added in private prices (A-B), therefore, P.C.R. equal to C/(A-B). Value added is the difference between the value of output and the cost of tradable inputs; it shows how much the system can afford to pay domestic factors, including a normal return to capital, and still remain competitive. The ratio P.C.R. equal to 1 indicates that farmers break even after earning normal profit, while P.C.R. greater than 1 or less than I imply that farmers are losing profit or earning excess profit, respectively. Results from Table 13 show that garlic and onion farmers earn excess profit while soybean farmers earn less than normal profit. Net policy transfer (N.P.T.) is defined as private profit minus social profit, L, **(D-H or I-J-K).** This value represents the net effect of the government policies. [The positive value of N.P.T. for onion and garlic imply that current government intervention in prices of onion and garlic production result in positive social benefit]. In contrast, the negative N.P.T. value of soybean under import regime implies that the net effect of current government intervention in both input and output prices on soybean production will result in negative social benefit. The nominal protection coefficient on output (N.P.C.O.) is defined as the ratio of private revenue and social revenue (A/E). This ratio indicates the degree of output transfer. The N.P.C.O. of soybean under an import regime of soybean meal and onion under an export regime are 1.08 and 1.19, respectively. The values of N.P.C.O. which are greater than one indicate that policies are driving up actual market prices of onion and soybean to a level of 8 and 19 percent higher than world prices. The benefit/cost ratios for soybean, onion and garlic are -0.19, 1.02 and 0.85, respectively.

6

Conclusions

This study constitutes one of the exercises using primary data from farm surveys for the estimation of private prices on the policy analysis matrix (PAM).

Comparative advantage of soybean and competing crops in Chiang Mai province was analyzed and discussed. The findings of this study may be useful in studying policies regarding the allocation of resources to production of different crops in the same area. The result of this study indicates that soybean is socially profitable, but privately unprofitable. It should be noted that the social profitability of soybean production occurs only under an export regime of soybean seed, which is somewhat unrealistic. The negative private profit indicates that the return to labor for soybean farmers is less than market wage rates. Onion and garlic production are both socially and privately profitable. In addition, producing onion is more profitable than producing garlic. The result also shows that onion production has comparative advantage over the other two crops. The D.R.C. coefficients indicate that the production of garlic and onion in Chiang Mai province is efficient.

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Appendices

Table A-1. Average Production Costs for Soybean in Chiang Mai Province, Thailand for 1990/91 season...... (Private Prices)

Labor Use	Amount (man/day)	Unit Price (Baht/day)	Cost (Baht/rai)
Field Preparation			
- Cutting rice straw	1.47	60	88.20
- Burning rice straw	1.34	60	80.40
- Making Drainage ridges	2.22	60	133.20
Planting	3.96	60	237.60
Applying Fertilizer	0.47	60	28.20
Weeding	0.56	60	33.60
Spraying Insecticide	1.14	100	114.00
Irrigation	4.05	55	222.75
Harvesting	4.13	65	268.45
Threshing		.50 Baht/Kg	149.10
Others	-	-	115.96
Total Labor Cost (C1)			1,471.46

Inputs	Amount	Unit Price	Cost (Baht/rai)
Seed	16.35 Kg/rai	16 Baht/Kg.	261.60
Fertilizer	31.05 Kg/rai	6 Baht/Kg.	186.30
Insecticide & Fungicide			186.58
Others	-		105.70
Total Tradable Input (B)			740.18
Land Rent (C2)		519.72	Baht/rai
Land tax (C3)		1.70	Baht/rai
Production		289.00	Kg./rai
Price		8.00	Baht/Kg.
Total Revenues (A)		2,312.00	Baht/rai
Total Costs (CI + B)		2,211.64	Baht/rai
Gross Profit		100.36	Baht/rai
- Land tax (C3)		1.70	Baht/rai
- Land rent (C2)		519.72	Baht/rai
Net Profit	-421.06	Baht/rai	

Source: Survey data
Note: Data were collected in Sanpathong area, Chiang Mai province, in April 1991.

Table A-2. Average Production Costs for Soybean in Chiang Mai Province, Thailand for 1990/91 Season...... (Social Prices)

Total Labor Cost (C1)*		1471.46	Baht/rai
Inputs	Amount	Unit Price	Cost (Baht/rai)
Seed	16.35 Kg/rai	16 Baht/Kg.	261.60
Fertilizer	31.05 Kg/rai	4.25 Baht/Kg.	131.96
Insecticide & Fungicide			186.58
Others	-	-	105.70
Total Tradable Input (B)			685.84
Opportunity Cost for Land (C2)		698.70	Baht/rai
Land tax (C3)		0.00	Baht/rai
Production		289.00	Kg./rai
C.I.F. Price + Transportation & Handling Cost		7.52	Baht/rai
Total Revenues (A)		2,173.28	Baht/rai
Total Costs		2,856.00	Baht/rai
Net Profit		-682.72	Baht/rai

Source: Survey data
Note: Data were collected in Sanpathong area, Chiang Mai province, in April 1991 The same as *(CI)* for private price in Table A-1.

Table A-3. Amount of Labor Used in Soybean Production in Chiang Mai Province in the Dry Season

Activity	Family Labor	Hired Labor	Exchanged Labor	Total Labor
		(man-day/rai)		
Land Preparation	1.95	3.08		5.03
Planting	1.14	1.63	1.19	3.96
Weeding	0.45	0.11		0.56
Pest Control	0.86	0.28	-	1.14
Applying Fertilizer	0.47		-	0.47
Irrigating	2.00	2.05		4.05
Harvesting	1.58	2.08	0.47	4.13
Total	8.45	9.23	1.66	19.34

Note: Hired Labor also including contracted labor

Table A-4. Wages Paid for Hired Labor in Soybean Production in Chiang Mai Province, Thailand, in 1989.

Activity	Contract Labor (Baht/rai)	Hired Labor (Baht/day) Male	Female
Cutting rice straw		65	50
Making Drainage Ridge	150		
Planting		70	50
Weeding (Spray)	-	100	
Weeding (Manual)	-	60	50
Pest control (Spray)	-	100	
Applying fertilizer	-	70	60
Harvesting	-	65	55
Threshing (machine)	0.5 Baht/Kg.		

Source: Survey data, Sanpathong area, Chiang Mai province, Thailand, 1991

Table A-5. Cost of Soybean Production in Chiang Mai Province, 1989/90

Cost (Baht/rai)	1	2	3	4
Labor Cost				
Land Preparation	235.00	238.00	275.00	301.80
Planting	200.00	203.00	200.00	237.60
Applying Fertilizer	60.00	130.00	28.20	
Weeding	20.00	128.00	80.00	33.60
Spraying insecticide	100.00	100.00	114.00	
Irrigation	140.40	280.00	222.75	
Harvesting	230.00	274.00	530.00	268.45
Threshing	121.00	128.00	121.00	149.10
Other*	17.00	49.00	17.00	115.96
Inputs				
Factors of Production				
Seed	205.00	212.00	205.00	261.60
Fertilizer	126.89	126.00	270.00	186.30
Insecticide & Fungicide	91.89	143.00	220.00	186.30
Others	122.30	24.00	175.00	105.70
Land rent & Tax	220.00	200.00	100.00	521.42
Opportunity cost for capital	59.58	152.00		-
Total Cost	1,950.15	1,877.00	2,603.00	2,211.64
Yield (Kg./rai)	300	300	300	289

Note: 1. = Government Information
2. = Survey data by S. Priebprom et al., 1991.
3. = Reported Information from farmers in Chiang Mai Province.
4.= Survey data from this study.
* : included transportation, handling et.

Table A-6. Planted Area of Soybean, Garlic, Onion, and Dry Season Rice in Thailand, 1977/78-1989/90.

Year	Soybean	Onion	Garlic	Dry Season Rice
	................................(1,000) rais)			
1977/78	N/A	N/A	167.8	2,979
1978/79	N/A	N/A	166.8	4,257
1979/80	N/A	N/A	163.0	2,103
1980/81	788	N/A	167.3	3,228
1981/82	797	N/A	191.5	3,578
1982/83	778	N/A	199.6	3,963
1983/84	1,008	9.7	228.8	4,481
1984/85	1,253	12.7	229.0	4,415
1985/86	1,524	11.3	172.2	3.958
1986/87	1,799	12.4	176.7	3,628
1987/88	2,260	15.1	215.6	4,564
1988/89	2,508	17.1	233.4	5,306
1989/90	2,669	14.4	181.3	5,244

Source: Office of Agricultural Economics, Thailand.

Table A-7. Average Production Costs for Garlic in Chiang Mai Province, Thailand, for 1990/91 Season...... (Private Prices)

Labor Use	Amount (man/day)	Unit Price (Baht/day)	Cost (Baht/rai)
Land Preparation and Planting	24.92	65	1,619.80
Applying fertilizer	2.27	60	136.20
Weeding	8.54	55	469.70
Spraying Insecticide	1.07	100	107.00
Irrigation	9.41	60	564.60
Harvesting	19.94	68	1,355.92
Others			100.00
Total Labour Cost (Cl)			4,363.22

Inputs	Amount	Unit Price	Cost (Baht/rai)
Seed	131.05 Kg/rai	27 Baht/Kg.	3,538.35
Fertilizer	124.91 Kg/rai	7 Baht/Kg.	874.37
Insecticide		-	286.40
Others	-	-	1,675.70
Total Tradable Input (B)			6,374.82
Land Rent (C2)		528.00	Baht/rai
Land tax (C3)		8.30	Baht/rai
Production		2,751.3	Kg./rai
price		7.40	Baht/Kg.
Total Revenues (A)		20,359.62	Baht/rai
Total Costs (CI + B)		10,738.04	6 Baht/rai
Gross Profit		9,621.58	Baht/rai
- Land tax (C3)		8.30	Baht/rai
- Land rent (C2)		528.00	Baht/rai
Net Profit		9,085.28	Baht/rai

Source: Survey data
Note: Data were collected in Sanpathong area, Chiang Mai province, in April 1991.

Table A-8. Average Production Costs for Garlic in Chiang Mai Province, Thailand, for 1990/91 Season..... (Social Prices)

Total Labor Cost (C1)*		4,363.22	Baht/rai
Inputs	Amount	Unit Price	Cost (Baht/rai)
Seed	131.05 Kg/rai	27 Bhat/Kg	3,539.35
Fertilizer	124.91 Kg/rai	4.83 Bhat/Kg	603.32
Insecticide			286.40
Others	-	-	1,675.70
Total Tradable Input (B)			6,103.77
Opportunity Cost For Land (C2)		896.00	Baht/rai
Opportunity Land Tax		0.00	Baht/rai
Production		2,751.3	Baht/rai
Price		7.40	Baht/Kg
Total Revenues (A)		20,359.62	Baht/rai
Total Cost		11,335.99	Baht/rai
Net Profit		9,023.63	Baht/rai

Source: Survey data
Note: Data were collected in Sampathang area, Chiang Mai Province, in April 1991.
* The same as (C1) for private price in Table A-7.

Table A-9. Average Production Costs for Onion in Chiang Mai Province, Thailand for 1990/91 Season...... (Private Prices)

Labor Use	Amount (man/day)	Unit Price (Baht/day)	Cost (Baht/rai)
Seedling Preparation	9.35	70	654.50
Land Preparation	42.04	62	2,606.48
Applying fertilizer	2.21	68	150.28
Weeding	5.67	60	340.20
Spraying Insecticide	4.01	100	401.00
Irrigation	9.68	65	629.20
Harvesting	14.93	70	1,045.10
Others			92.10
Total Labor Cost (CI)			5,918.86

Inputs	Amount	Unit Price	Cost (Baht/rai)
Seed	1.2 lbs/rai	978.83 Baht/Kg.	1,174.60
Fertilizer	201.0 Kg/rai	8.50 Baht/Kg.	1,785.00
Insecticide	-		558.80
Others	-	-	684.40
Total Tradable Input (B)			4,202.80
Land Rent (C2)		869.40	Baht/rai
Land tax (C3)		2.60	Baht/rai
Production		3,384.50	Kg/rai
Price		6.30	Kg/rai
Total Revenues (A)		21,322.35	Baht/rai
Total Costs (CI + B)		10,121.66	Baht/rai
Gross Profit		11,200.69	Baht/rai
- Land tax (C3)		2.60	Baht/rai
- Land rent (C2)		869.40	Baht/rai
Net Profit		10,328.69	Baht/rai

Source: Survey data

Note: Data were collected in Sanpathong area, Chiang Mai province, in April 1991.

Table A-10. Average Production Costs for Onion in Chiang Province, Thailand for 1990/91 Season.........(Social Prices)

Total Labor Cost (Cl)* Inputs	Amount	5,918.86 Baht/rai Unit Price	Cost (Baht/rai)
Seed	1.2 lbs/rai	978.83 Baht/lbs	1,174.60
Fertilizer	201.0 Kg/rai	4.83 Baht/Kg.	970.83
Insecticide			558.80
Others	-	-	684.40
Total Tradable Input (B)			3,388.63
Opportunity Cost for Land (C2)		528.00	Baht/rai
Land tax (C3)		0.00	Baht/rai
Production		3,384.50	Kg/rai
F.O.B. Price - Transportation & Handling Cost		5.28	Kg/rai
Total Revenues (A)		17,870.16	Baht/rai
Total Costs		9,835.49	Baht/rai
Net Profit		8,034.67	Baht/rai

Source: Survey data
Note: Data were collected in Sanpathong area, Chiang Mai province, in April 1991
* The same as (CI) for private price in Table A-9.

Table A-11. Planted Area, Production, Average Yield and Farm Price of Dry Season Rice in Chiang Mai Province, Thailand, 1980-1990.

Year	Planted Area (rais)	Production (tons)	Average Yield (kg/rai)	Farm Price (Baht/kg)
1980	40,434	17,876	442	3.12
1981	20,277	10,145	504	3.42
1982	28,928	12,500	432	2.62
1983	28,572	9,172	441	2.90
1984	42,350	27,739	656	2.97
1985	38,889	21,389	550	2.50
1986	35,977	19,859	552	2.16
1987	32,636	17,551	544	2.49
1988	65,861	40,309	620	3.61
1989	42,307	25,918	613	3.68
1990	40,416	26,578	663	2.95

Sources: Office of Agricultural Economics, Thailand.
Chiang Mai Provincial Agricultural Office

Table A-12. National Average Farm gate and Wholesale (Bangkok) Price of Soybean in 1990

Month	Farm gate Price (Baht/Kg)	Wholesale Price in Bangkok (Baht/Kg)	Future Market Price at Chicago (Baht/Kg)
January	7.17	9.25	5.35
February	7.32	9.25	5.35
March	7.28	9.25	5.58
April	7.11	N/A	5.79
May	7.27	9.68	5.85
June	7.49	9.83	5.79
July	7	10.16	5.69
August	6.92	9.5	5.7
September	7.7	9.17	N/A
October	7.53	9.88	5.63
November	7.19	9.47	5.35
December	7.13	10.6	5.36
Average	7.26	9.64	5.58

Source: Office of Agricultural Economics, Thailand.

Table A-13. Quantity and Price of Soybean meal imported, Wholesale Price Bangkok and Future Market price in Chicago

Month (1990)	Quantity Import (tons)	Value (1,000 Bht)	C.I.F. Bkk (Bht/Kg)	Wholesale (Bht/Kg)	Future Market Price in Chicago (Bht/Kg)
January	N/A	N/A	N/A	8.44	5.68
February	17,454.5	104,265.90	5.97	8.4	4.3
March	46,807.9	301,889.96	6.45	8.56	4.34
April	4,260.9	25,143.74	5.9	8.5	4.55
May	15,045.5	86,399.34	5.74	8.77	4.67
June	11,686.6	65,870.77	5.64	9.08	4.57
July	28,577.8	162,039.74	5.68	9.07	4.49
August	23,551.8	129,503.57	5.5	8.71	4.48
September	18,178.8	102,241.23	5.62	N/A	N/A
October	84,218.4	471,785.31	5.6	8.95	4.61
November	27,983.4	148,310.42	5.37	8.49	4.37
December	34,646.8	183,628.00	5.3	8.43	4.29
Average	28,401.1	161,916.18	5.7	8.67	4.49
Total	312,412.3	1,781,078.00			

Source: Department of Customs, Bangkok, Thailand

Table A-14. Monthly Quantity, Value, and F.O.B. Prices of Onion Export from Thailand in 1989

Month (1989)	Quantity Export (tons)	Value (1,000 Baht)	F.O.B. BKK. (Baht/Kg)
January	325.1	2,936.98	9.03
February	3,639.0	32,836.55	9.02
March	5,257.4	41,634.52	7.92
April	706.7	3,832.05	5.42
May	505.4	2,011.45	3.98
June	0.0	0.00	0.00
July	10,433.5	83,251.55	7.98
August	8.3	53.01	6.40
September	0.0	0.00	0.00
October	0.3	12.97	4.05
November	0.0	0.00	0.00
December	0.0	0.00	0.00
Total	20,875.7	166,569.07	7.98
Average/month	1,739.6	13,881.51	7.98

Source: Department of Customs, Bangkok.

Table A-15. A Set of Opportunity Prices (Social Prices) for the Soybean Case Study, 1990.

Commodity'	Regime	Commodity Prices at the border[2] (Baht/Kg)	Import Costs (Baht/Kg)	Transportation & Handling	
				Port to Wholesale (Baht/Kg)	Farm to Wholesale (Baht/Kg)
Soybean	Import	6.87[3]	-		
	Export	13.74[4]	-	1.74	0.07
Soybean cake	Import	5.71[5]	13.44	1.74	0.07
Onion	Export	7.12		1.74	0.10
Garlic	-	7.40	-	-	

Source: Office of Agricultural Economics and Department of Customs, Bangkok, Thailand.
[1] Garlic farm gate prices are assumed to be social values.
[2] F.O.B. prices for for export regime, C.I.F. prices for import regime,
[3] C.I.F. Rotterdam prices from F.A.O. Production yearbook. (S 1.U.S. = 25 Baht)
[4] F.O.B. Bangkok Price
[5] C.I.F. Bangkok = 5.71, Average Surcharge = 1.70 Baht/kg. (Import from China)

Commodity	Regime	Farm gate Price Calculation, (Baht/Kg).
Soybean	Export	13.74 - 1.74 - 0.07 = 11.93
Soybean cake	Import	5.71 + 1.74 + 0.07 = 7.52
Onion	Export	7.12 - 1.74 - 0.10 = 5.28

Export = F.O.B. Prices -Transportation and handling cost
Import = C.I.F. BKK Prices + Transportation and handling cost

Table A-16 Policy Analysis Matrix of Soybean In Chiang Mai Province, Thailand (Export of soybean)

	Revenue (Baht/rai)	Cost Bath/rai) Tradable Inputs	Domestic Factors	Land rent	Land Taxes	Total Cost (Baht/rai)	Profits (Baht/rai)
Private Prices	2,312.00	740.18	1,471.46	519.72	1.70	2,733.06	-421.06
Social Prices	3,447.77	685.84	1,471.46	698.7	0	2,856.00	591.77
Policy Effects	-1,135.77	54.34	0	-178.98	1.70		170.71

D.R.C. = 0.79
P.R.C. = 1.268
Note: Transportation and handling cost from farm to port = 1.80 Baht/Kg. F.O.B.
Bkk price = 11.93 Baht/Kg.
Revenue from 1 rai, yield = 289 Kg/rai.

Table A-17. Policy Analysis Matrix of Soybean in Chiang Mai Province, Thailand (Import of Soybean meal).

	Revenue (Baht/rai)	Cost Bath/rai) Tradable Inputs	Domestic Factors	Land rent	Land Taxes	Total Cost (Baht/rai)	Profits (Baht/rai)
Private Prices	2,312.00	740.18	1,471.46	519.72	1.70	2,733.06	-421.06
Social Prices	2,141.49	685.84	1,471.46	698.7	0	2,856.00	-714.51
Policy Effects	170.51	54.34	0	-178.98	1.70		-293.45

D.R.C. = 1.49
P.R.C. = 1.268
Note: Transportation and handling cost from farm to port = 1.80 Baht/Kg. C.I.F.
Bkk price = 7.41 Baht/Kg.
Revenue from 1 rai, yield = 289 Kg/rai.

Table A-18. Policy Analysis Matrix of Soybean in Chiang Mai Province, Thailand (Import of Soybean seed).

	Revenue (Baht/rai)	Cost Bath/rai) Tradable Inputs	Domestic Factors	Land rent	Land Taxes	Total Cost (Baht/rai)	Profits (Baht/rai)
Private Prices	2,312.00	740.18	1,471.46	519.72	1.70	2,733.06	-421.06
Social Prices	2,508.52	685.84	1,471.46	698.7	0	2,856.00	-347.48
Policy Effects	-196.52	54.34	0	-178.98	1.70		-73.58

D.R.C. = 1.19
P.R.C. = 1.26
Note: Transportation and handling cost from farm to port = 1.80 Baht/Kg. C.I.F.
Rotterdam = 6.87 Baht/Kg.
Revenue from 1 rai, yield = 289 Kg/rai.

Table A-19. Policy Analysis Matrix of Garlic in Chiang Mai Province, Thailand.

	Revenue (Baht/rai)	Cost Bath/rai) Tradable Inputs	Domestic Factors	Land rent	Land Taxes	Total Cost (Baht/rai)	Profits (Baht/rai)
Private Prices	20,359.62	6,374.82	4,363.22	528	8.30	11,247.34	9,085.28
Social Prices	20,359.62	6,103.77	4,363.22	869	0	11,335.99	9,023.63
Policy Effects	0	271.05	0	-341	8.30		61.65

D.R.C. = 0.37
P.R.C. = 0.350
Note: Transportation and handling cost from farm to port = 1.81 Baht/Kg. Revenue from 1 rai, yield = 2,751.3 Kg/rai.

Table A-20. Policy Analysis Matrix of Onion in Chiang Mai Province, Thailand (Export Regime).

	Revenue (Baht/rai)	Cost Bath/rai) Tradable Inputs	Domestic Factors	Land rent	Land Taxes	Total Cost (Baht/rai)	Profits (Baht/rai)
Private Prices	21,322.35	4,202.80	5,918.86	869.40	2.60	10,993.66	10,328.69
Social Prices	17,870.16	3,388.63	5,918.86	528.00	0	9,835.49	8,034.67
Policy Effects	3,452.19	814.17	0	341.40	2.60		2,294.02

D.R.C. = 0.45
P.R.C. = 0.40
Note: Transportation and handling cost from farm to port = 1.84 Baht/Kg. F.O.B. Bkk price = 7.12 Baht/Kg.
Revenue from I rai, yield = 3,384.50 Kg/rai.

Table A-21. Cost, Revenue and Profit Per Rai of Soybean Production in Chiang Mai Province.

Items	Unit	Profit-making (n = 28)	Non-profit-making (n = 64)	Both (n = 92)
Costs:	baht	2.434.4	2.884.6	2.747.6
a. Fixed Costs				
- Rent	baht	481.0	529.8	514.9
- Tax	baht	0.8	2.1	1.7
b. Variable Costs				
b.1 Labor	baht	1,299.5	1,564.3	1,462.4
- Cutting straw	baht	81.8	90.1	87.6
- Burning	baht	63.8	86.5	79.6
- Ditching	baht	111.2	143.4	133.6
- Planting	baht	192.7	257.3	237.6
- Applying fertilizer	baht	24.6	30.9	29.0
- Weeding	baht	34.8	34.5	34.6
- Irrigating	baht	103.0	121.6	122.0
- Spraying	baht	176.5	254.8	231.0
- Harvesting	baht	241.7	278.4	267.2
- Threshing	baht	167.3	142.6	150.1
- Others	baht	102.1	124.0	117.3
b.2 Material	baht	653.0	788.5	747.3
-Seeds	baht	250.5	265.9	261.2
- Fertilizers	baht	164.8	197.5	187.6
- Chemicals	baht	167.2	203.2	192.2
- Other	baht	70.5	121.9	106.3
Revenues:				
a. Yield	kg	326.0	275.0	290.5
b. Price/kg	baht	8.4	7.8	8.0
c. Revenues	baht	2.738.4	2.145.0	2.324.0
Profits	baht	481.0	529.8	514.9

Source: Survey data, 1991.

Table A-22. Statistical Estimation of Production Function of Soybean: Example of Profit-making Farmers in Chiang Mai Province.

DEP VAR: Y(1) N: 28 MULTIPLE R: 0.918 SQUARED MULTIPLE R: 0.843
ADJUSTED SQUARED MULTIPLE R_˙.673 STANDARD ERROR OF ESTIMATE: 0.110

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	2.873	1.098	0.000		2.616	0.021
L(1)	-0.069	0.048	-0.217	0.544	-1.454	0.170
L(2)	0.013	0.023	0.089	0.466	0.552	0.590
L(3)	-0.031	0.078	-0.091	0.229	-0.396	0.699
L(4)	0.134	0.110	0.242	0.309	1.222	0.243
L(5)	0.050	0.051	0.313	0.188	0.977	0.346
L(6)	0.004	0.019	0.034	0.484	0.214	0.834
L(7)	-0.000	0.023	-0.001	0.427	-0.008	0.993
L(8)	0.001	0.044	0.009	0.102	0.025	0.980
L(9)	-0.160	0.112	-0.228	0.476	-1.430	0.176
L(10)	0.549	0.111	0.723	0.566	4.948	0.000
M(1)	0.158	0.162	0.158	0.462	0.974	0.348
M(2)	-0.175	0.096	-0.410	0.240	-1.826	0.091
M(3)	0.106	0.053	0.286	0.582	1.986	0.068
X(1)	-0.007	0.073	-0.015	0.557	-0.099	0.923

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	0.850	14	0.061	4.976	0.003
RESIDUAL	0.159	13	0.012		

Table A-23. Statistical Estimation of Production Function of Soybean: Example of Non-Profit-making Farmers in Chiang Mai Province.

DEP VAR: Y(1) N: 54 MULTIPLE R: 0.892 SQUARED MULTIPLE R: 0.797
ADJUSTED SQUAREM MULTIPLE R.˙.738 STANDARD ERROR OF ESTIMATE: 0.129

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	2.964	0.730	0.000		4.061	0.000
L(1)	-0.028	0.043	-0.048	0.736	-0.639	0.526
L(2)	-0.010	0.012	-0.060	0.860	-0.869	0.389
L(3)	-0.008	0.040	-0.015	0.791	-0.211	0.834
L(4)	-0.060	0.045	-0.094	0.831	-1.331	0.189
L(5)	0.046	0.027	0.146	0.559	1.694	0.097
L(6)	-0.013	0.014	-0.080	0.568	-0.935	0.354
L(7)	-0.002	0.019	-0.008	0.665	-0.105	0.917
L(8)	0.003	0.030	0.007	0.710	0.093	0.926
L(9)	-0.014	0.060	-0.017	0.816	-0.242	0.810
L(10)	0.769	0.070	0.851	0.699	11.038	0.000
M(1)	-0.118	0.099	-0.086	0.803	-1.196	0.237
M(2)	-0.023	0.027	-0.073	0.550	-0.838	0.406
M(3)	0.308	0.025	0.142	0.462	1.501	0.140
X(1)	-0.046	0.041	-0.098	0.571	-1.144	0.258

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	3.190	14	0.228	13.703	0.000
RESIDUAL	0.815	49	0.017		

Table A-24. Statistical Estimation of Production Function of Soybean: Case for Both Profit and NonProfit-making Farmers in Chiang Mai Province.

DEP VAR: Y(1) N: 28 MULTIPLE R: 0.918 SQUARED MULTIPLE R: 0.843
ADJUSTED SQUARED MULTIPLE R:.673 STANDARD ERROR OF ESTIMATE: 0.110

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	2.964	0.709	0.000	.	4.179	0.000
L(1)	-0.028	0.042	-0.055	0.396	-0.658	0.513
L(2)	-0.010	0.012	-0.059	0.628	-0.895	0.374
L(3)	-0.008	0.039	-0.017	0.445	-0.217	0.829
L(4)	-0.060	0.044	-0.096	0.560	-1.370	0.176
L(5)	0.046	0.026	0.175	0.274	1.744	0.086
L(6)	-0.013	0.014	-0.082	0.382	-0.962	0.340
L(7)	-0.002	0.018	-0.009	0.378	-0.108	0.914
L(8)	0.003	0.030	0.011	0.194	0.096	0.924
L(9)	-0.014	0.058	-0.017	0.573	-0.249	0.804
L(10)	0.769	0.068	0.866	0.476	11.360	0.000
M(1)	-0.118	0.096	-0.089	0.533	-1.231	0.223
M(2)	-0.023	0.026	-0.065	0.483	-0.862	0.392
M(3)	0.038	0.024	0.127	0.409	1.545	1.127
X(1)	-0.046	0.039	-0.092	0.454	-1.177	0.244
D	-0.090	1.433	-0.168	0.000	-0.063	0.950
DL(1)	-0.042	0.068	-0.332	0.009	-0.608	0.545
DL(2)	0.023	0.028	0.175	0.059	0.810	0.421
DL(3)	-0.023	0.097	-0.194	0.004	-0.234	0.816
DL(4)	0.194	0.132	1.878	0.002	1.473	0.146
DL(5)	0.004	0.063	0.021	0.020	0.057	0.955
DL(6)	0.018	0.026	0.118	0.091	0.678	0.500
DL(7)	0.002	0.032	0.015	0.038	0.055	0.956
DL(8)	-0.002	0.058	-0.016	0.009	-0.029	0.977
DL(9)	-0.145	0.139	-1.470	0.001	-1.041	0.302
DL(10)	-0.221	0.143	-2.087	0.002	-1.546	0.127
DM(1)	0.276	0.208	2.824	0.001	1.331	0.188
DM(2)	-0.152	0.112	-1.424	0.003	-1.361	0.178
DM(3)	0.068	0.065	0.634	0.008	1.046	0.300
DX(1)	0.039	0.091	0.116	0.038	0.430	0.669

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	4.697	29	0.162	10.318	0.000
RESIDUAL	0.973	62	0.016		

Table A-25. Area Response to Relative Prices

Commodity		Intercept	Ratio of own price to price of					Adj. R2
			Soybean	DS Soybean	Garlic	Onion	DS Rice	
Soybean	(1)	12.571 (79.90)***	x	x	1.243 (12.63)***	-	0.326 (2.16)*	0.981
	(2)	11.722 (12.90)***	x	x	-0.531 (0.90)	-	0.380 (0.44)	0.169
DS Soybean	(1)	12.075 (488.86)***	x	x	-	0.431 (8.10)***	-	0.899
	(2)	12.204 (128.45)***	x	x	-	0.167 (0.80)	-	0.115
Garlic	(1)	10.844 (165. 64)***	-	-	x	0.214 (2.35)*	-	0.594
	(2)	10.854 (116.72)***	-	-	x	0.219 (1.54)	-	0.467
Onion	(1)	9.850 (340.96)***		-	0.236 (7.45)***	x	-0.634 (48.52)***	0.999
	(2)	8.436 (20.77)***		-	-0.601 (1.31)	x	0.705 (3.87)*	0.872
DS Rice	(1)	11.264 (184.51)***			0.537 (10.08)**'	0.143 (5.31)**	x	0.986
	(2)	9.761 (44.66)***		-	-0.489 (2.57)*	-0.114 (0.98)		0.801

(1) Model without lagged price ratio variables
(2) Model with 1-year lagged price ratio variables
- Not significant at the 90 % confidence level
x Not included in the model
( ) t ratios with the following specifications:
*** significant at the >99%
** significant at the 96-99%
*significant at the 90-95%
DS Dry Season

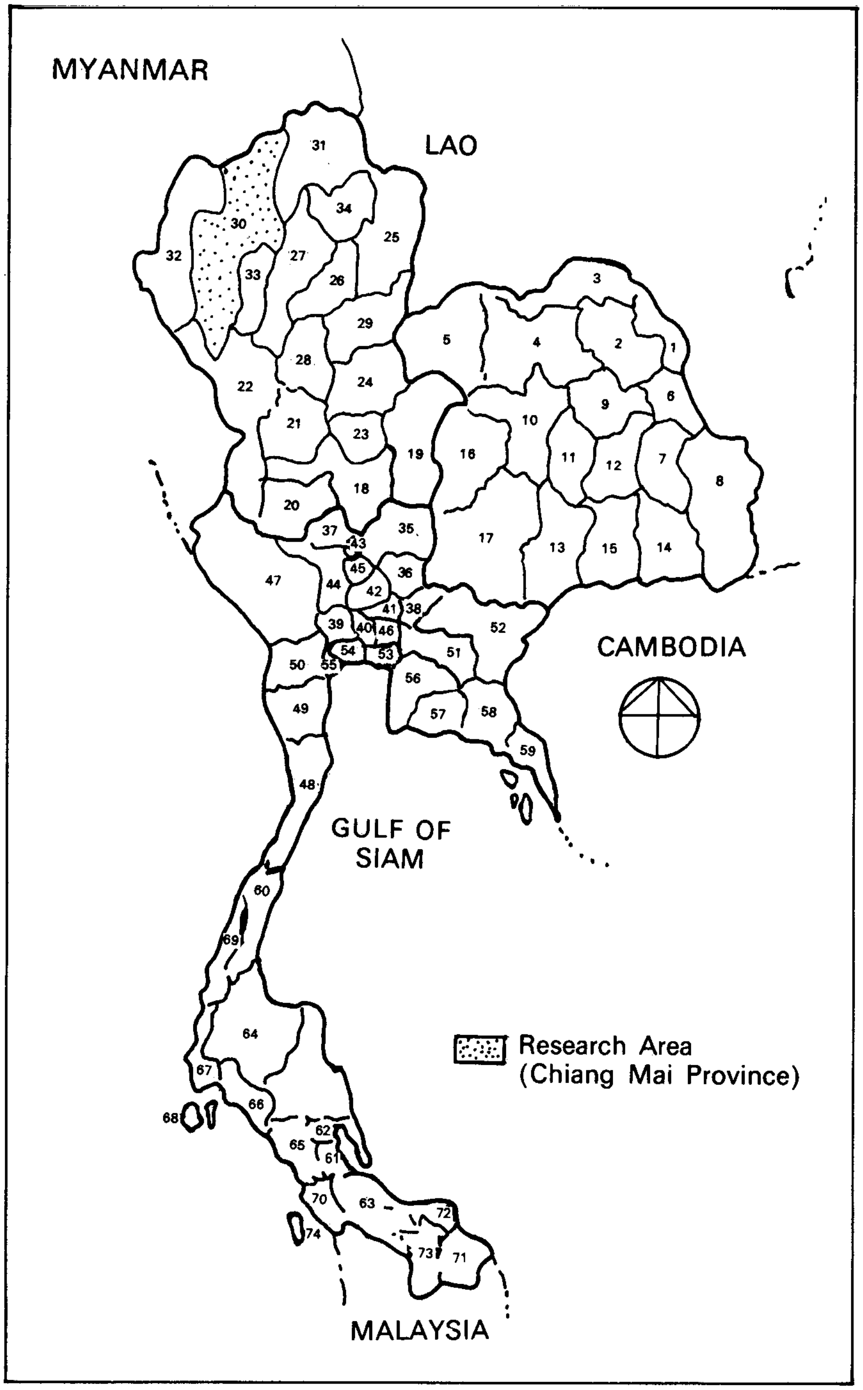

Figure A-1. Map of Thailand

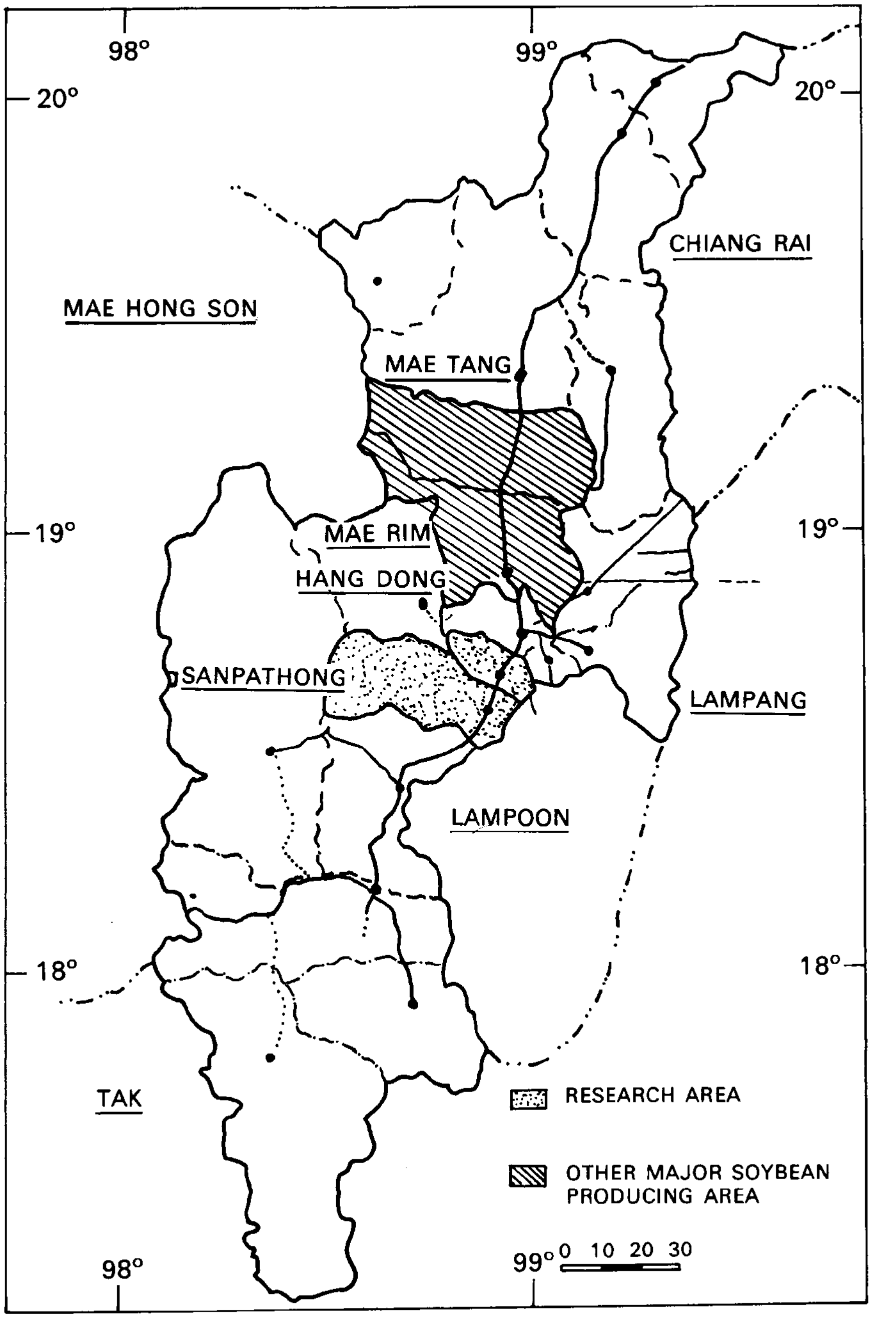

Figure A-2. Map of Chiang Mai Province Thailand

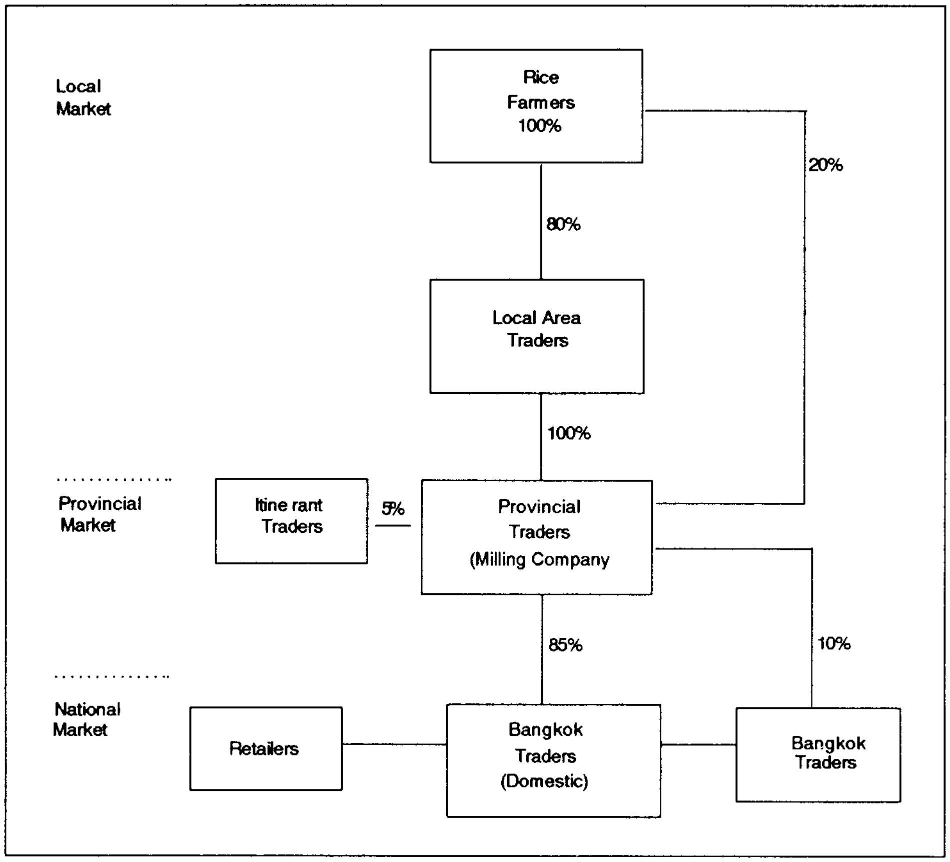

Figure A-3. Marketing Channels of Dry Season Rice in Chiang Mai Province, Thailand, 1990.
Source: Chiang Mai Provincial Agricultural Office.
Survey Information in Sanpathong Area, Chiang Mai Province, 1991.

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Part II

Local Comparative Advantage of Soybean Production: Cases from East Java, Indonesia

Hermanto, Annen Zulham, and Sri H. Suhartini

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Summary

Soybean can be regarded as a strategic commodity in Indonesia because it can generate added value in the economy and it can also generate income and employment in rural areas. In addition, soybean has nutritional value because of its high protein and vegetable fat content.

To promote soybean production, the Indonesian government has implemented many policies, which can be categorised as: (1) trade policy, (2) price policy, and (3) input subsidy. The development of domestic soybean production also supports the agricultural diversification program, as well as reducing import dependency.

East Java was selected as a case study location because it is the main soybean producing province in Indonesia. The South Blitar district was selected to represent a relatively low productivity area, while Jember was selected to represent a high productivity area.

Farmers in Jember spent a relatively low proportion of total cost to buy chemical fertilizer. The farmers apply a low dose of fertilizer for soybean because of the residual effect of fertilzer from the previous crops - however, farmers in Blitar applied relatively high doses of fertilizer due to the low soil fertility.

It has been recorded that about 75 percent of the soybean produced in Jember was transported to Surabaya and Solo through the regional wholesale system, a smaller portion of the soybean produced in Blitar was traded regionally. Cottage industries, producing tofu and soybean tempe are major consumers of soybean in the local villages.

The results from PAM analysis show that soybean production brings financial profit to farmers, while social profit is negative.

In contrast to the soybean production in Blitar, soybean production in Jember is both financially and socially profitable, as soybean production in Jember benefits from good soil and climatic conditions. In addition soybean production in this area is supported by good water management.

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1

Introduction

Soybean as a Food Commodity

Soybean is one of the major processed foods consumed in Indonesia. Winarno (1985) estimated that about 4 percent of soybean production is lost in the post-harvest activities but that 95 percent is consumed in the form of the processed foods tempe, tofu, and soy sauce, the most popular soy foods in Indonesia. These foods are a major source of protein. Tempe and tofu contain about 40% protein and 10% vegetable oil. They are a healthy substitute for meat protein (Young and Scrimshaw, 1985).

Soybean as a Source of Income and Employment

Soybean can be considered as a secondary crop for many farmers in Indonesia. It is usually planted both in wetland (sawah) and dry land towards the end of the rainy season. In 1988, soybean occupied an area of about 1.10 million ha, 56% of which is located in Java, 26% in Sumatra, 9% in Bali and Nusa Tenggara, 7% in Sulawesi, and the remaining 2% in Maluku and Irian (BPS, 1989).

The production statistics also show that soybean production in Indonesia increased from 500.000 tons in 1970 to 1,314.000 tons in 1989. The nominal price of soybean has also increased from 287 Rp/kg in 1980 to 517 Rp/kg in 1986 and on to + 1000 Rp wholesale in early 1991. In addition, the production per hectare of soybean, as a proxy of the crop's productivity, increased from 0.72 ton/ha in 1970 to 1,1 ton/ha in 1989. From these figures we can see that the contribution of soybean to the Indonesian economy has increased due to the increase of both production and prices.

Soybean, as are most secondary crops, is grown for cash income, but the economic benefit of producing soybean is not limited to the farm level. Since most soybean is processed, the production expansion of soybean will increase the value-added as well as labour absorption in the soy processing industry. For both soy-producer and soyprocessor, soybean has a steadily increasing and important role in agricultural and rural development in Indonesia.

Prospects for Soybean

Even though soybean production in Indonesia has increased recently, the level of domestic soy production does not match the level of national Soya consumption. Food balance sheets show that Indonesia is a net importer of soybean. Import of soybean has increased from 101 thousand tons in 1980 to 287 thousand tons in 1987 (Food Balance Sheet, BPS), and reached approximately 500.000 tons in recent years. It is projected that with the slow development of domestic production, imports of soybean u ill reach the level of 1.2 million tons per year in the near future.

To promote soybean production in Indonesia, the government has implemented many policies. The government policies on soybean can be categorized as follows: 1) trade policy, 2) price policy, and 3) input subsidy. Consistent with the fifth Five

Year Development Plan (PELITA V), the government launched a diversification program, to promote among others, the development of soybean. The development of increased domestic soybean production is also intended to decrease import dependency on soybean.

BULOG, the national marketing and trade board, is the national agency with the authority to implement the soybean trade policy in Indonesia. BULOG sets the import quota in order to protect the soy producer from the low soybean price in the world market. The ratio of world price to domestic price of soybean has ranged from 0.6 to 0.42 in recent years (Pribadi and Sampath, 1990). The government policy on the soybean import quota, therefore, can be regarded as an indirect price subsidy for soybean producers.

As a complement to the government trade policy, the government also sets a floor price. The government announced a minimum price of soybean at the farm gate level. The government, through BULOG, will buy soybean at the floor price if the soybean price drops below the minimum price. Experience shows, however, that this policy has never been implemented because the farm gate price of soybean has never dropped below the minimum price.

In addition to these policies the government has also provided input subsidies. The government subsidizes, although now at a reduced level, technical inputs such as fertilizers (Urea, TSP, KCI, ZA) and some pesticides. Another form of input subsidy is the capital subsidy. The government provided until recently a farm credit program (KUT) with a subsidized interest rate. In 1990 this program was partly abandoned and reduced.

Soybean and Technological Development

The crucial factor which determines soybean production is production technology. The Indonesian government has financed and conducted research to support the development of soybean. This research can also be regarded as an indirect subsidy to soybean producers through technological improvements, which in turn will increase soybean productivity.

Since PELITA I, the Co-ordinating Research Institute for Food Crops (CRIFC) has released 13 high yielding varieties, for instance, Lokon, Guntur, Wilis, and MLG 2684. These improved varieties have a potential farm yield ranging from 1.5 to 2.0 ton/ha. With improved farm technology farm yield of soybean could increase from 1.1 ton/ha to 1.7 ton/ha.

One of the remaining questions is whether the farmers are capable of adopting the newly introduced technology to increase their level of production. This is a basic agronomic and socio-economic question which should be answered through further research. Recent research has indicated that there are substantial inter-regional and - zonal variations. This study may contribute to determining whether the present government subsidies and policies have different impacts on farmers depending on their level of soybean productivity. It is self-evident that impacts vary with productivity levels. Quantification of spatial policy impact differentials under the present trade regime is therefore important.

The recognition of spatial distribution of inefficiencies will become more important in the on-going process of market formation in rural areas in Indonesia.

2

Objectives and Approach

Scope of the Research

The study was conducted in two villages in East Java. East Java is selected as a case study location because it is the main soybean producing province in Java. In East Java, one village is selected to represent a region with low production and another to represent a region with high production. These are located in two different zones, in limestone based soils and in alluvial soils.

Because of budget and time limits only 60 farmers were interviewed in each village.

Research Objectives

The objectives of the study are:

1. To analyze the economic comparative advantage of the soybean production in specific areas.
2. To identify the impact of government policy on the soybean farmers in relation to their level of soybean productivity.
3. To provide an insight into using P.A.M. as an approach to determine national and local comparative advantage analysis.

Analytical Tools

The study analyses the comparative advantage of producing soybean, taking into account the technology used by the farmers. One way to analyze the comparative advantage of producing soybean is by using the Policy Analysis Matrix (PAM) method (Pearson and Monke, 1989) to compare the private profitability and economic profitability of producing soybean.

PAM has two basic identities. The first is the Private Profit identity which uses market prices to calculate both cost and revenue. The second is the Economic Profit which uses shadow prices to calculate the cost and benefit of producing soybean. From these two identities we can analyze whether there is any transfer in either input cost and output income to or from the economy in producing soybean. The general framework of PAM is presented in Table 1.

Table 1. Policy Analysis Matrix

	Output	Cost		Profit
		Tradable Input	Domestic Input	
Market Price	A	B	C	D[a)]
Shadow Price	E	F	G	H[b)]
Impact Policy and Market Distortion	10[c)]	J[d)]	K[e)]	L

Note: [a)] Profit with market prices: D = A-B-C
[b)] Profit with shadow prices: H = E-F-G
[c)] Transfer of output
[d)] Transfer of traded inputs
[e)] Transfer of non-traded inputs

In addition to the PAM, analysis will be conducted in conjunction with standard descriptions of the agricultural and market situations. This is of special importance to identify competing crops at local level.

3

Two Cases in East Java, in Upland and Irrigated Areas

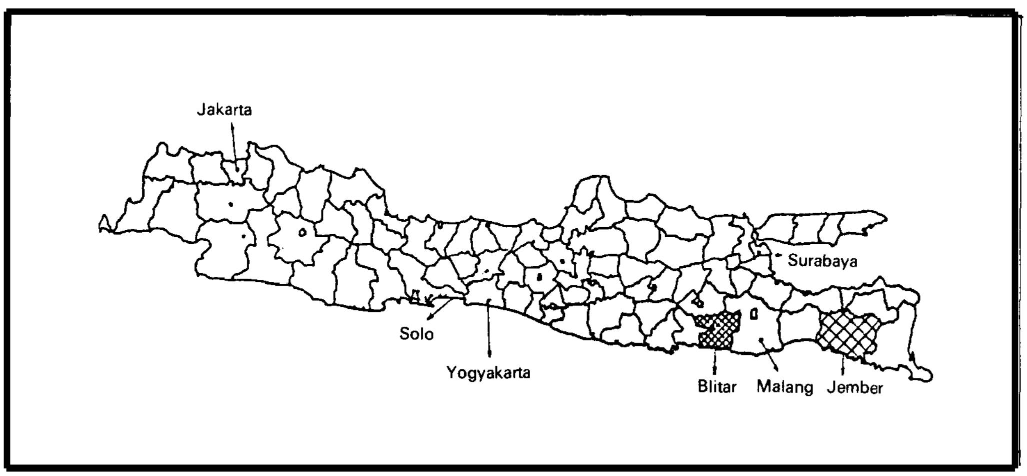
Two districts were selected, the district of Jember which has the highest level of soybean production in Indonesia, and the district of Blitar which has low but sustained production, although the southern part is located on marginal and some critical land For their locations see maps 1, 2 and 3.

The cropping patterns in the two research areas differ considerably. Thesse differences are related to the different soil types, soil fertility, rainfall, and available irrigation.

Pontang village, Jember district

The Jember district has consistently been the most important soybean producing district of Indonesia. In 1973, 70.000 tons were produced, declining to 31.000 tons in 1983, after which production climbed again to reach 72.000 tons in 1987. In 1989 production reached 64.000 tons. The sub-district (kecamatan) of Ambulu in which Pontang is located, produced 5.250 tons (8.3%) of this total in 1989.

The village of Pontang is located in a fertile area, with alluvial (Regosol) flat lands. These soils are suitable for the cultivation of rice, sugarcane, palawija, and tobacco. Technical irrigation is practiced in every village benefiting rice production. The area under technical irrigation in Pontang reaches 457,16 ha. Farm-yards occupy 263,16 ha, whereas upland (tegalan) occupies 66,40 ha. Other land uses (roads. recreation, village lands) occupy an area of 165,55 ha.



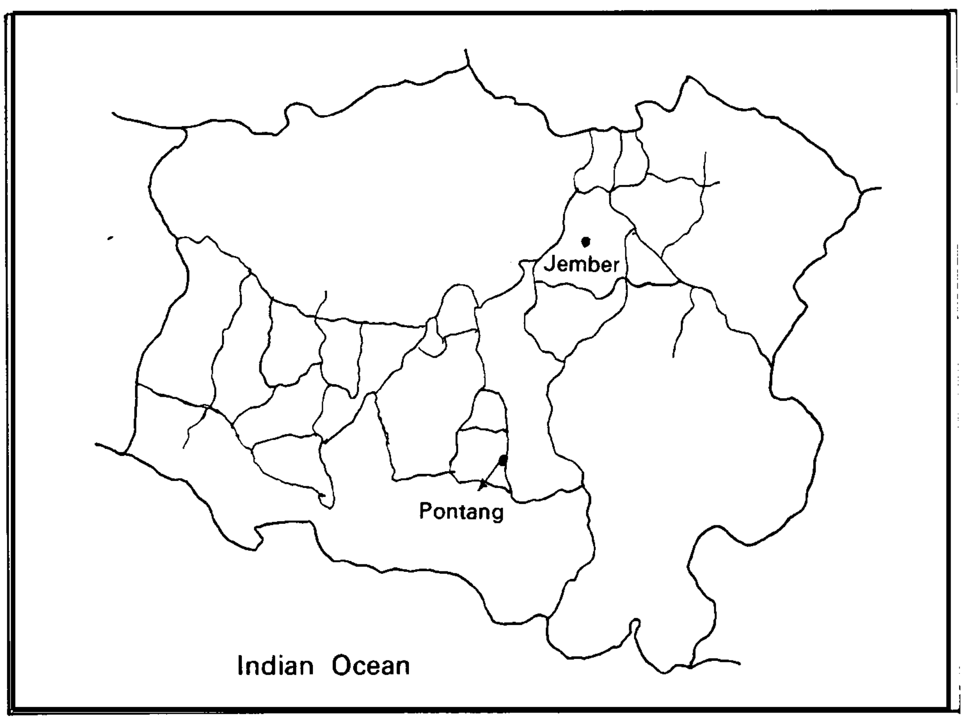
Map 1. Java

In Table 2, rainfall is given for the years 1986-1988. Usually the rainy season starts in November and lasts to March in the following year. The village of Pontang is classified in the category of dry areas in the agricultural zonal map (AARD, BORIF. 1991).

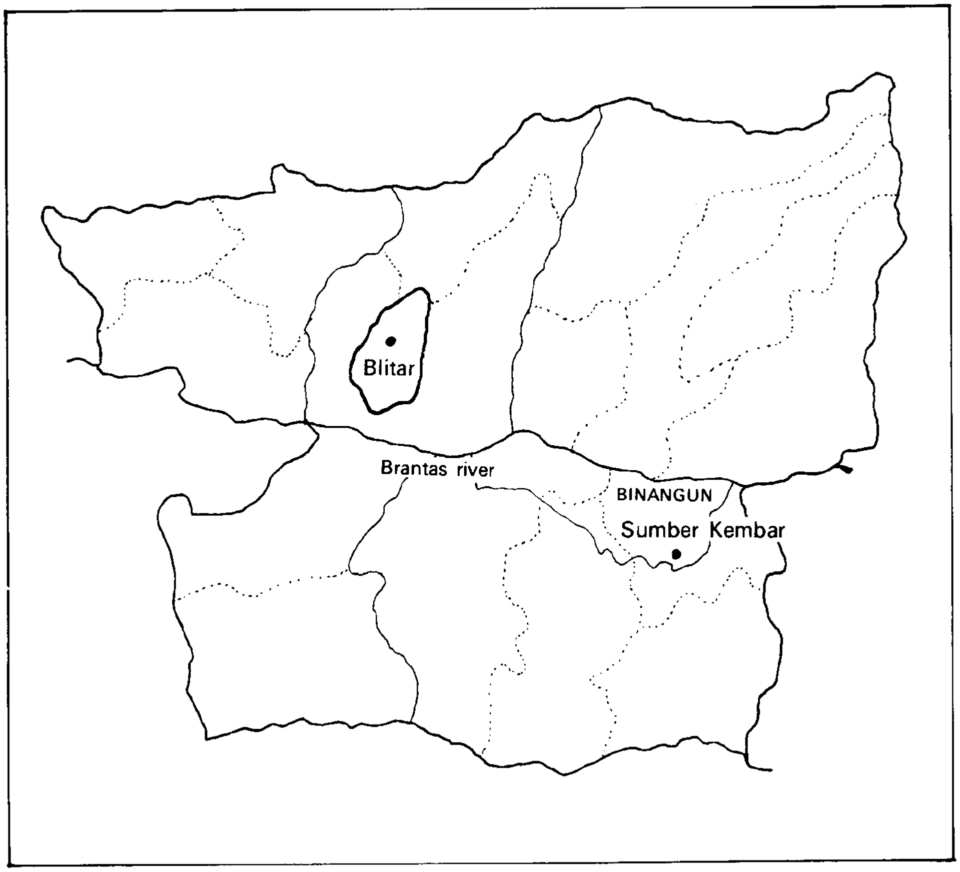
Table 2. Average of rainy days and rainfall per month in Kecamatan Ambulu 1986-1988

Month	Rainy Days			Rainfall (MM)		
	1986	1987	1988	1986	1987	1988
January	24	16	11	524	261	154
February	5	12	11	101	175	156
March	20	7	14	295	140	174
April	7	3	4	147	36	40
May	3	-	5	25	-	47
June	10	-	4	158	-	76
July	3	1	2	14	4	8
August	2	-	I	28	-	4
September	2	-	2	20	-	3
October	3	-	9	34	-	55
November	13	10	13	265	77	300
December	7	22	13	95	456	103

Source: Agriculture Statistics, Kecamatan Ambulu, 1989



Map 2. Jember District, Major roads



Map 3. Btitar District

At the onset of the rainy season, farmers usually plant rice (IR 64) while towards the end of the rainy season, in the second cropping system, farmers plant soybean. In the third cropping period there are farmers who plant soybean again and there are those who plant tobacco. Two farmer's groups planted in the third cropping period on rented land. The fairly lively market in land lease and rent is reflected by the high land rents which are linked to specific crops. For example a rent of 1,250.000 Rp of irrigated land was reported for tobacco cultivation while upland (tegalan) would fetch 400.000 Rp for tobacco. For soybean in irrigated areas, land rent is 500.000 Rp.

Soybean Costs and yields

Pontang village, Jember district

The cost of production for soybean in Pontang village shows distinct trends. Money spent for fertilizer is relatively small, between 2% and 5% of the total cost. Usually no fertilizer is applied in the second cropping period because crops can still benefit from the heavy fertilization of the first cropping period. Farmers reported that if they applied large doses of fertilizer for soybean in the second cropping period, the soybean would not flower. As a consequence the proportion of fertilizer expenditure is low in the cost of production. The proportions of expenditures on chemicals and irrigation are relatively high. The intensification of soybean has led to a growing nuisance of pests in recent years. However, farmers are still attracted to soybean because of its high productivity and returns.

Table 4. Average cost of soybean farming in Pontang village, 1990

Lot	Costs (Rp.)					Total
	Seed	Fertilizer	Chemicals	Labor	Others	
1	56,412.2 (14.3)	7,601.8 (1.9)	43,813.7 (11.0)	126.457. (32.0)	160,618. (40,7)	394,903.5 (100)
2	63,137.88 (13,5)	20,905.7 (4.6)	56,486.5 (12.5)	120,236. (26.7)	190.396, (42.3)	451,162.1 (100)

Lot I classified as a location near by the house; Lot 2 classified as other locations. Number in brackets is total cost percentage

In 1988 an average of 1,26 ton of soybean was obtained and in 1990 this had increased to 1,35 tons. It can be seen from Table 4 that farmers invest substantially in chemicals, labor and other items such as *pancen* (village tax), water supply and others. Usually in Pontang outside labor is used for all activities with the exception of chemical application (spraying) which is done by family labor. The majority of farmers spend around 425.000 Rp in cash on one soybean crop.

Yield distributions of plot 1 and 2 do not differ significantly, although productivity of plot 1 seems to be more stable with yields ranging from 1.1 to 2.3 tons/ha. The second plot yields a wider distribution (Figure 4 and 5).

In Figure 6 and 8 scatter grams are presented and it is striking that the input-output relation in plot 1 behaves very consistently in Cobb-Douglas fashion. This would be indicative of mature well-adapted technology. In plot 2 the relationship is less well-behaved but still a clear trend is visible of rewards to inputs.

Sumber Kembar village, Blitar district

In the Blitar district soybean has been grown for a long time. In the last decade production has increased from 5,000 tons to 12,000 tons. Yields reported at district level are surprisingly high, on the average 0.9 ton/ha. This district estimation does no: apply to the southern part of the district. The importance of soybean as a commercia: crop has increased which is reflected in expanded expenditure on cultivation. In Table 5 the average cost of production for soybean is given for the Sumber Kembar village

Table 5. Average cost of soybean farming in Sumber Kembar village, 1990

Lot	Costs (Rp.)					Total
	Seed	Fertilizer	Chemicals	Labor	Others	
1	23,102.3 (21.1)	40,372.3 (36.9)	3,191.5 (2.9)	26,495.9 (24.2)	16,296.4 (14.9)	109.449.4 (100)
2	19.109.7 (24.8)	30,291.4 (39.4)	2,741.3 (3.5)	19,326.6 (25.1)	5,448.6 (7.1)	76,917.6 (100)

Lot 1: location near the house; Lot 2: other locations.
Number in brackets is total cost percentage

It can be seen that fertilizer is the major item of investment, followed by labor. Unlike Pontang, expenditure on chemicals is small. An interesting difference in the use of labor between Pontang and Sumber Kembar is that in Sumber Kembar the major activities are all conducted by the family. This may underline the fact that the local labour market formation is constrained in more marginal areas. There is substantial seasonal migration from Sumber Kembang. It can be seen that in Sumber Kembar the expenditures on the first plot are substantially higher than the expenditure on the second plot, although the internal proportions are more or less similar. The second plot is not worked as intensively as the first plot during the second cropping period.

Figure 7 and 9 present yield distributions. Yield distribution in the first plot shows an almost perfect distribution, averaging at 0.4 tons/ha. Two farmers managed to get 1.3 tons, showing the possibilities and potential available even in marginal lands.

In Figure 9 marginality is even more clearly depicted with yields averaging at 0.33 ton/ha. The input-output relationships are depicted in Figure 8 and 10 and show clearly the higher expenditure on plot 1 and the weakening input-output relationship towards the right side of the curve in plot 1. In plot 2 the relation is somewhat stronger as could be expected under fairly low input conditions.

Some observation on production input and output

Per hectare total labour utilization in Blitar (777,84 man-hours) was not significantly different from labour utilization in Jember (811,69 man-hours). The only difference was that soybean production in Blitar tends to use more family labour than in Jember.

We will describe inputs being used in soybean production in both Blitar and Jember. As mentioned earlier, soil fertility and water supply are not really suitable for soybean production in Blitar. In contrast, we observe that in Jember soil fertility and water supply is favorable to soybean production.

The average per hectare input and output data on soybean production are listed in Table 6. The table shows that the quantity of seed used in Blitar was significantly different from seed use in Jember. Furthermore, the table also shows that fertilizer application, of Urea, TSP and ZA, is higher in Blitar than in Jember. It should be noted that in Jember soybean is grown in the second cropping period and profits from high level of fertilizer on the first crop, which is usually rice. However, liquid fertilizer application in Jember was higher than in Blitar. The levels of insecticide and pesticide use in both locations were not significantly different.

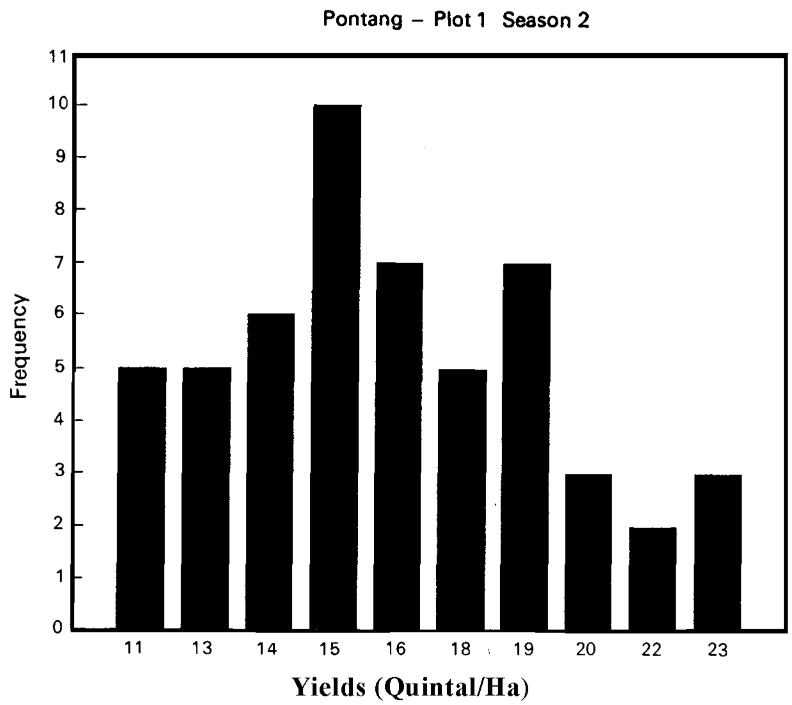


Figure 3. Soybean Productivity Frequency Pontang - Plot 1 Season 2

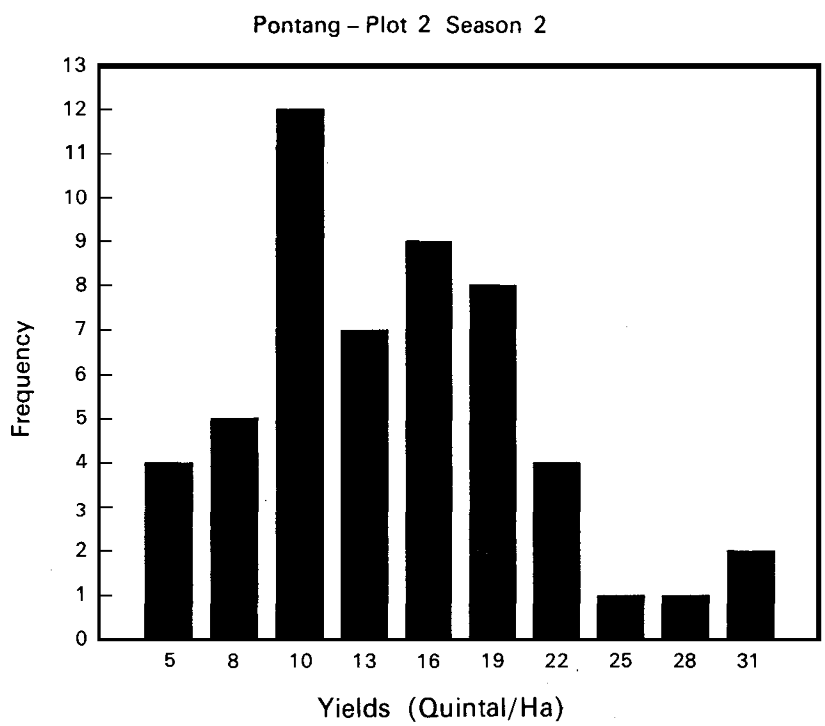


Figure 4. Soybean Productivity Frequency Pontang - Plot 2 Season 2

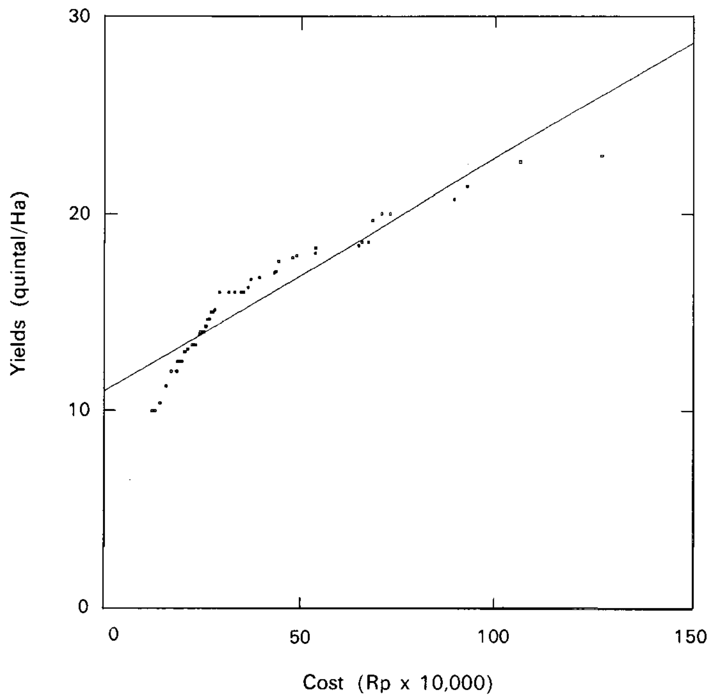


Figure 5. Soybean Production Costs in Pontang Plot 1 Season 2

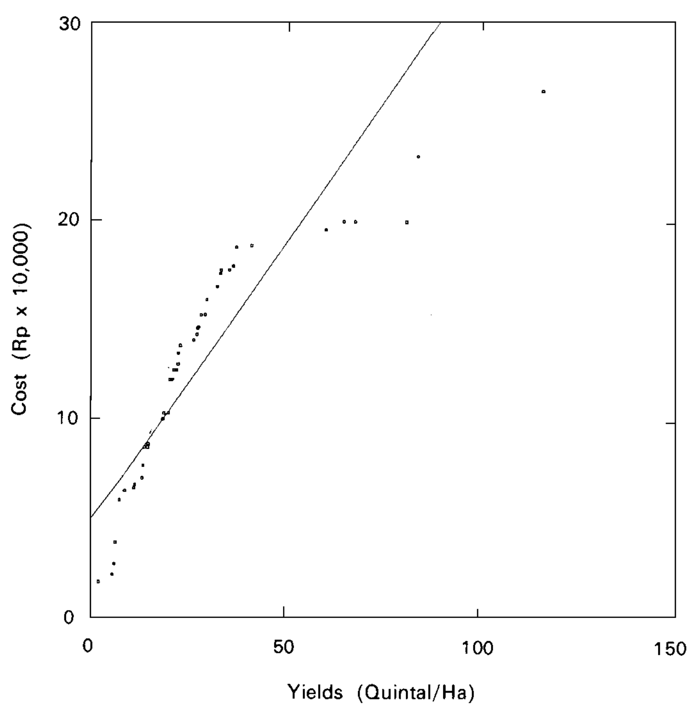


Figure 6. Soybean Production Costs in Pontang Plot 2 Season2

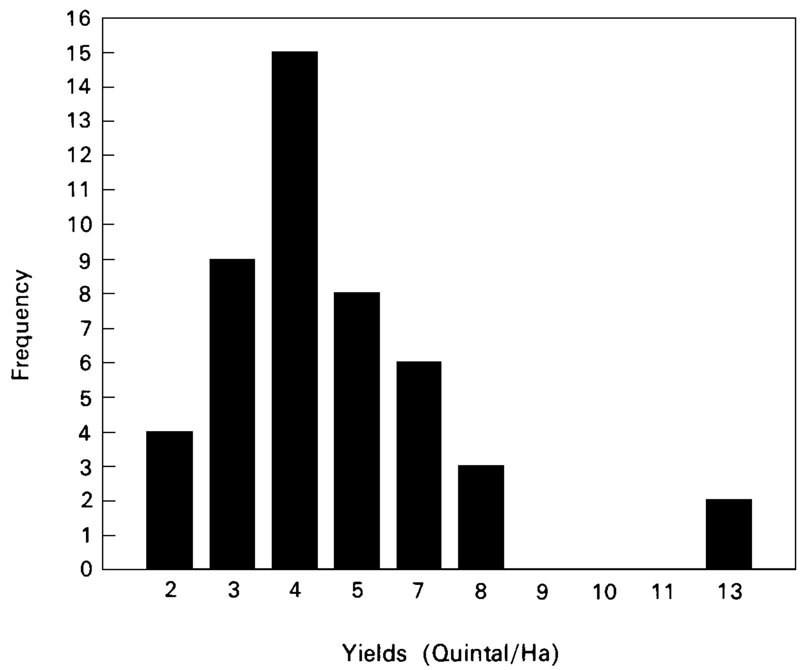


Figure 7. Soybean Productivity Distribution Sumber Kembang - Plot 1 Season 2

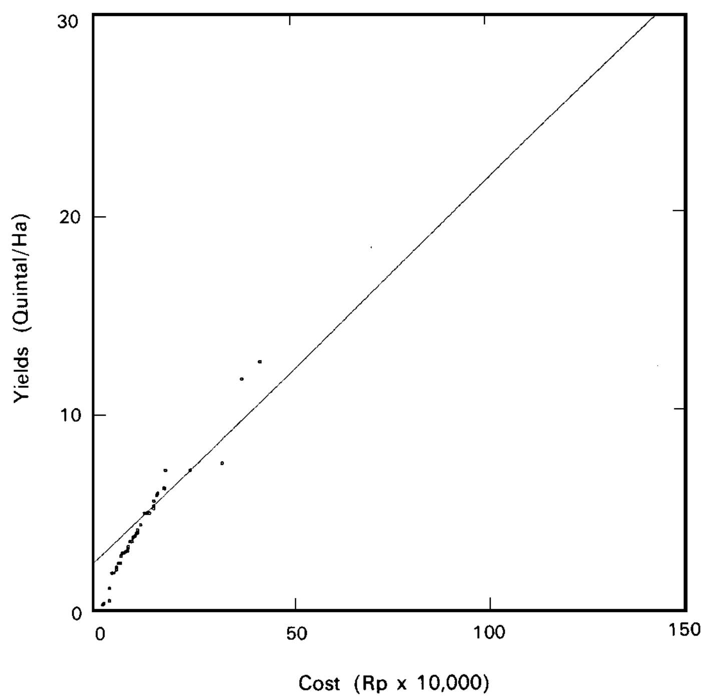


Figure 8. Soybean Production Costs in Sumber Kembang -Plot 1 Season 2

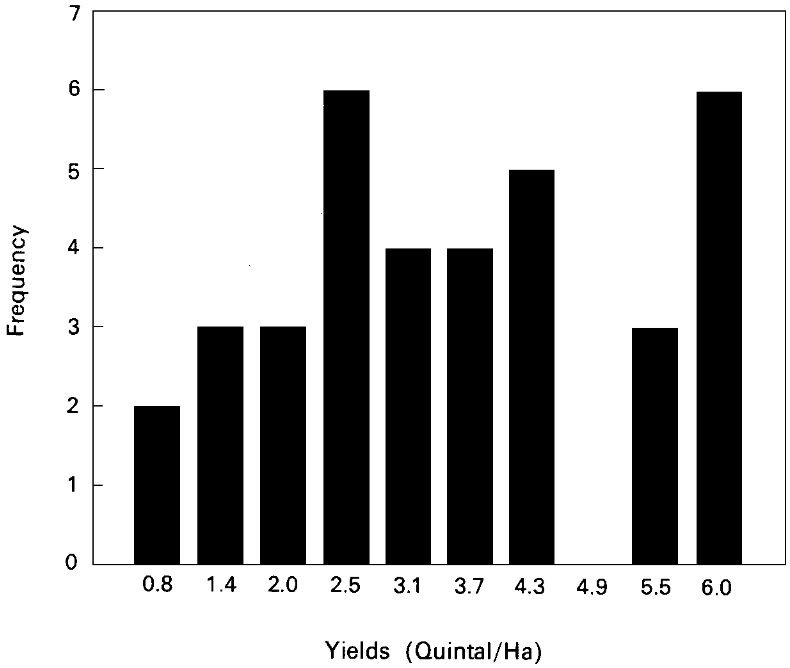


Figure 9. Soybean Productivity Distribution Sumber Kembang – Plot 2 Season 2

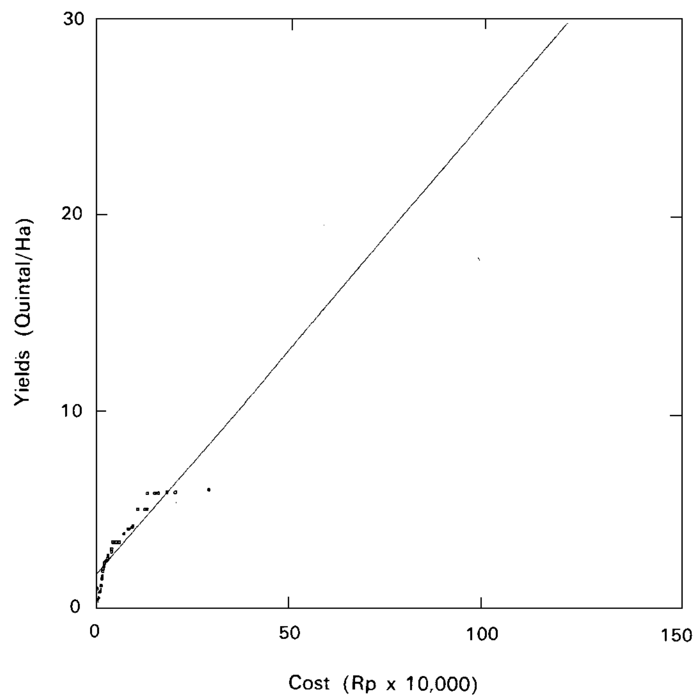


Figure 10. Soybean Production Costs in Binangun-Plot 2 Season 2

The most frequent cropping systems in Jember are given in Figure 1.

N ———— F	———— M ————	A ———— N
Rice	Rice	Soybean
Rice	Soybean	Soybean
Rice	Soybean	Maize Soybean
Rice	Chili	Soybean
Rice	Sugarcane	
Rice	Tobacco	

Figure 1. Cropping systems in Jember district

In Ambulu the most frequent sequences are rice-soybean-soybean and ricesoybean-tobacco.

Sumber Kembar village, Blitar district

Soil fertility and structure are not very favorable in the Sumber Kembar village. The topography is characterized by steep, rocky hills, shallow soils, and hardly any flat land. The moisture retaining capacity of the soil is very limited. Soils are classified as *Grumosol* associated with *Litosol.* Erosion is common. According to the local erosion control project 1,426 ha is classified as critical land subject to erosion. In the sub-district of Binangun in which Sumber Kembar is located, area was classified in 1989 as follows:

Irrigated land	99 ha
Upland	6,297 ha
Other lands	1,283 ha

In the village of Sumber Kembar, which occupies an area of 83,90 ha, 2 ha is classified as under semi-technical irrigation, while 33 ha is classified as under simple irrigation. 48,5 ha is classified as upland.

In the sub-district irrigated rice, upland rice, maize, cassava, groundnut, and soybean and vegetables are the major food crops. In upland areas intercropping is widely practiced.

In the last two decades substantial changes have taken place in the village of Sumber Kembar. In 1970 the most important crop was reported to be upland rice, followed by maize, sesame, and groundnut. In 1990 this ranking had changed to maize, cassava, soybean, with upland rice occupying the fourth position.

It was reported that in 1990 over 50% of maize was sold and that 10-40% was consumed by the household. 20% of cassava was consumed by the household while 80% was sold. Soybean is a pure cash crop. Upland rice is usually consumed by the household.

Thus, it can be seen that even in a marginal area the last twenty years witnessed d process of commercialization.

In Sumber Kembar, as in Pontang, the rainy season commences in November, and lasts until March, with a very distinct dry period in the month of July-October (see Table 3). In the first cropping period starting in November maize and groundnut are usually intercropped while in the second cropping period usually soybean is planted. In the third cropping period, if possible, mungbean or chili is planted. Cassava is usually a border crop and on occasion interplant from the end of the first cropping season or the beginning of the first cropping season (see Figure 2).

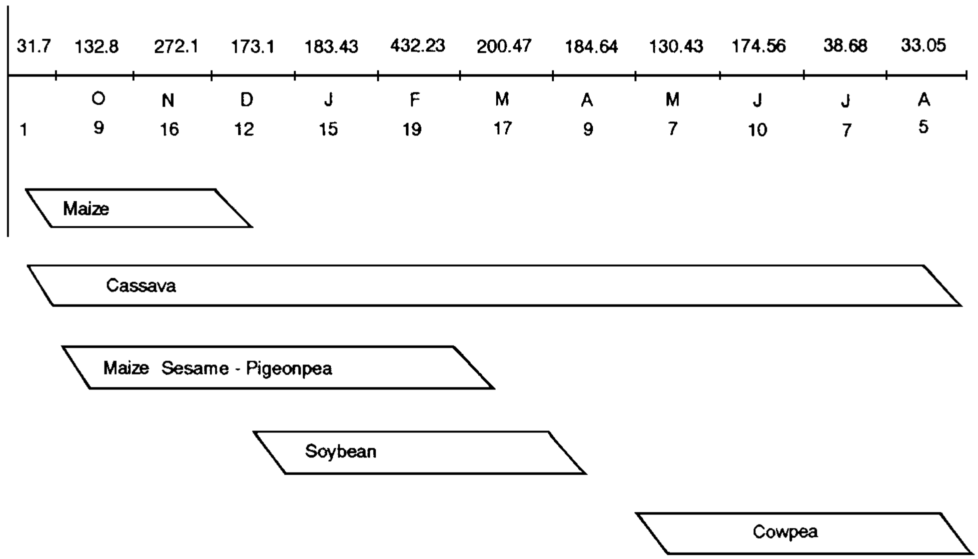


Figure 2. Total of Rainfall, rainy days and Cropping Patterns at Sumber Kembar in 1988/1989.

Table 3. Average of rainy days and rainfall per month in Kecamatan Binangun 1986-1988

Month	Rainy Days			Rainfall (MM)		
	1986	1987	1988	1986	1987	1988
January	28	24	26	428	416	431
February	15	12	9	143	219	189
March	19	14	25	301	237	460
April	19	3	12	152	16	194
May	2	-	3	5	-	95
June	9	1	2	121	8	47
July	4	-	-	25	-	-
August	5	3	-	39	7	-
September	2	-	-	9	-	-
October	7	-	7	39	-	-
November	19	7	11	315	199	200
December	13	21	8	120	450	167

Source: Agriculture Statistics, Kecamatan Binangun, 1989

Table 6. Input and Output Data on Per Hectare Soybean Production in Blitar and Jember, East Java, 1990

Inputs/Output	Units	Blitar	Jember
Seeds	kg	20.95	45.36
Urea	kg	57.00	10.57
TSP	kg	85.02	26.01
ZA	kg	45.84	1.41
Manure	kg	4.58	19.66
Insecticides	litre	0.71	1.79
Pesticides	litre	0.26	0.99
Liquid fertilizer	litre	0.08	8.89
Family Labour	man-hour	655.45	97.81
Hired Labour	man-hour	122.39	713.88
Soybean	kg	378.44	1449.92

As expected the soybean yield in Jember is considerably higher than in Blitar. The soybean productivity in Jember was 3.8 times greater than in Blitar. The explanation is that soils in Jember are far more fertile than in Blitar while water control is also far better in Jember. Comparing the input and output for soybean production in the two locations, one may conclude that the soybean production in these areas is not determined by the level of production effort.

One would expect in Sumber Kembar the more modest use of inputs, though the quantities of urea and TSP used in Jember are not exceptionally high from an agronomic point of view. If anything, the comparison confirms that even in relatively unfavourable circumstances, and marginal conditions, farmers invest actively to gain cash income.

Soybean Marketing and Use

Pontang village, Jember district

Collection trade

Soybean farmers in the village of Pontang have several choices when selling soybean. Soybean is sold to the trader who gives the best price, and soybean is usually sold in the week following harvest. Sales take place at the house of the farmers. Farmers retain seed for the next crop, up to 30 kg on average.

The sub-district of *(Kecamatan)* Ambulu is one of the production centers of soybean in the Jember district. As previously mentioned, this sub-district produced 5,250 tons soybean of the total production of Jember of 64,100 tons in 1989. Because the Jember districts, and particularly the irrigated areas south of Jember, are the major soybean production areas, many trade activities take place during the harvesting of soybean.

The larger collection traders operating at sub-district level usually obtain produce from farmers through village level collection traders, who operate on the basis of credit supplied by the larger collection traders. In Figure 11, major marketing channels and proportions of production flows are presented.

It can be seen that 25% of total produce stays in the area and is channeled to local retail traders in the local village market. The remaining 75% of soybean production is bought by sub-district collection traders who transport soybean to Surabaya (75%) and Solo through the regional wholesale collection system.

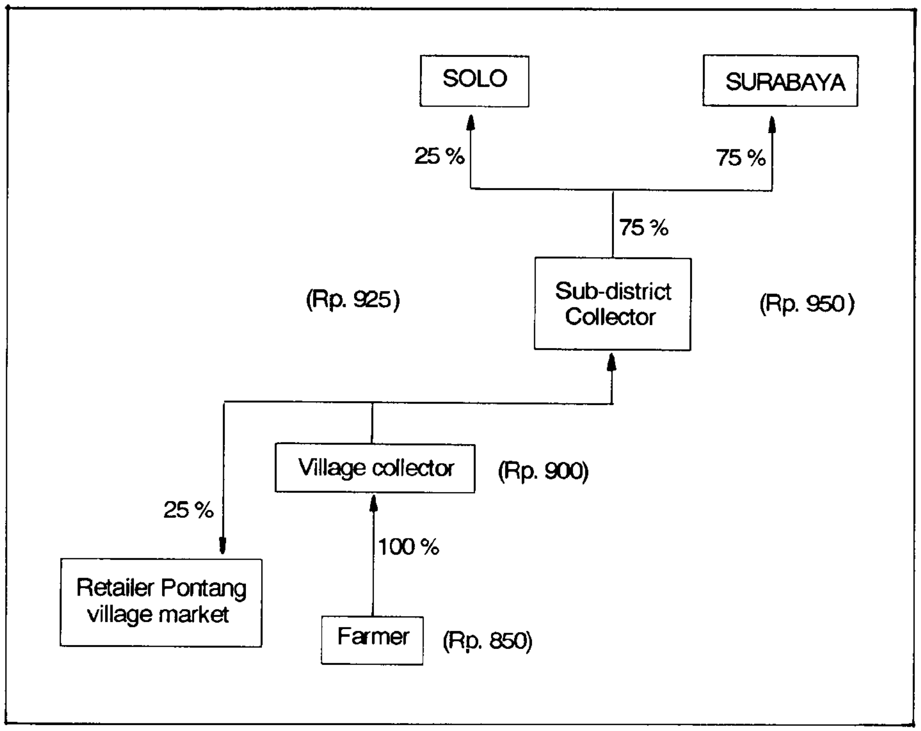


Figure 11. Marketing channels of Soybean from Pontang village

Nine local collection traders operate in Pontang which indicates the competition at the primary collection level of the market. If there is agreement among local collection traders and farmers regarding prices, local collection traders advance one quarter of the estimated sum to the farmers before harvest. Invariably farmers sell all soybeans to the local collection traders.

Local Use and Marketing

Five *tempe* processors operate in Pontang. Rather more *tempe* processing takes place in the bordering village of Andongsari. Sales both in the retail market and through peddling, take place exclusively in the local area. Volumes processed are small in Pontang at 5 kg/day, and 15 kg/day prior to celebrations. There is substantial competition with *tempe* from Andongsari where *tempe* production is substantially larger, which underlines the fact that rural tempe distribution is not confined to local areas.

The production of *tempe* takes four days. Five kg soybean are necessary for the production of five trays of *tempe* (20 x 5 x 80 cm). Processing is marginally rewarding as shown by the cost/benefit calculation:

Input:	
5 kg soybean	5.000 Rp.
4 x 3 hrs	in kind labour
Output	7.000 Rp.

Wilis is the most popular variety for *tempe* production. Imported soybean is seldom used. In fact Wilis is not the best variety because often black spots appear on the skin. Orba would be a better choice. It seems that producer preference induced by the importance of tahu in the rather more important *tahu* industry prevails over quality rewards at local level.

Processors reduce the size of the *tempe* bars when prices of soybean go up between harvests. In retailing the experience is that retail prices should not go over 1.000 Rp for good quality *tempe,* which should not be adulterated. As an indication of rural welfare there seems to be a strong consumer preference for unmixed and unadulterated *tempe.* Retailers also mentioned that local low-income buyers prefer large pieces of *tempe,* which the processors produce by mixing with *sago,* papaya and banana.

Thus, even at the local level consumer-market differentiation is already a fact, and is catered to by small local entrepreneurial activities.

Tahu, which is easier to produce, is rather more popular than tempe processing in Pontang. Approximately 25 cottage industries produce tahu. Volumes are larger, at 30 to 40 kg/day. Some even process 300 kg/day at harvest time.

In Pontang two *tahu* products are sold: dried *tahu* for use in soups, mainly sold to street food vendors and restaurants *(warung)* and fresh *tahu* for home consumption. This provides an interesting example of forward ("vertical") business integration or expansion. Produce is marketed mainly within the sub-district of Ambulu.

Wilis is the variety mostly used for *tahu* production. In earlier years *kretek* and *orba* were also used. These varieties apparently have a favorable transformation ratio. Imported soybean reportedly has never been used.

For each tray of *tahu* of 5 x 20 x 80 cm 2 kg of soybean in needed. Usually two people are employed, at a cost of 250Rp per tray. The produce of 2 kg soybean can be sold for 3.500 Rp, resulting in a gross profit of 1.500 Rp based on a price of 1.000 Rp/kg of soybean. The product, *bungkil,* is sold to chicken farmers in the neighbouring village of Sidomulyo for 75 Rp. Total profit is therefore 1.575 Rp. Profit for fried *tahu* is larger. Costs are the same as for fresh *tahu,* 2.000 Rp, + 800 Rp for oil and fuel. Every piece sells for 25 Rp, which amounts to 5.000 Rp, with 200 pieces from one tray. Profit amounts to 2.200 Rp per tray.

The proportion of fried *tahu* - fresh tahu is approximately 40 : 60. It takes two days for fresh *tahu* and three days for fried *tahu* to be ready for human consumption.

In one day an average home industry can produce about 20 trays of *tahu. A* working day occupies about four hours, from seven to eleven. The strategy of the processors is that they fry fresh *tahu* which could not be sold, thereby adding shelf-life and value. As in the case of *tempe* pieces are made smaller when the price of *tahu* goes up.

Soybean is usually purchased from the local collection traders, rarely from farmers. The credit-advance relation between farmers and traders explains this. This would imply that processors with sufficient capital could also secure local supply if need be.

Collection traders usually deliver soybean to the cottage industries. Payment is usually delayed for two days, when on the evening of the second day the first fresh *tahu* sales have taken place. The price is agreed upon at the delivery order, and is not changed, even if local prices go up.

Traders

In the village of Pontang traders do not engage exclusively in soybean trading. Local collection traders engage in trading all locally produced commodities. During the research, which took place at harvest time, it was reported that one local collection trader could handle approximately 1 ton/day.

It is has become clear that soybean is a commercial commodity in Pontang. Usually farmers receive an advance prior to harvest, of approximately 100.000 Rp, which ties the deal between the two. Quality and quantity are estimated, and the advance will cost the farmers between 25-100 Rp/kg.

Usually the wholesale price in forward trade dictates the local price paid by the local collection traders to producers. Traders reported that on the average they manage outstanding loans of 5-10 million Rp, which are substantial amounts in local terms. Transactions between local collection traders and wholesale traders need to be paid within 5 days. Perhaps because only one variety is grown, no clear quality rewards apply at producer level.

Sumber Kembar village, Blitar district

Collection trade

The village of Sumber Kembar is located south of the town of Blitar, across the Brantas river. The village is located in a heavily undulating limestone based area. In recent years soybean has become a relatively important cash crop in the village. The production of soybean in the sub-district was estimated at 2,250 tons in 1988, making up 25 percent of the total production of 8,200 ton for the district of Blitar. (Kecamatan dalam angka, Binangun, 1988, Kabupaten dalam angka, Blitar, 1988)

The lack of local employment possibilities is probably reflected by the large number of village collection traders who number twenty. In the sub-district Binangun, three sub-district collection traders operate in different areas which overlap (Figure 12).

Farmers sell all production, only retaining a minor quantity for seed on occasion. The sub-district collection trader, handling produce from Sumber Kembar village, reported an annual turn-over of approximately 200 tons of soybean which goes to the district wholesale traders in Blitar and of which 90 percent is used locally for *tahu* and *tempe*. On occasion part of the produce would enter forward trade to Malang or Surabaya. Local village collection traders would operate, if necessary, on the basis of credit from the sub-district collection traders. It was reported that this credit was fairly minimal and would be extended only when harvest time is close. Local village collection traders seek to build up a group of clients and provide seed, the major difficult input. This seed in turn is purchased on request by the sub-district collection traders in Blitar or other places.

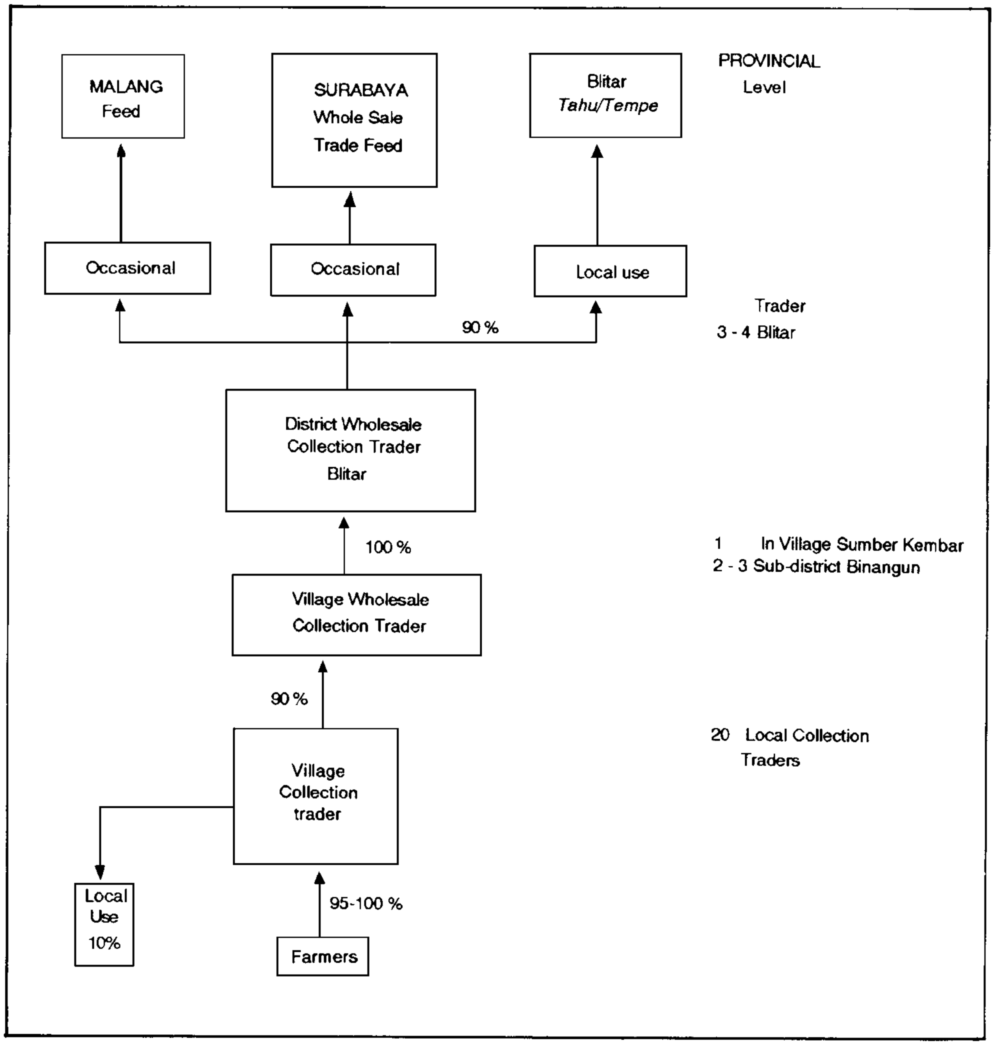


Figure 12. Marketing channels in Sumber Kembar, Blitar District

Local Use and Trade

There is only one small *tempe* processor in Sumber Kembar. In the neighbouring village of Salamrejo two others, among whom is one large processor, conduct business. *Tempe* production requires somewhat more know-how and precision than the production of *tahu. Tahu* processing is more popular in the two villages where together *15 tahu* processors are in business

The larger *tempe* processor turns over approximately *50* kg of of soybean per day. which he buys from the village wholesale collection trader or the local collection trader, depending on ease of supply. He complained that *50* kg soybean contains on the average two kg of dirt, sand, dirt, dust and little stone.

An important cost item is the transport of clean water from a well to the place of operation at his house. The cost is 1.000 Rp for 10 loads of water. About 50 kg soybean would yield 36 trays of *tempe* of 12 x 21 x 5 cm which each yield three pieces. Each piece is sold at 500 Rp, half the retail price at Pontang which 4 1.000 Rp. Sales are all direct through peddling. The major buyers are small local *warungs.*

There is no credit between the *tempe* processor and the soybean supplier. Profits are rather meagre at 3000 Rp/day for the whole operation which involves one family. No outside labour is used

The more popular *tahu* business involves only one costly investment: a homogenizer which pulps soybean. Usually 30 kg of soybean/day is used to produce 500 pieces. In Sumber Kembar *tahu* fermentation time is kept very minimal at 2 hours. Cost items include heating for which dried empty maize cobs are used. Usually *tahu* processing is a household activity.

Pieces of fresh *tahu* are sold for 75 **Rp,** yielding an equally meagre profit as for *tempe*. Sales are direct to *warungs,* and also to households.

Local market formation and trade

It has become clear that soybean processing generates local employment and entrepreneurial activities both in marginal conditions in Sumber Kembar and in Pontang, which is located in a more favourable production environment. It is not known whether the entrepreneurial density is similar in both villages. No conclusion can be made as to whether comparatively higher density would be induced by either local demand or local availability of soybean. It seems likely, though, that local availability is an important factor in inducing cottage industry.

The number of wholesale collection traders is closely connected with a minimum of trade turn-over: there is only one in the Sumber Kembar village whereas there are 9 in Pontang. It is interesting that a relatively large number of micro-collectors operate in Sumber Kembar. This large number reflects both the part-time nature of soybean collection as well as infra-structural difficulties in the hilly area

The consumer market for *tahu* and *tempe* in Pontang is clearly stratified, in Sumber Kembar this is not yet the case. Both cases prove that substantial entrepreneurial initiative exists in rural areas which follow imitative patterns, leading to a rather large number of tahu processors. It is likely that changes in the scale of *tahu* processing and in the number of cottage industries will take place in the future

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Comparative Advantage Analysis

Introduction

Soybean production in Indonesia is being subsidized in two ways. Firstly, the domestic price of soybean is protected from the lower world market price through the application of an import quota. The soybean import quantity is regulated by BULOG. In that way the domestic soybean price can be maintained at a higher level than the world market price. Secondly, the input production prices, such as those for chemical fertilizers, insecticides, and pesticides are also subsidized by the government. Although the government's policy on input subsidy is mainly targeted to support rice production it in fact benefits all farm input users.

Because soybean production is subsidized, one might expect that soybean production in Indonesia could still increase. However, the aggregate data on soybean production growth show no dramatic increase since 1986. The quantity of imported soybean has tended to increase over time.

Focusing on this problem, several studies have been conducted to analyse the economic and private profitability of soybean production, by using aggregate national or regional data (Simatupang, 1989; Pribadi and Rosegrant, 1989; Wiebe, 1990; Altemeier and Gijsbers, 1989; Sampath, 1990). Unlike other studies, this study is designed to analyse primary farm survey data. To capture variability in soybean production, this study includes data from a typically low soybean production area, namely South Blitar, and Jember an area of considerably higher productivity.

This chapter will first discuss how the private and social input output prices were derived. The second part describes the production input and output of soybean from the farm survey. Finally, this chapter will discuss the PAM results for soybean and also for other competing crops, namely maize in Blitar and rice in Jember

Input and Output Prices

(1) Private Prices

The private prices of both input and output of soybean production were estimated from the survey data. The price data were averaged for each location. The average price data were then used in the analysis.

(2) Social Prices

The border prices (f.o.b., or c.i.f.) were used as the social prices of both input and output of soybean production. However, these border prices should be adjusted to represent the social on-farm prices. Rosegrant et. al. (1989) applied a 23 to 25 percent additional transportation and handling (transfer) cost from the port of entry to farm gate. Here we adopt a 24 percent additional transfer cost from the border prices. It is conceded that this is not a satisfactory procedure, because in isolated areas, already in a disadvantageous position, the price of imported soybean is usually somewhat higher than in more accessible areas. However, the team had no choice because of limits on time and resources

Indonesia can be considered as a net exporting country for Urea and ZA fertilizers. Accordingly, the f.o.b. 1990 prices of Urea and ZA were used as a basic approximation for their social prices. In contrast, Indonesia is a net importing country for TSP, insecticides, and pesticides. Therefore, the c.i.f. 1990 prices of TSP, insecticides, and pesticides were used as the basis of the calculation of their social prices. In this study we used information on these prices from Simatupang (1989). Simatupang used the insecticides/pesticides social prices based on 1987 data, therefore the data are inflated by 5 percent per year to be comparable to the 1990 data

Even though wages are locally determined, there are no significant differences in agricultural labor wages among neighboring villages. For this reason, this study will adopt the local labor wage as a social cost of labor. This being the case, we will also adopt the same social cost for both family and hired labor. The other input for which we use the local price as a social price, is manure

It has been mentioned that Indonesia is a soybean importing country. Under an import regime, the c.i.f. price of soybean applies as a basis for determining the social cost for soybean. For simplification purposes, we apply the same social prices for both soybean seeds and soybean products

Simatupang (1989) found that the difference between the shadow exchange rate and the official exchange rate was not significant. His statement sounds reasonable in view of the latest developments in the exchange rate; Indonesia has been implementing a relatively "open" foreign exchange trade. The exchange rates between Indonesian Rupiah and US$ have been gradually adjusted over the last few years

Results

Soybean

Table 7 contains the PAM's results for Blitar and Jember. Private profitability both in Blitar and Jember are positive. This implies that soybean production is profitable when we apply both actual prices (price paid or received by farmers) of both input and output in soybean production. In Table 7 the family labour cost was not imputed. In the appendix family labour costs are imputed. Private profit in Jember was six times greater than in Blitar. If one includes family labor as a cost item this ratio increases substantially.

Table 7. List of PAM Results in Blitar and Jember, East Java, 1990

Type of Analysis	Blitar	Jember
Private Profit (Rp)	197.899,57	715.775,54
Private Cost Ratio	0,14	0,29
Social Profit (Rp)	-27.029,06	467.400,85
DRC Ratio	1,18	0,40
Net Policy Transfer (Rp)	-77.941,17	235.486,98
Nominal Protection	1,27	1,29
Effective Protection	1,58	1,30
Profitability Coefficient	- 7,32	1,53
Subsidy Ratio to Producers	- 0,34	0,27

Note: Costs of family labour not imputed

We can compute the relative value between non-tradable (domestic cost) and the difference between private revenues and tradable costs, by using the Private Cost Ratio (PCR). that the PCR in Blitar is lower than in Jember. These results indicate that at a given price level, the farmers at Blitar who spent relatively little cash for hired labor operate in a slightly more cost-effective way than the farmers in Jember. If family labor is not included in the cost picture, returns to capital in Blitar seem to be higher than in Jember.

As expected, the social profit for soybean production in Blitar is negative, while it positive in Jember. It is obvious that the social profitability of soybean production is largely dependent upon the local productivity of soybean. The social comparative advantage of soybean production is represented by the DRC Ratio. The DRC Ratio of soybean production in Blitar is high, namely 1.18, while the DRC Ratio for soybean production in Jember is quite low, i.e. 0.48. Production of soybean in Blitar would therefore be inefficient under an import regime, while Jember is efficient.

We can compare our micro-level economic analysis with other analyses from national and provincial data. Simatupang (1990) computed that the DRC Ratio for soybean production in East Java was 0.95 under an import substitution regime. Pribadi and Sampath (1990) found a DRC Ratio of East Java for soybean as 1.20. Their PCR Ratio was 0.4. Altemeier and Gijsbers (1989) computed the DRC Ratio for soybean in East Java to be 0.47. The Altemeier and Gijsbers' result is close to the Jember result, while the results of Simatupang and Pribadi and Sampath seem to represent the average yield of soybean in East Java. Our findings support the notion that there is a distinct need for zoning of soybean production, especially for areas where soybean is promoted because of suitable agro-ecological conditions.

The Net Policy Transfer listed in Table 7 represents the net effect of the government policies. The negative Net Policy Transfer value in Blitar implies that the net effect of current government intervention in both inputs and output prices on soybean production will result in a negative social benefit. In contrast, under the present policy regime a positive social benefit is generated in Jember.

The Nominal Protection figures listed in Table 7 reflects the protection of domestic soybean price. Moreover, the Effective Protection figures in Table 7 imply that government intervention in the input market and output price, i.e. price protection against the world market, will result in a deviation of the value added in the production systems.

However, we observe that the profitability coefficient and subsidy ratio to producers are negative and positive for soybean production in Blitar and Jember respectively. These figures are consistent with previously mentioned findings that the government price policies will generate a negative social benefit for soybean production in Blitar, while it will generate a positive social benefit in Jember.

Competing Crops

It has been mentioned earlier that the major competing crop of soybean in Jember was rice, and in Blitar, maize. In this section, the local profitability of soybean is compared to competing crops. Comparison allows us to gain more understanding of how farmers make decisions in selecting crops. It is obvious that profitability is a major factor which determines the farmers' choice in planting a crop. One may then expect that a high profit from a certain crop will relate to the higher probability of this crop being planted.

The results of both private and social analysis for soybean, maize and rice in Blitar and Jember are presented in Table 8. The Private Profit and Private Cost Ratio indicate private profitability. Social Profit and DRC ratio are the indicators for the measurement of social profit.

Table 8. Private and Social Profitability of Soybean, Maize and Rice in Blitar and Jember, East Java, 1990. ('000 Rp)

	Blitar		Jember	
	Soybean	Maize	Soybean	Rice
1. Private Profit	197,9	313,4	715,8	1.127,2
2. Private Cost Ratio	0,14	0,15	0,29	0,24
3. Social Profit	-27,0	421,2	467,4	2.087,6
4. DRC Ratio	1,8	0,35	0,40	0,16

Note: Family labor is not imputed.

Results from Table 8 show that maize production yields more cash income than soybean production in Blitar. However, if we regard the profitability in relative terms, as expressed in PCR, then we can see that the PCR of maize is similar to that of soybean. This implies that if a farmer is concerned about cost efficiency, according to our data, maize and soybean are equally attractive choices in Blitar.

From the social point of view, the benefit of planting maize is higher than the benefits from planting soybean. The Social Cost Efficiency as measured by DRC Ratio is consistent with the analysis of social profit.

The results from Jember for soybean and rice are presented in the last two columns of Table 8. Rice is financially more profitable than soybean. However, the PCR value of rice is only slightly lower than that of soybean. This indicates that crops as rice or soybean are equally attractive to farmers who are concerned about cost efficiency.

The Social Profit figures of soybean and rice indicate that the rice farmers receive more benefit from the government's present price policy than the soybean farmers. The DRC Ratio figures of rice and maize show that planting rice was socially more cost efficient than planting soybean.

From this discussion, we may infer that soybean is a commodity which has good prospects for development especially in the areas where the agro-ecological conditions are favourable for soybean production, such as in Jember. In this region, soybean can be regarded as both private and socially profitable, and an alternative commodity to rice. The development of soybean in marginal land, under the present technology, crop management and infrastructure, will be socially non-profitable.

Appendices

Appendix 1. MAIZE, BLITAR

	DOMESTIC PRICES AND INTERNATIONAL PRICES (in Rp)	
Labor (hour)	214,16	214,16
Seeds (kg)	434,34	309,00
Urea (kg)	195,75	278,35
TSP (kg)	205,67	390,58
ZA (kg)	172,54	246,92
Manure (kg)	248,67	248,68
Insecticides (1)	3.818,32	10.832,18
Pesticides (1)	3.303,90	10.832,18
Liq. Fertilizer	2.327,27	2.327,27
Corn	181,13	309,00

Source: Rosegrant (1990)
1987 data update to 1990

Appendix 2. PAM
MAIZE, BLITAR, FAMILY IMPUTED LABOUR

	REVENUES	TRADABLES	FACTORS	PROFIT
PRIVATE	438.606,30	71.057,21	260.690,22	106.858,87
SOCIAL	748.243,50	99.399,58	260.690,29	388.153,63
DIVERGENCE EFFECT	-309.637,21	-28.342,31	-0,07	-309.637,28

PRIVATE PROFIT	106.858,87	[D = A-B-C-1
PRIVATE COST RATIO	0,71	[C/(A-B)]
SOCIAL PROFIT	388.153,63	[H=E-F-G]
DRC RATIO	0,40	[DRC=G/(E-F))
NET POLICY TRANSFER	-309.637,28	[L=I+J+K]
NOMINAL PROTECTION	0,59	[A/E]
EFFECTIVE PROTECTION	0,57	[(A-B)/(E-F)]
PROFITABILITY COEFFICIENT	0,28	[D/H]
SC BSIDY RATIO TO PRODUCERS	-0,41	[L/E]

Software: SAS

Appendix 3. SOYBEAN, BLITAR

	DOMESTIC PRICES AND INTERNATIONAL PRICES (in Rp)	
Labor (hour)	214,16	214,16
Seeds (kg)	1.020,56	607,65
Urea (kg)	195,75	278,35
TSP (kg)	205,67	390,58
ZA (kg)	172,54	246,92
Mannure (kg)	248,67	248,68
Insecticides (1)	3.818,32	10.832,18
Pesticides (1)	3.303,90	10.832,18
Liq. Fertilizer	2.327,27	2.327,27
Soybean	772,62	607,65

Appendix 4. PAM
SOYBEAN, BLITAR, FAMILY LABOR IMPUTED

	REVENUES	TRADABLES	FACTORS
PRIVATE	292.388,92	61.689,98	173.171,41
SOCIAL	229.957,97	83.815,54	173.171,49
DIVERGENCE EFFECT	62.430,95	-22.125,56	-0,05

PRIVATE PROFIT	57.527,49	[D=A-B-C-]
PRIVATE COST RATIO	0,75	[C/(A-B)]
SOCIAL PROFIT	-27.029,05	[H=E-F-G]
DRC RATIO	1,18	[DRC=G/(E-F))
NET POLICY TRANSFER	62.430,90	[L=I+J+K]
NOMINAL PROTECTION	1,27	[A/E]
EFFECTIVE PROTECTION	1,58	[(A-B)/(E-F)]
PROFITABILITY COEFFICIENT	-2,13	[D/H]
SUBSIDY RATIO TO PRODUCERS	-0,27	[L/E]

Appendix 5. IRRIGATED RICE, JEMBER

	DOMESTIC PRICES AND INTERNATIONAL PRICES (in Rp)	
Labour (hour)	214,16	214,16
Seeds (kg)	586,59	370,14
Urea (kg)	195,75	278,35
TSP (kg)	205,67	390,58
ZA (kg)	172,54	246,92
Manure (kg)	248,67	248,68
Insecticides (1)	3.818,32	10.832,18
Pesticides (1)	3.303,90	10.832,18
Liq. Fertilizer	2.327,27	2.327,27
Rice	223,61	370,14

Source: Rosegrant et al. (1990) Ajusted.

Appendix 6. PAM
RICE, JEMBER, FAMILY LABOUR IMPUTED

	REVENUES	TRADABLES	FACTORS	PROFIT
PRIVATE	1.643.318,83	155.807,01	393.094,13	1.094.417,69
SOCIAL	2.720.173,67	239.455,60	393.094,16	2.087.623,90
DIVERGENCE EFFECT	-1.076.854,83	-83.648,59	-0,02	-1.076.854,85

PRIVATE PROFIT	1.094.417,69	[D=A-B-C-]
PRIVATE COST RATIO	0,26	[C/(A-B)]
SOCIAL PROFIT	2.087.623,90	[H=E-F-G]
DRC RATIO	0,16	[DRC=G/(E-F)]
NET POLICY TRANSFER	-1.076.854,85	[L=I+J+Kl
NOMINAL PROTECTION	0,60	[A/El
EFFECTIVE PROTECTION	0,60	[(A-B)/(E-F)l
PROFITABILITY COEFFICIENT	0,52	[D/H]
SUBSIDY RATIO TO PRODUCERS	-0,40	[L/E1

Appendix 7. SOYBEAN, JEMBER

	DOMESTIC PRICES AND INTERNATIONAL PRICES (in Rp)	
Labour (hour)	172,79	172,79
Seeds (kg)	1.317,79	607,65
Urea (kg)	207,11	278,35
TSP (kg)	225,14	390,58
ZA (kg)	223,46	246,92
Manure (kg)	0,00	0,00
Insecticides (1)	9.510,78	10.832,18
Pesticides (1)	6.949,36	10.832,93
Liq. Fertilizer	3.009,93	3.009,93
Soybean	781,72	607,65

Appendix 8. PAM
SOYBEAN, JEMBER, FAMILY LABOUR IMPUTED

	REVENUES	TRADABLES	FACTORS	PROFIT
PRIVATE	1.133.431,46	118.797,52	315.759,00	698.874,95
SOCIAL	881.043,89	97.884,04	315.759,00	467.400,85
DIVERGENCE EFFECT	252.387,57	20.913,47	-0,00	252.387,57

PRIVATE PROFIT	698.874,95	[D=A-B-C-]
PRIVATE COST RATIO	0,31	[C/(A-B)]
SOCIAL PROFIT	467.400,85	[H=E-F-G]
DRC RATIO	0,40	[DRC=G/(E-F)]
NET POLICY TRANSFER	252.387,57	[L=I+J+K]
NOMINAL PROTECTION	1,29	[A/El
EFFECTIVE PROTECTION	1,30	[(A-B)/(E-F)]
PROFITABILITY COEFFICIENT	1,50	[D/H]
SUBSIDY RATIO TO PRODUCERS	0,29	[L/E]

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Part III

Regional Costs and Comparative Advantage in Secondary Crops, Indonesia

Frederic Roche, Budiman Hutabarat, Abubakar, Nuryanto Daris, Toni SW, and Bambang Adinugroho

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Introduction

This paper serves two purposes. Our primary task is to assess the ways in which Indonesia's main secondary crops can contribute to achieving the interdependent objectives of efficient resource use, income growth, and food security. This subject has been addressed recently by numerous authors, so we will try to review the policy issues succinctly, and to introduce a national, farm-level data set on food crop production that the Central Bureau of Statistics (BPS) will distribute regularly during the coming years. Since these data will be valuable for a variety of food policy studies, we investigate this survey's representative ness and quality prior to the cost analysis.

Maize, soybean, and cassava are the major food crops grown on Indonesia's rainfed lands. Soybean is characterized by income-elastic demand both as food and (indirectly) as feed. Maize, and, to a lesser extent, cassava, are also inputs into the feed industry, but the direct (food) demand for these staples is expected to decline with increasing income.

Despite `crash' efforts to expand soybean areas during the past few years, Indonesian policy makers have been alarmed by growing imports due to the widening imbalance between domestic supply and demand (Figure 1). Some analists believe that present soybean production is largely inefficient (Wiebe, 1990; Rosegrant, et al., 1987). Others have argued that it will be difficult to raise soybean productivity significantly without intensive varietals research to overcome agronomic and cropping system constraints (Bottema, et al., eds., 1987). The arguments of seasoned agriculturalists must be given weight. But food self-sufficiency is also a heavily-weighted objective in Indonesian policy discussions. Policy makers ask whether private efforts *(swasembada)* can be cost effective in the case of soybean. The recent deregulation of the soybean trade may significantly reduce the trade protection that Indonesian farmers have enjoyed during the past decade, thus lowering incentives for domestic production.

In contrast, the agronomic potential for raising yields of maize and cassava with known technology is believed to be far greater. Indeed, yields of both crops have risen rapidly during the past decade. Given the nature of domestic demand, it is likely that large shares of added output can be traded internationally if the agronomic potential for productivity increases is realized fully (Falcon, et al., 1984; Timmer, ed., 1987). Growth in maize yields has permitted Indonesia to export occasionally to Asian markets in recent years. However, substantial investments in maize drying and port capacity will probably be necessary for Indonesia to become a regular exporter of significant scale (Dorosh, 1987). The analysis below will examine the implications of high marketing costs for crop intensification and trade in Indonesia's eastern provinces.

Indonesian exports of dried cassava have grown explosively during the past five years, but farmers and traders now face a trade regime wherein Indonesia's export supply fetches low prices in markets outside the quota system of the European Community. Hence, policy makers, never much enamored of cassava, question whether serious intensification efforts are warranted in view of the clouded market prospects.

From an analytical standpoint, the question is one of whether Indonesia can maintain its role as an efficient cassava exporter at low world prices

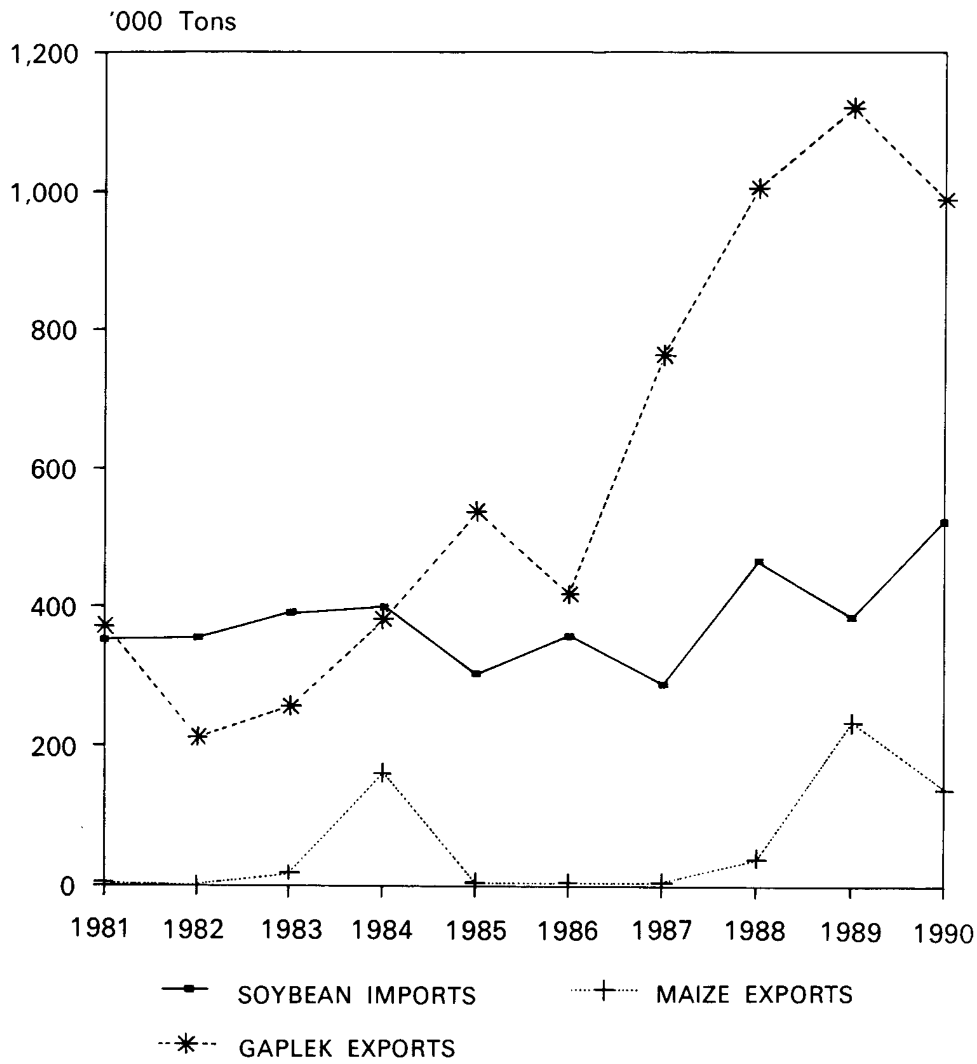

Figure 1. Secondary Crop Trade, 1981-1989 (Gross Imports or Exports as Indicated)

Methodology

Our study employs the principles of comparative advantage analysis by comparing current and potential costs of maize, soybean, and cassava production in agro climatic regions that may be used as recommendation domains in future crop programs. We assess the need for change in technology, extension and markets in order to expand secondary crop output in Indonesia's various regions. This study builds upon past research by integrating household level data from a national farmer survey **(BPS,** 1989).

with a typology of agro climatic zones developed recently by researchers in the Indonesian ministry of agriculture (Las, et al., 1991).

Comparative advantage analysis uses competitive market prices as a benchmark by which to measure the costs and benefits of policies that influence resource allocation. Indicators of comparative advantage, such as resource cost ratios, generally are pure numbers that are devoid of statistical significance. Confidence in such indicators depends upon the quality of the analyst's data. Given the time and funding constraints faced in many research projects, there is often a significant trade-off between data quality and sample representative nesses at the macro level where key policy decisions are made.

For example, the Stanford studies of Indonesian secondary crops have involved careful village and market surveys in major producing regions (Falcon, et al., 1984; Timmer, ed., 1987), but may be questioned as to their national representation. Alternatively, some researchers have relied entirely upon aggregated secondary data sets of unknown quality (for example, Rosegrant, et al., 1987; Wiebe, 1990; Kasryno and Simatupang, eds., 1990). In general, the higher the degree of data aggregation - moving from village to province, and on to the island group - the more difficult it becomes to estimate potential changes in comparative advantage that could result from aggressive efforts to develop and promote new farm technology'. In a country as agro climatically diverse as Indonesia, practical suggestions for change require detailed knowledge of location-specific agronomic research. Data sets aggregated at the provincial or island levels typically obscure the variation in soils, climate, and farmer performance that leads to significant variability within regions in current and potential productivity.

The following two sections describe our data sets and parameter assumptions. Section 1 assesses current regional costs and comparative advantage as revealed in the national farm survey. Section 4 synthesizes recent agronomic research in Indonesia, with a specific focus on the prospects for improving efficiency through improved farm practices. Section 5 concludes with implications for policy.

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[1] Given the emphasis on food self-sufficiency in Indonesia, food production and marketing studies that draw negative conclusions about comparative advantage are unlikely to be received warmly unless there are also positive suggestions on how the situation might be improved. The Indonesian policy maker will most certainly comment, "Don't just tell me it's broke, tell me how to fix it!"

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The Data

The Cost Structure *(Struktur Ongkos)* Survey

For more than twenty years, BPS has undertaken an annual nationwide survey of food crop production costs at the farm level. Known as the "Survey Struktur Ongkos Usahatani Padi dan Palawija[2]," the survey requests information on crop output, areas planted, and the use of variable inputs. Quantity and expenditure data are recorded for labour and chemical inputs. For animal and machinery services, and other cash costs, information is collected on expenditures alone. The questionnaire asks about irrigation status, intensification program participation, and seed types, but provides few additional data on socioeconomic characteristics of the farm households.

Table 1. Food Crop Production in Selected Provinces, 1989
('000 Tons; Source: BPS)

	Irrigated Rice	Maize	Cassava	Soybeans
Aceh	1,133	23	85	118
North Sumatra*	2,370	199	458	25
South Sumatra	1,146	43	431	14
Lampung	1,034	454	2,073	100
West Java	9,925	265	2,203	71
Central Java	7,662	1,257	3,530	199
Yogyakarta	541	115	714	65
East Java	8,004	2,498	3,989	459
Bali	871	104	228	26
West Nusa Tenggara (N'I'B)	1,079	48	172	128
East Nusa Tenggara (NTT)	204	377	973	2
North Sulawesi	298	155	88	24
South Sulawesi	3,277	371	586	26
Southern Sulawesi	135	67	217	5
Other Provinces	4,691	215	1,381	52
Total Indonesia	42,371	6,193	17,117	1,315
Share of 14 provinces	88.9%	96.5%	91.9%	96.1%

* Deleted from the cost survey sample.

[2] Prior to 1979, the survey was published under the title, *"Survey Pertanian"*. Sampling procedures for crop cuttings and the Struktur Ongkos survey are described in Biro Pusat Statistik (1988). Field methods for crop cuttings and yield estimates are explained in BPS (1984).

In cooperation with Bappenas, BPS has computer-processed the 1989 survey data from 14 of Indonesia's 27 provinces. As shown in Table 1, these provinces together contribute about 90 percent of Indonesia's total production of rice and secondary crops. Data problems led us to drop the North Sumatra sample [3], but the remaining 13 provinces cover more than 6,100 households engaged in maize, soybean, or cassava production.

Sampling and Data Reliability

Sampling for the Struktur Ongkos surveys is coordinated with the national program for food crop cuttings from which crop yield statistics are derived. During the late 1980s, the national crop cutting sample was selected by **BPS** in Jakarta using t n: sampling frame of the 1983 Agricultural Census. By commodity and season, the 19-crop cutting and Struktur Ongkos samples were designed to be proportional to official's estimates of provincial harvest areas in the 1986 calendar year (**BPS**, 1988). At the field level secondary crop cuttings are undertaken by sudistrict agricultural officials (*Mantri Tani*), while staff from local statistical offices (*Mantri Statistik*) follows these up with the cost structure interviews.

For rice and the major secondary crops, a total of over 130,000 crop cuttings been taken annually in recent years. The Struktur Ongkos survey covers a second, randomly selected, 15-20 percent sub sample, or more than 20,000 households. In view, of selection procedures and size, the sample should, in principle, provide information the determinants of food crop productivity that parallels closely the data used for national crop yield estimates.

The correspondence between principle and practice can be judged by comparing indicators of crop supply from the two sources. Where these indicators diverge, one must consider the field-level problems that arise due to the difficulty of implementing standardized surveys in a country as large and diverse as Indonesia. Figure 2 show that BPS is doing an excellent job of selecting provincial sample sizes that are proportional to shares of harvest areas. A few minor misrepresentations can be seer but these are to be expected as a result of normal fluctuations in crop supply between agricultural years.

Although the sample is not intended to be representative below the provincial level, the fit between harvest area and sample shares at the district *(kabupaten)* level is reassuringly good. As illustrated for East Java in Figure 3, sample shares follows harvest areas fairly closely for districts with moderate or low production, but one more of the major production districts are under-represented for each crop. In East Java, this occurs for maize in Sumenep on Madura Island, soybeans in Jember, and cassava in Pacitan and Sampang. In the present analysis, with data assembled by agro climatic zone rather than administrative region, this type of error will affect sample sizes by zone, but the overall bias in estimated yields and costs should be minor.

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[3] Suspicious regularities were discovered in almost all data on labor use from North Sum a~-Unfortunately, deleting this province from the sample greatly limits the analysis of the northern region of Sumatra Island.

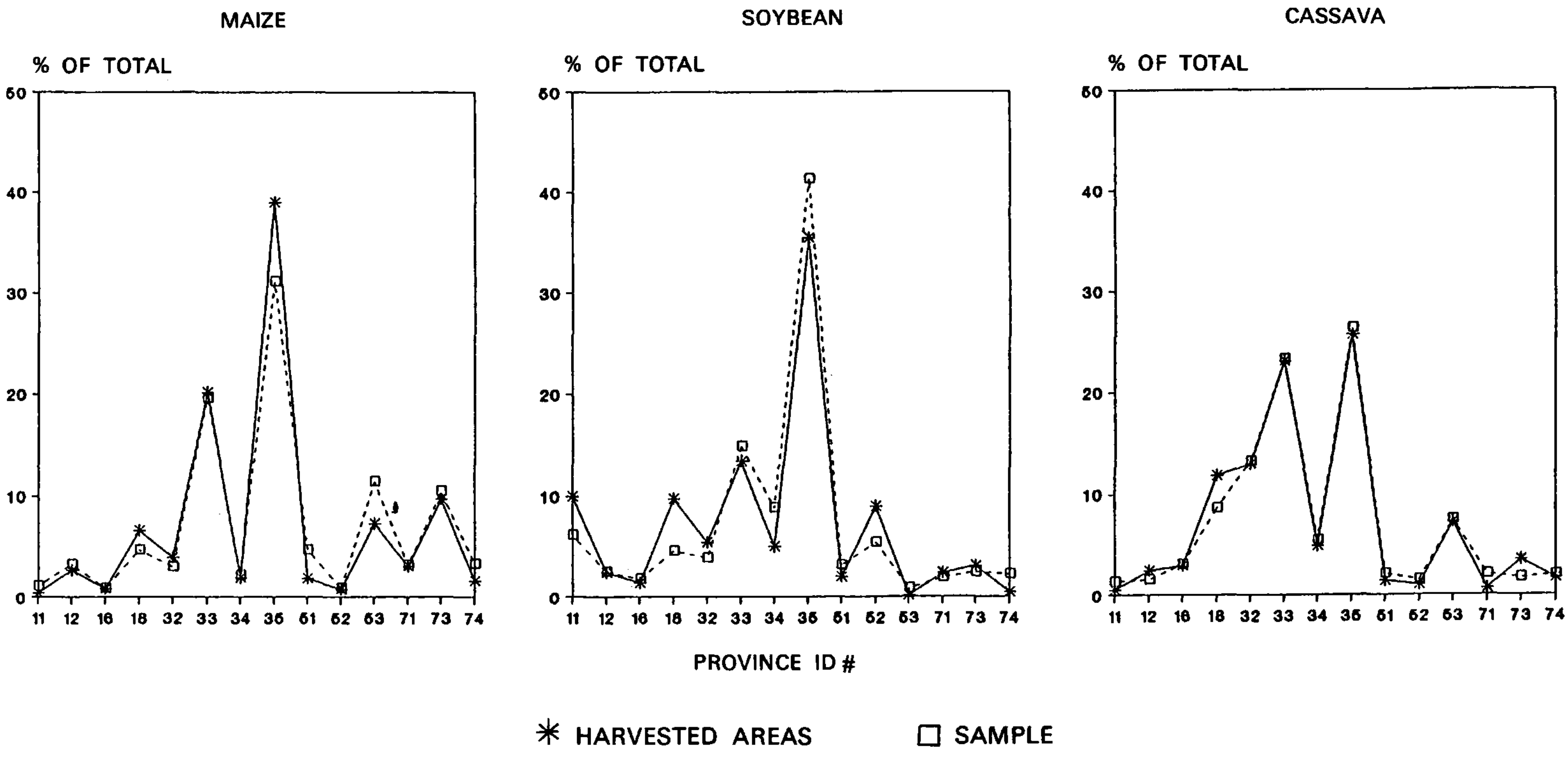

Figure 2. Crop Harvest Area and Sample Shares by Province (Provinces Range East from Aceh (11) to South East Sulawesi (74)) (Harvest Areas are Averages for the 1987-1989 Period)

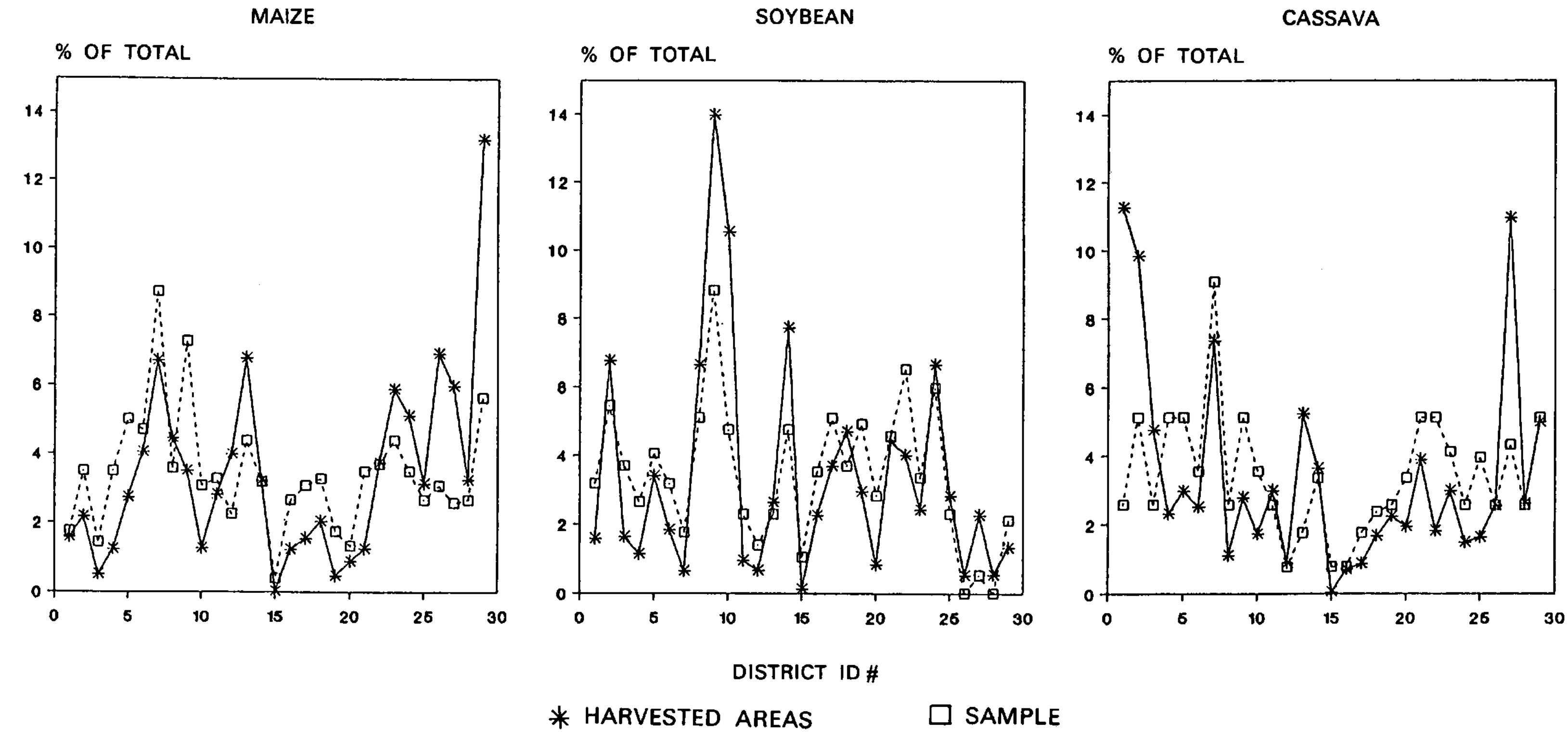

Figure 3. Crop Harvest Area and Sample Shares by East Java District (Districts Range East from Pacitan to Sumenep) (Harvest Areas are Averages for the 1987-1989 Period)

The cost structure survey is designed to capture seasonality in production on a quadrimester (4-month) basis, corresponding to the major data compilation rounds for official food crop statistics. As Figure 4 illustrates, there is variability among provinces in the seasonal representative ness of the cost structure survey. Quadrimester harvest shares are represented reasonably well in South Sulawesi and East Java, for example, but the Lampung samples for maize and soybeans correspond rather poorly to actual 1987-1989 harvest patterns. As explained, the 1989 sample was designed to correspond to the distribution of production during 1986, but year-to-year variability in rainfall will accelerate or delay planting schedules. In both the crop cutting and farm cost surveys, the timeliness of data collection may also be affected by practical constraints such as impassible roads. In the analysis that follows, seasonal desegregations is limited to the wet season (January-June) and dry season (July-December) harvest periods, primarily so that the cost structure data correspond to information synthesized from agronomic trials.

Overall, it seems fair to conclude that the Struktur Ongkos survey captures regional and seasonal crop production patterns in a manner that represents official statistics more than adequately for our purposes. Such a conclusion is important, for it allows us to assume that the significance of production systems for a given crop can be inferred by the sample sizes that emerge in the survey. On a different note, however, there are discrepancies between official crop yields and those measured by Struktur Ongkos that will influence estimates of production costs.

Table 2 compares published BPS figures with the Struktur Ongkos data after the latter were cleaned carefully. The crop cutting estimates are based on output weighed from a standard measurement unit, while the cost survey yields represent the farmer's self-reported production divided by the land area planted to a crop. For soybeans and cassava in the sample as a whole, average yields estimated from the Struktur Ongkos are quite close to official figures. If the latter are taken to represent true population means, then Struktur Ongkos sampling errors - below five percent of a standard deviation - fall well within acceptable limits for the sample as a whole[4].

For all three crops, however, average Struktur Ongkos yields differ significantly from official estimates in many provinces. With the sole exception of the minor province of NTB, estimated corn yields are higher in the Struktur Ongkos sample than in official publications. This occurs despite a large sample as compared to soybeans and cassava. Crop sample size at the provincial level appears to bear little relationship to the magnitude of difference between alternative estimates.

Since crop yields are crucial determinants of comparative advantage, one must ask what causes such differences. Official statistics are based upon physical measurements of output at the time of harvest. If done properly, this is certainly a superior methodology as compared to a respondent recall survey. But estimating per-hectare output even from physical crop cuttings is surely a difficult task for the secondary crops, which are planted at diverse seeding rates, often in uneven row spacing and complex intercropping systems.

[4] This assumes that the population and Struktur Ongkos yield variances are the same. A common criterion for sampling error is that a population parameter estimated from a sample should be expected to fall within 10 percent of a standard deviation from the true value with 90 percent confidence.

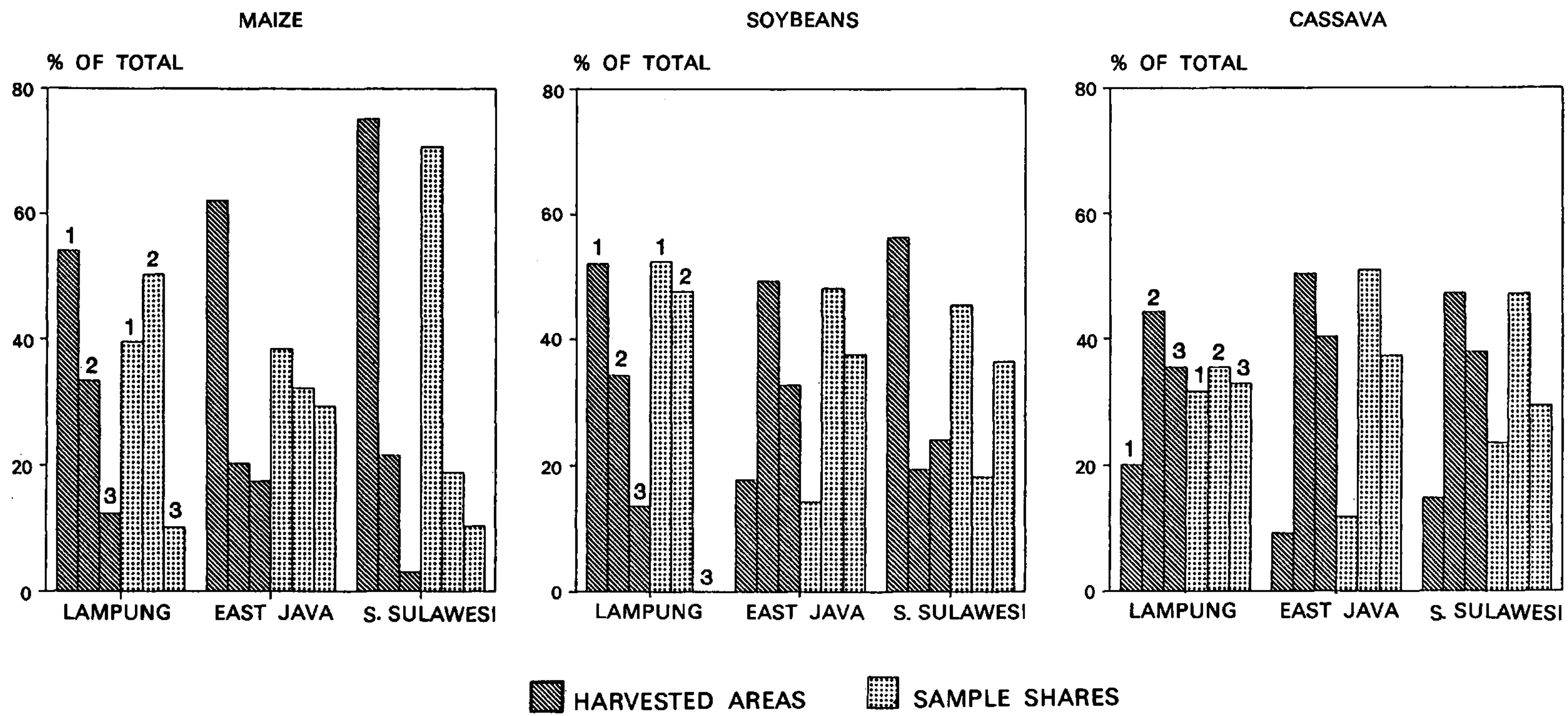

Figure 4. Seasonal Harvest Area and Sample Shares, 1987-1989 Averages.
(1 = January-April; 2 = May-August; 3 = September-December)

Table 2. Secondary Crop Yields in 1989 (Kg/Ha)*

Province	Maize				Soybean				Cassava			
	Official	S.O.	% Diff.	N	Official	S.O.	% Diff.	N	Official	S.O.	% Ditl'.	N
Aceh	1,969	2,365	20.1	34	994	1,308	31.6	85	12,300	11,192	-9.0	26
S. Sumatra	1,911	2,430	27.2	21	1,094	1,268	15.9	19	12,800	10,975	-14.3	58
Lampung	2,193	2,330	6.2	135	893		740	63	12,800	11,483	-10.3	164
W. Java	2,237	2,626	17.4	88	1,109	1,010	-8.9	48	12,800	14,120	10.3	251
C. Java	2,322	2,584	11.3	601	1,202		958	201	12,700	14,654	15.4	435
Yogyakarta	1,979	2,175	9.9	69	1,206	1,157	-4.1	121	12,300	17,229	40.1	98
E. Java	2,246	2,844	26.6	965	1,158	1,046	9.7	566	12,300	13,197	7.3	489
Bali	1,995	2,702	35.4	145	1,146	1,196	4.4	43	13,400	16,090	20.1	40
NTB	1,818	814	-55.2	28	1,078		668	71	11,300	4,990	-55.8	21
NTT	1,722	1,807	4.9	357	1,020	1,020	0.0	8	10,900	5,203	-52.3	142
N. Sulawesi	2,024	2,530	25.0	101	1,051	1,868	77.7	26	10,500	14,356	36.7	35
S. Sulawesi	1,609	1,898	18.0	328	1,096	1,389	26.8	33	11,200	8,658	-22.7	34
S.E. Sulawesi	1,775	1,790	0.8	105	1,183	1,267	7.1	31	11,600	3,805	-67.2	34
Overall**	2,129	2,390	12.3	2,977	1,098	1,068	-2.7	1,315	12,200	12,604	3.3	1,827
Difference as % of Sample Stand.	17.5%				4.8%				4.9%			
Between-Province Coef. of Var. (%)	11.1%	24.4%			8.2%	26.6%			7.3%	39.0%		

* Difference as a % of sample standard deviation shows absolute difference between overall yield estimates divided by standard deviation of yield in the Struktur Ongkos sample. Between-province coefficient of variation shows standard deviation of average provincial yields divided by overall mean yield estimates.

** Overall yields for irrigated paddy include North Sumatra.

BPS staffs point out that the primary purpose of the Struktur Ongkos survey is to estimate production costs, not yields. The Struktur Ongkos publications themselves estimate gross income based on official yields rather than the farm production data collected in the survey. Although staff of the Struktur Ongkos division has confidence in the quality of their survey, use of official figures is intended to ensure consistency among alternative BPS publications on the food crop sector[s].

The crop cutting and Struktur Ongkos samples differ significantly in size, and the methods for data recording and validation are also likely to account for some of the discrepancy in yield estimates. For the crop cutting sample, the Mantri Tani weight output from a standard fresh crop cutting and measures plant spacings within the field from which the cutting is taken. The Mantri Statistik must convert local post-harvest forms of marketed or stored output to the standard units required in the StruktuOngkos questionnaire. In both cases, dry unhusked maize *(tongkol kering)* must often be converted to dry seed *(pipilan kering).* In the cost structure survey, farmers ma% report cassava output in the form of dried *gaplek*, which must then be converted to fresh root equivalent. If these conversions are not made, estimated yields will be too high in the case of maize, whereas cassava yields would be too low. Imprecision in local measurement units and the field worker's assumptions about crop moisture content are further sources of error that could bias yield estimates in either direction

Cross-checking suspicious yields with questionnaire information on output values and prices were the most time consuming task in cleaning the data set. All data were examined record-by-record to fix obvious data entry errors[6]. When necessary, uncorrectable outliers were deleted from further analysis. Implausibly high per-hectare values were removed, but it proved more difficult to identify data transcription errors, at the low range of yields and input use [7.] Hence, the averages discussed below may be biased downward insofar as errors at the low end remain in the sample.

Field observations suggest that crop yields vary more among and within provinces than official figures show. The Struktur Ongkos results support such a conclusion and, as shown below, the survey demonstrates differences in farm technology that should logically be associated with the yield variation revealed in the data. For regions in which the authors have significant field experience (Java, Nusa Tenggara, and southern Sumatra), the Struktur Ongkos estimates are consistent with our observations. The raw

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[5] Indeed, the official yields themselves represent the result of ad hoc adjustments so that statistics from the bureau for agriculture are free of extreme year-to-year fluctuations and correspond to figures published h, the BPS divisions concerned with food consumption, marketing, and trade (personal communication. Suwandhi, head, BPS Bureau for Agriculture and Industry Statistics).

[6] This often involved comparison of individual farm records with yield and price information from a giver farmer's neighbors, that is, farms within the same sub district (kecamatan) and seasonal (sub-round) bloc}k that constitutes the basic unit of Struktur Ongkos sampling.

[7] Crop yields well below average levels may occur due to the effects of drought, pests, and other growing season problems. Similarly, input use and yields are low in many traditional secondary crop systems, a, well as in the dry season when moisture availability is uncertain. Labor use may also be unusually low in systems where farmers make cost-reducing substitutions of tractors, animal power, and herbicides. Each o; these considerations makes it difficult to identify outliers at the low end of input use and yields. It should be noted that yields and/or labor use were extremely high for a number of farmers planting cassava on plots of less than 0.10 hectare, perhaps due to the practice of sequential harvest and replanting under which cassava can be cultivated at a variety of ages on the same piece of land. Hence, all cassava farmers harvesting less than 0.10 hectare were deleted from the final sample. Maize and soybeans were also grown on small plots, but with far less apparent bias in yields and costs.

data have been cleaned carefully, with many records adjusted to reduce estimated yields, thus raising production costs. We have some confidence in the resulting data set. However, to assess differences in cost estimates arising from the use of alternative yields, a comparative analysis is undertaken in the full report on this study (Roche/, et al., forthcoming, 1992). The results of that exercise indicate that the level of data aggregation (for example, agro climatic zone versus province) often has a greater impact on cost estimates than does the choice of yield figures.

Agroclimatic Characteristics and Crop Productivity

Official estimates of crop productivity are made by administrative region, often obscuring the substantial variation in soils, climate, and land use that exists within provinces and sub provincial districts. In contrast, agronomic field trials are designed to be specific to the agro climatic and socioeconomic characteristics of farming systems. When production systems overlap provinces and districts, the agronomist's recommended domain will fail to follow the administrative boundaries that are convenient for extension planning. Hence, it is desirable to understand how agro climatic characteristics influence productivity, and, at the same time, to be able to relate these characteristics back to administrative units in which programming will be undertaken.

A step toward this goal can be taken with a map of Indonesia's agro climatic zones (Figure 5) that has been developed by Las and his associates at the Agency for Agricultural Research and Development (Las, et al., 1991). Based upon regional mappings of climate, elevation, and soil types, the map identifies six land types that primarily define the potential duration of annual crop cultivation. These are shown in Table 3. The map is drawn at a scale of 1:5,000,000 for all islands except Java, which is reproduced at a scale of 1:1,888,000.

The Struktur Ongkos sample has been linked to this map by grouping farms into agro climatic zones by the BPS codes provided for sub district *(kecamatan)* administrative units, which typically contain from 10 to 15 villages. This was accomplished by visual comparison of the agroclimatic map with administrative maps showing district and subdistrict boundaries. Since Java has been drawn to a larger scale and contains a more diverse mixture of zones (Figure 5), the map of Java is presently being computer digitized in a geographical information system. This procedure classifies administrative units more accurately than is possible with manual methods alone, and it also allows areas covered by the various agro climatic zones to be quantified. However, the digitization was incomplete at the time data analysis was undertaken, so our presentation of farm budget information is based upon the visual classification of kecamatan into zones.

Several features of the map should be noted. By necessity in a map of small scale, there is much overlap among land use forms. Many areas within the map's "rainfed" zones contain irrigation systems and, likewise, extensive urban areas and rainfed farmland may be found within the "irrigated lowland" category. Indeed, the map's authors estimate areas covered by each agro climatic zone that differ significantly from those derived by the digitization (Table 3), suggesting that they used secondary information to fine-tune the area estimates based on the map itself.

With the exception of the tidal swampland category, the zones are defined primarily on the basis of water availability and elevation, and do not distinguish among soil classes. The upland zone is defined only with respect to elevation. Given the variation of soils and seasonal rainfall in Indonesia's upland areas, the upland, category is likely to contain the most heterogeneous farming systems, particularly 07 the island of Java. Since zones 1 through 3 (Table 3) are lowland areas, one would expect that productivity variations within them will emerge primarily as a function of season and irrigation status. Finally, the map does not show land form and contour characteristics that influence potential soil erosion and, in turn, the productivity and sustainability of alternative land use patterns. To incorporate land contours would, require a more ambitious and costly effort with maps of considerably larger scale.

Hence, this map provides a broadly brushed portrait of Indonesia's regional agro climatic variability. Nonetheless, it reveals several plausible productivity differences when merged with the data provided by Struktur Ongkos. The degree of detail may be appropriate for planning at the national level, but more refined land use maps would be necessary for practical design and implementation of crop development programs a: the provincial and sub provincial levels.

Table 3. Characteristics of Indonesia's Agroecological Zones*

Zone	Agro climate	Estimated Distributions Java I	II	Indonesia
1. Irrigated Lowland	- Irrigation water available > 5 months per year - Water availability independent of rainfall - Elevation <700 meters a.s.l.	19.0%	n.a.	2.2%
2. Rainfed Lowland	- Irrigation water available > 5 months per year - Water availability dependent of rainfall -Elevation < 700 meters a.S.l.	7.3%	n.a.	1.2%
Total Sawah	- At least partially irrigated - Rice cultivation predominates - Elevation < 700 meters a.s.l.	26.3%	35.0%	3.4%
3. Drvland, Wet Climate	- Annual rainfall > 2,000 mm. -> 6 consecutive months with at least 100 mm. rainfall - Elevation < 700 meters a.s.l.	29.9%	16.5%	51.7%
4. Dryland, Dry Climate	- Annual rainfall < 2,000 mm. -> 6 consecutive month with at least 100 mm. rainfall -Elevation < 700 meters a.s.l.	16.6%	23.6%	10.0%
5. Upland	-Elevation > 700 meters a.s.l.	26.7%	23.9%	14.1%
6. Tidal/Swamp Lands	- Land influenced by ocean or river tides - Soil characterized by organic matter layer and potentially acid reaction	0.5%	0.9%	20.7%

* Source: Las, et al. (1991). Estimated distributions on Java show for (I), the estimates made by the map's authors, and for (II), estimates derived from computer digitization.

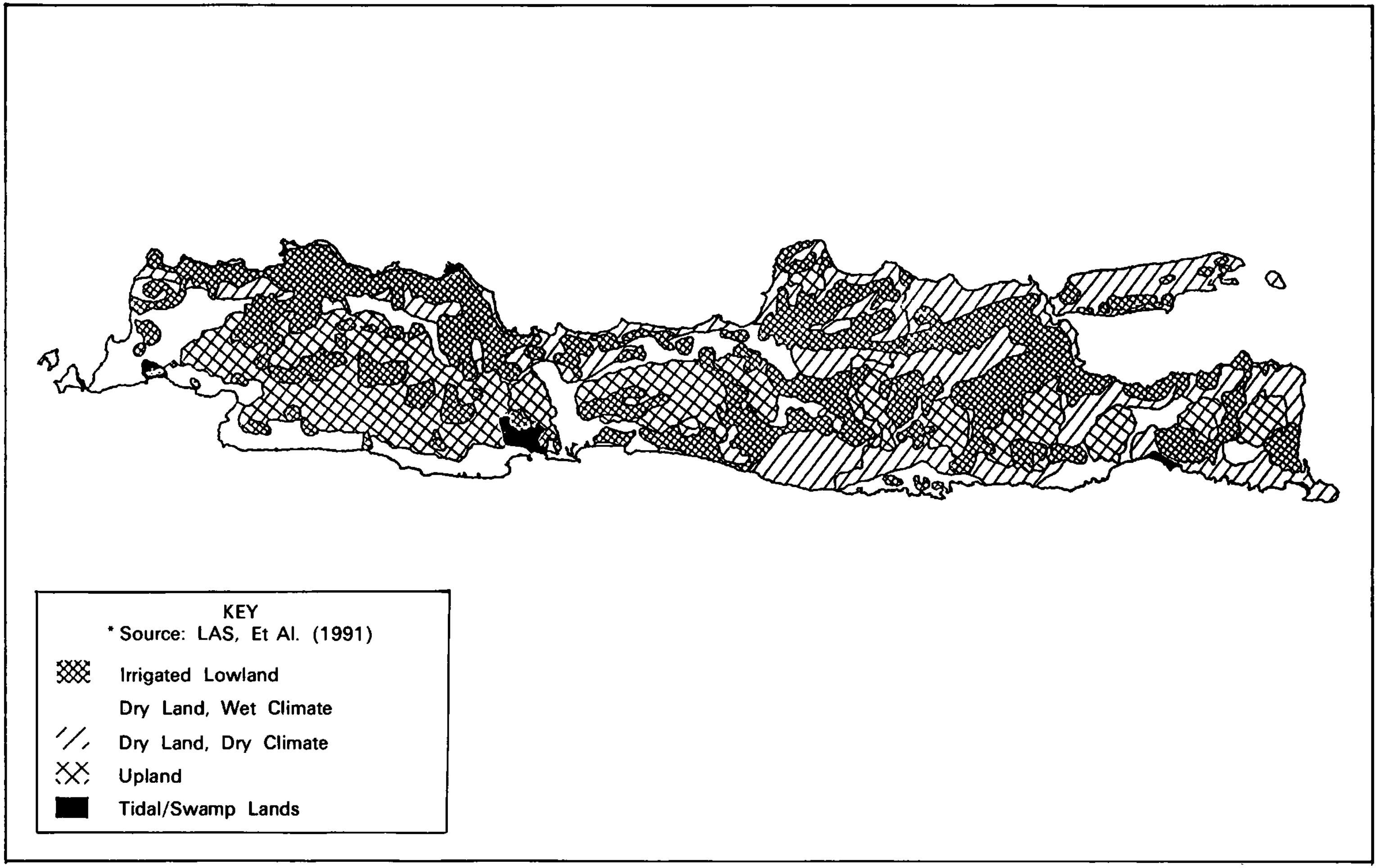

Figure 5. Java's Agroclimatic Zones*

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Measuring Production and Marketing Costs

Comparative advantage depends upon the relative costs of domestic production and marketing when these activities are valued as opportunity costs that would arise in competitive markets. The basic conditions for competition are that multiple buyers and sellers participate freely in a market in which prices vary in space and time due to changes in demand and supply. Although the competitiveness of world commodity markets is often arguable, international prices - c.i.f. for imports and f.o.b. for exports - are the best benchmark for evaluating the opportunity costs of tradable inputs and outputs. There has been no significant distortion recently in the Rupiah exchange rate, so dollar prices in international markets can be converted to Rupiah at the average 1989 rate of 1,770:1. For no tradable domestic factors, primarily land and labor, it is appropriate to use Rupiah prices if factor markets are reasonably competitive.

Since Indonesia trades internationally in the major secondary crops, full domestic resource use includes costs incurred on the farm and costs in marketing up to the relevant port where trade would occur. The 1989 farm cost survey has been supplemented with secondary data on regional costs of storage, transportation, and processing between the farm and border. Labor, land, and transportation are the major components of total supply costs.

Labour

Although there are significant regional differences in work opportunities, market information, and mobility, observers of rural Indonesia have generally concluded that wage rate and job search behavior are consistent with the conditions of a competitive labor market. For most farm activities, it is reasonable to value hired and family labor at local wage rates calculated in the Struktur Ongkos survey (Appendix Table 1). These wage levels conform broadly to regionally disaggregated data provided by separate BPS wage statistics (BPS, 1991), as well as by other specialized studies (ministry of agriculture, summarized in Pasandaran, et al., 1990; Naylor, 1991).

Complications arise because the Struktur Ongkos questionnaire defines a labor "day" as any work period of at least one hour in duration. In addition, no distinction is made between adult and child labor inputs. These problems should not be serious for hired laborers, since they are typically adults for whom work hours and wage rates are set on a full or half-day basis. However, family labor often includes children and may be undertaken for shorter periods. This occurs most frequently in weeding and crop maintenance *(pemeliharaan).* Many farmers report that family members undertake these activities for at least one hour daily throughout the growing season. Extremely high labor use may result on a per hectare basis, but "daily" doubtless means merely that the farmer walks by his fields regularly or sends his children out to weed and scare away birds. Much of this work is done in the slack period between planting and harvest when the true opportunity cost of family labor is likely to be lower than the market wage rate.

No objective adjustment is possible in the raw data to correct for the labor-day definition. As a result, the figures on labor use shown below are likely to overestimate the levels of sustained work effort in crop production. Since the use of market wage~ for family labor in pemeliharaan would often produce dramatic upward bias ir estimates of economic labor costs, we value this labor at one-half the market wage rate. This compensates for mismeasured labor days and gives a lower value to labor provided by children and adults in the slack season.

Land and Irrigation Costs

The value of land is often the largest component of farm production costs. It i~ also the most difficult input to value with precision, as land is not an explicit cash cost of production for farm owner-operators. The opportunity cost of land can be measured in two ways. In competitive land markets, prevailing rental rates will reflect the net value of land in its most profitable use. In Indonesia, however, land is traded infrequently, so the assumptions for competition may not hold. In such a situation, one must estimate land values by seeking the highest net return to land among all feasible production systems. In a study of comparative advantage, these estimates must also account for price distortions that influence the net returns to land. The data requirements for these calculations are substantial, but the Struktur Ongkos survey allows a plausible approximation for the staple crops[8].

Data on cash rental and share payments have been aggregated by region, agro climatic zone, crop type[9], season, and irrigation status, with an average of six land rental observations in each group (Appendix Table 2). In the cost calculations, land rental rates were assigned according to the highest average value calculated for equivalent food crops that could be planted in a given season. Since soybean farmers have, until very recently, been heavily protected by trade policy, reported rental costs for soybean fields were lowered to account for the distortion in price'° that existed in 1989. In a few cases where no data on land rents were available for a production.

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[8] The survey provides no information on intercropping systems, nor on crops other than the major stapleIrrigation status is recorded, but there are no data on slope and soil type that are major determinants o' land productivity for the rainfed secondary crops. A total of 514 secondary crop farmers (eight percent o' the sample) were tenants on all or part of the land they operated. Of these, 46 percent reported cash rental payments and 37 percent engaged in a 50-50 crop sharing arrangement. The remainder indicated either - combination of cash payment and crop sharing, or crop share arrangements in which variable input cost were divided between tenant and owner. The frequency of tenancy was approximately equal among provinces, with the exceptions of NTT, and North and Southeast Sulasesi, where few tenants were captured by the survey.

[9] Crop types included cereals (maize and upland rice), legumes (soybeans and groundnuts), and root crops (cassava and sweet potato). Since the root crops typically require at least a six-month growing period, no seasonal desegregation was undertaken in calculating land costs.

[10] Soybean import prices averaged $ 300 per ton c.i.f. Jakarta during the years 1988-90. With 1989 domestic wholesale prices averaging close to Rp. 700 per kg., and an exchange rate of Rp. 1,770 per dollar. Domestic prices were about 24 percent above import parity. This differential translates unambiguously intc higher rental payments for share tenants who plant soybeans. Over time, high domestic prices would also raise the values of cash rentals and land sales in soybean producing regions. Hence, prior to calculating rental rates based on the highest return to alternative crops, we reduced rental costs for soybean farmers by 24 percent to adjust for the effects of price distortion. Similar adjustments seem unwarranted for the, other secondary staples, as there have been no persistent biases away from world price (export or import parity during recent years.

domain, values have either been imputed from nearby regions with similar characteristics or assigned as a 50-percent crop share. These imputations were necessary for tidal swamplands in western Java, and rainfed lands in Sulawesi and East Nusa Tenggara (NTT).

Although the major secondary crops are grown primarily on rainfed land, irrigation water contributes to higher yields in some systems. Indonesia's farmers pay only a small share of the capital and variable costs of irrigation. Estimates of the implied subsidy vary by region (see, for example, Djamaluddin, (1978). In a recent review of the irrigation sector, Varley (1989) estimated that the variable costs of operating and maintaining an irrigation command area average about Rp. 25,000 per ha. Annually, over and above village fees paid by farmers at the tertiary canal level. Since maintenance is labor intensive, actual costs will vary with regional wage rates. Hence, we adjust Varley's estimate to allow for sample wage differences and add one third of the annual amount (two-thirds in the case of cassava) to the local irrigation fees paid by farmers in the Struktur Ongkos sample. In order to illustrate the static effect of irrigation and other input subsidies on production costs directly, subsidies are presented as a separate component of total costs in the following section.

Chemical Inputs

Indonesian subsidies in fertilizer production and distribution are well known. We value urea at f.o.b. prices and use c.i.f. prices for phosphate (TSP) and potassium (KCL). (In 1989, domestic prices for urea, TSP, and KCL were, respectively, 12, 93, and 72 percent lower than world price equivalents). We have also added costs for regional distribution that are proportional to average distances between provincial ports and the sample farm districts. For pesticides, we have used the price adjustments shown in Heytens (1991).

Intercropping

The Struktur Ongkos asks a simple yes-no question about whether a given crop is grown in monoculture or interplanted in a mixed stand. Intercropping was practiced by about 25 percent of all secondary crop farmers. It is impossible to allocate joint costs" in these systems since the survey provides no information about the types of intercrops, nor about their contribution to farm income. Hence, these observations are deleted from most of the production cost and yield calculations that follow. The only exception is maize in NTT, which according to the both survey and field observations, a rarely planted in monoculture.

[11] Joint costs include labor used in land preparation and weeding, plus fertilizer and other chemical inputs that are broadcast over crops. Since most farmers would presumably find it difficult to distinguish among the use of these inputs by crop during the cost survey interview, we believe that average production cost calculations would be inflated by including intercropped stands. In fact, there is evidence that crop costs per ton of output should be lower in mixed stands since labor and other inputs generally do not increase n proportion to the value added by the intercrops (see the discussion for cassava on Java in Falcon, et al.. 1984). However, it is impossible to demonstrate this in the absence of information on relative crop densities and output value shares in the intercropping systems.

Marketing Margins

The Struktur Ongkos questionnaire records data on labor and transport activities undertaken in post-harvest processing and manual porterage between the farm and points of sale or on-farm storage [1z]. Falcon, et al. (1984), Timmer, ed. (1987, including working papers cited therein), BIN˜US (1988), and Rosegrant, et al., (1987) provide estimates of regional secondary crop marketing margins that we have update-to 1989 by adjustments for inflation in fuel, labor and other costs. Although fu: (diesel) prices have been subsidized heavily during the past two decades, recent policy changes have reduced fuel subsidies, so domestic prices are now more or less in line with the world market. The estimates of average regional marketing costs are shown Appendix Table 3. Since transportation fees vary with distance and road quality within regions, we have adjusted land transport costs in each production system in proportion to weighted average distance between the sample farm districts and the close international port active in each crop's trade during 1989. These estimates were cross-checked against unpublished figures on land and inter-island shipping rates from the ministry of transportation. Information on marketing costs in the provinces of NTB and NTT was provided by field studies conducted in 1988 by the Bogor Agriculture Institute (described in IPB, 1990). Overall, these sources are broadly consistent for Indonesia's principal producing regions, but secondary information on markets scarce for the remote provinces of Aceh, North Sulawesi, and Southeast Sulawesi'. Some cost assumptions proved unavoidable for these regions, but time limitation - unfortunately prevented us from undertaking regional surveys of traders and other-market agents.

Cost Computations

In order to ensure consistency among indicators of average yields and costs, tot~ resources used in a given production domain must be summed over farmers prior : computing means. Traditional algorithms produce cost and value estimates that m:.. fail to satisfy logical adding-up restrictions. Methodological details on the-computations are contained in our full report (Roche, et al., forthcoming, 1992).

[12] The cost categories include "other labor", which would typically cover post-harvest processing porterage, and "transport costs" for cash expenditures in local transport to the farmer's home o: roadside and local markets

4

1989 Production Costs

In order to reduce a great deal of information to manageable size, the farm survey and marketing data must be presented in a succinct format that summarizes the key aspects of regional production costs. The discussion concentrates on cost shares for farm inputs, production subsidies, and marketing margins that are broken down into production `systems' defined by region, agroclimatic zone, season, and irrigation status' [3]. The choice among systems was determined primarily by survey sample sizes, since, given the sampling framework, these are roughly proportional to the frequency of individual cropping environments.

Indonesia's provinces have been grouped to reflect similarities in agroclimate and marketing costs (Appendix Table 4). Java is divided into western and eastern regions that demarcate the approximate boundary between the predominant short and long dry-season climates shown for rainfed soils in Figure 5. South Sumatra and Lampung have been merged since they possess similar soils and climate. North and Southeast Sulawesi are grouped together due to their isolation from major trading centers, in addition to having relatively small provincial sample sizes

In the following charts on production costs, the horizontal axis provides numeric codes 1-5 to identify the agroclimatic zones outlined in Table 3. "W" and "D" refer, respectively, to the wet and dry seasons, while "R" and "I" indicate whether a system is rainfed or irrigated. The vertical axis shows production and marketing costs in Rupiah per kg., with horizontal grids for recent benchmark prices that indicate the cost competitiveness of each system.

Maize

Figure 6 shows regional production costs for maize. Within regions, systems are ranked in increasing order of production and marketing costs, giving the appearance of an upward sloping cost curve that represents a partial equilibrium relationship between price and supply. This interpretation would be proper if the width of each chart bar were proportional to the corresponding system's sample size.

The price grid shows an average f.o.b. price of Rp. 213 per kg. for Indonesian maize in 1989, a level around which nominal prices varied little during the years 19861990. The f.o.b. price is slightly above the Surabaya wholesale price during the peak East Java harvest months of January through June in East Java, indicating that domestic prices were close to export parity.

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[13] The appendix provides summary tabulations of major production cost components. Spreadsheet files showing a more detailed breakdown of costs and our methods of cost calculation are available on request from the authors.

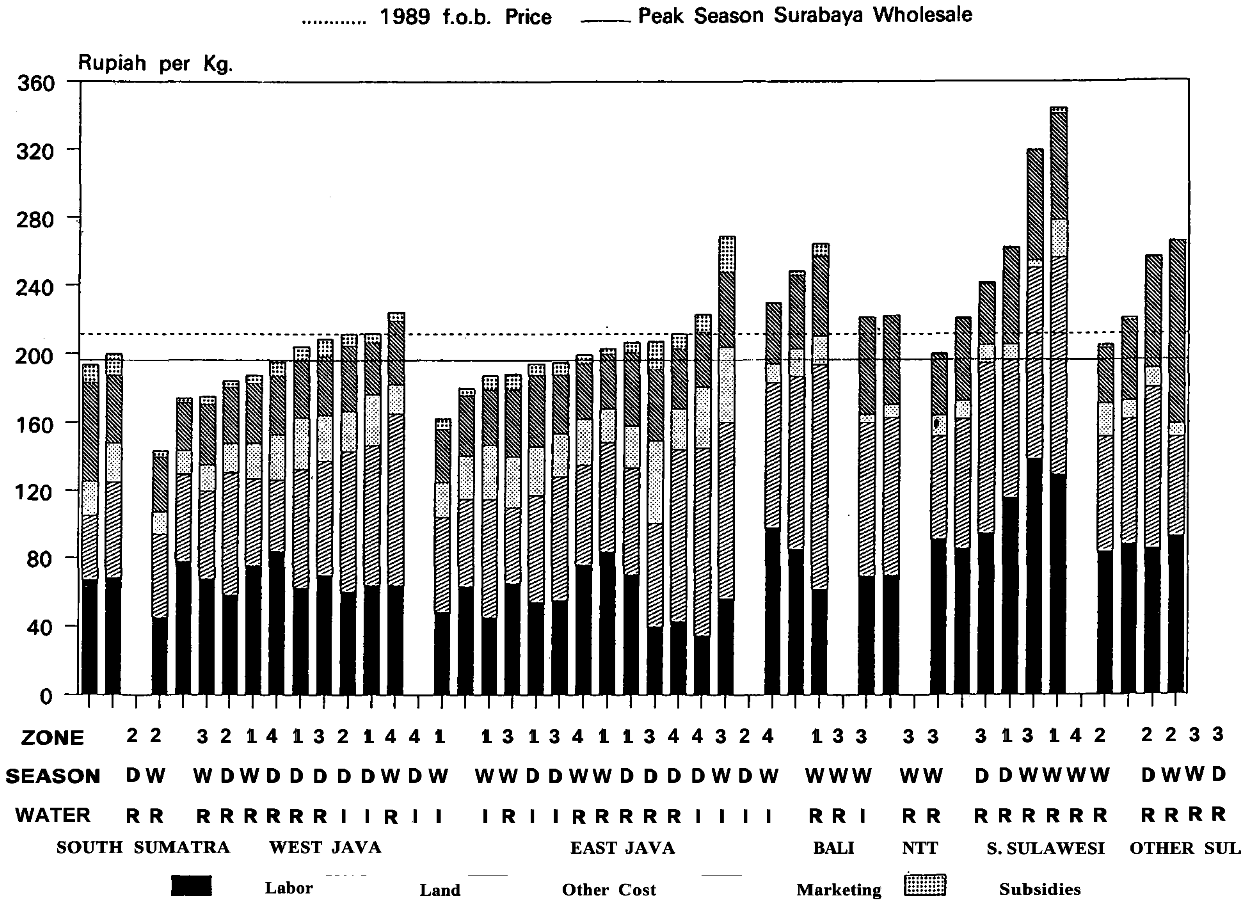

Figure 6. Maize Production Costs

Production is efficient and competitive at world prices if total costs fall below the grid. The difference between domestic costs - including input subsidies and wage rate adjustments - and the world benchmark price indicates the net social income shared by farmers and marketing agents. Low cost systems generate high positive profits, while systems close to the f.o.b. price may just fully recover costs. The precise distribution of income among farmers and traders is unknown [14]. Relative shares of income will certainly vary over time and within regions due to prescience and errors in planting and trading decisions.

Where total costs rise well above the price grid, it can be inferred that producers cannot compete with supply costs in the world market. This does not necessarily mean that inefficient farmers suffer losses. Regional marketing costs are often an effective barrier to inward and outward trade flows, thus allowing inefficient producers to benefit from high prices in isolated markets. Producing for such markets or for subsistence normally must provide positive returns to farmers or production simply would not occur.

Maize production costs vary widely both within and among regions, ranging from less than Rp. 150 per kg. in West Java (zone 3-W-R, or the rainfed, wet season crop in agroclimatic zone 3 (Table 3) to a high of almost Rp. 350 in South Sulawesi (zone 2-WR). Overall, average costs rise gradually moving west to east from Sumatra to the eastern islands. The lowest costs are observed on Java, primarily in the lowland systems (zones 1 through 3).

The agroclimatic breakdown shows that the upland systems (zone 4) on Java and South Sulawesi are usually located at the upper and of the cost distributions. In lower lying areas with extensive irrigation (zone 1) and those with an extended dry season (zone 3), production costs on rainfed land are generally higher in the dry season than in the wetter months. Patterns are less clear in the humid, primarily rainfed lowlands (zone 2) since the sample sizes are small.

Irrigation and seasonality have mixed relationships with production costs. Costs are relatively high in the irrigated, dry season systems of Java and Bali, yet East Java's cheapest maize is grown with irrigation in both seasons. Differences in fertilizer use, marketing margins, and land rental costs are the primary causes of per-unit cost differences among the irrigated systems. The higher cost irrigated systems in East Java use very high levels of urea and TSP. Within the sample, these systems are also located relatively far from the Surabaya market (see Appendix la).

Indonesia's maize yields are generally highest on irrigated land, but high yields do not necessarily imply low per-unit costs as one might expect (Figure 7)[15]. Irrigated sawah is more productive than rainfed land, and this higher productivity is reflected in land rental rates (Appendix Table 2). In several cases, rental costs are higher for irrigated land during the dry season, doubtless reflecting the greater scarcity of water.

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[14] Net returns to individual farmers or farm groups can be determined by deducting production costs from the gross value of output, but prices paid by final consumers are unknown.

[15] It is worth noting that maize yields and per unit production costs in rainfed areas of zones 1 and 3 are higher during the dry season than in the wetter months. The cost differences generally are small, however, and apparently result from variation in seasonal sampling by location that influences the marketing costs calculated here. Such an effect is most visible in the two zone-3 systems of Outer Sulawesi and will be examined more closely in future work on the data set.

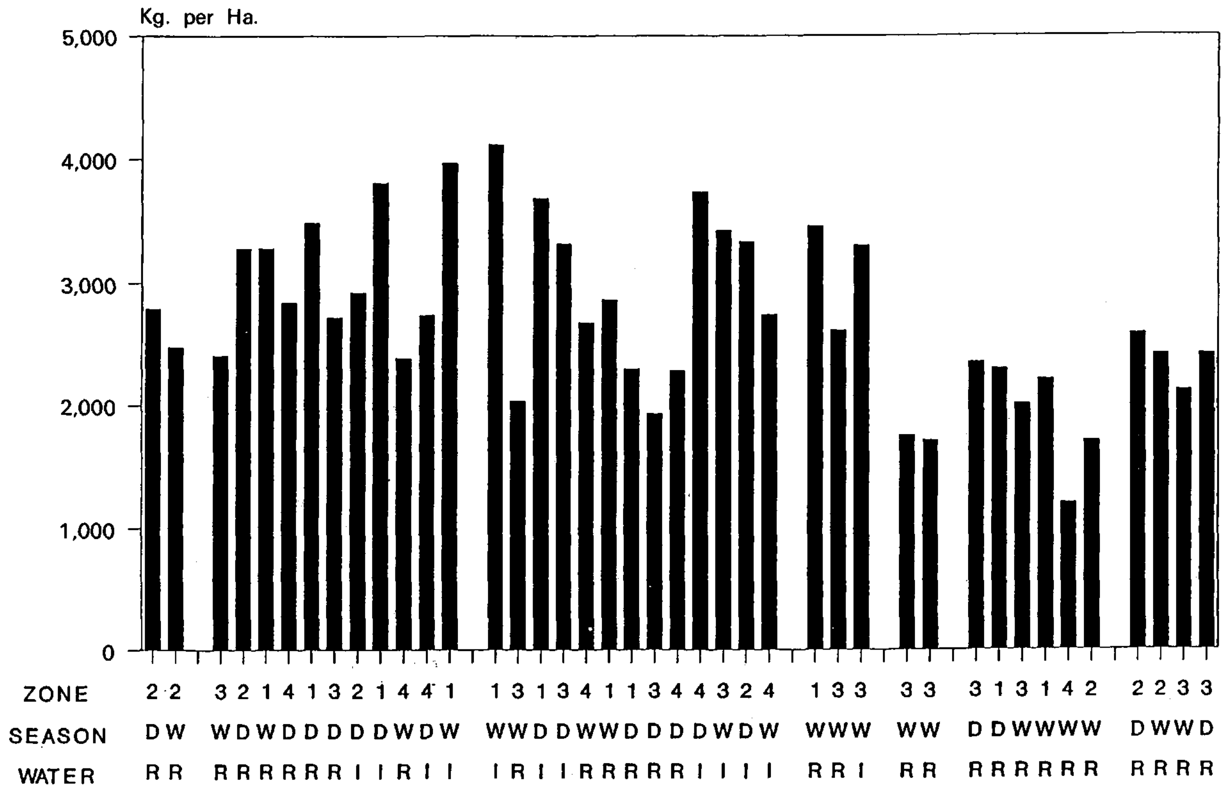

Figure 7. Maize Yields (Ranked by Production Costs)

Even at high levels of productivity, relatively low-valued crops such as maize often cannot compete profitably with higher-valued legumes and vegetables on irrigated land.

Input subsidy costs in maize production vary directly with irrigation status and the use of chemical inputs. Subsidies account for 3 to 21 Rupiah per kg. of the cost of maize in Java and Southern Sumatra, but are negligible in the eastern islands of NTT and Sulawesi. Although subsidies usually constitute a small share of farm costs, the aggregate public cost is large. As judged by Struktur Ongkos sample sizes [16] (Appendix la), subsidies in the major maize systems of Java and Southern Sumatra average about seven Rupiah per kilogram. More than 75 percent of Indonesia's 1989 maize crop of 6.2 million tons was grown in these regions. Hence, a rough calculation shows that the government paid more than $ 18 million in 1989 as an indirect income transfer to maize farmers in these provinces. A much smaller transfer was made to farmers in NTT and Sulawesi, where maize is rarely irrigated, few chemical inputs are used, and farmers are often relatively poor.

Most systems in the eastern provinces are not yet able to produce maize at export parity cost. As Figures 6 and 7, and Table 6 make clear, this is due to the combination of high marketing costs, particularly in Sulawesi, and low productivity, most notably in NTT. Even with zero marketing margins, the two most costly systems in South Sulawesi would not be competitive due to high costs at farm level. In section 4 below, we examine whether yield- increasing technology could reduce farm costs so that maize would be competitive despite high marketing margins.

Soybeans

Figure 8 reveals that there is wide variation in soybean production costs both among and within regions. The principal factor associated with cost variation within regions would seem to be the value of land, which is generally much higher in the irrigated systems. Non-labor costs, primarily for fertilizer and pesticides, tend to be a larger share of total costs in the less efficient systems (Appendix Table lb). Since soybeans are a high value crop, marketing margins constitute a relatively small share of costs that is fairly constant among systems, as are per unit labor costs in the main growing areas of eastern Java. Input subsidies range between 20 to 25 Rupiah per kg. in eastern Java, but are lower elsewhere. They are also more evenly distributed among regions than was the case for maize.

The price grids show three alternative benchmarks by which to assess the efficiency of soybean production. By the standard of wholesale prices in Indonesia's protected domestic market, all systems generate positive profits. If the average c.i.f. price of 1989 is used, private profits disappear in most upland systems on Java and in a number of largely rainfed systems elsewhere. But 1989 c.i.f. prices, averaging $ 330 per ton, were above their long-run trend level in the world market. In 1990, average Rupiah wholesale prices increased by about 20 percent, while the c.i.f. price fell to $ 272 per ton. In the absence of trade protection, most of Indonesia's irrigated.

[16] The largest samples on Java are in the lowlands (zone 1), on both irrigated and rainfed land and in both seasons. Eastern Java samples are also large for rainfed crops planted in zone 3 in both the wet and dry seasons. Maize production in Sumatra occurs almost exclusively on rainfed land with a short dry season (zone 2).

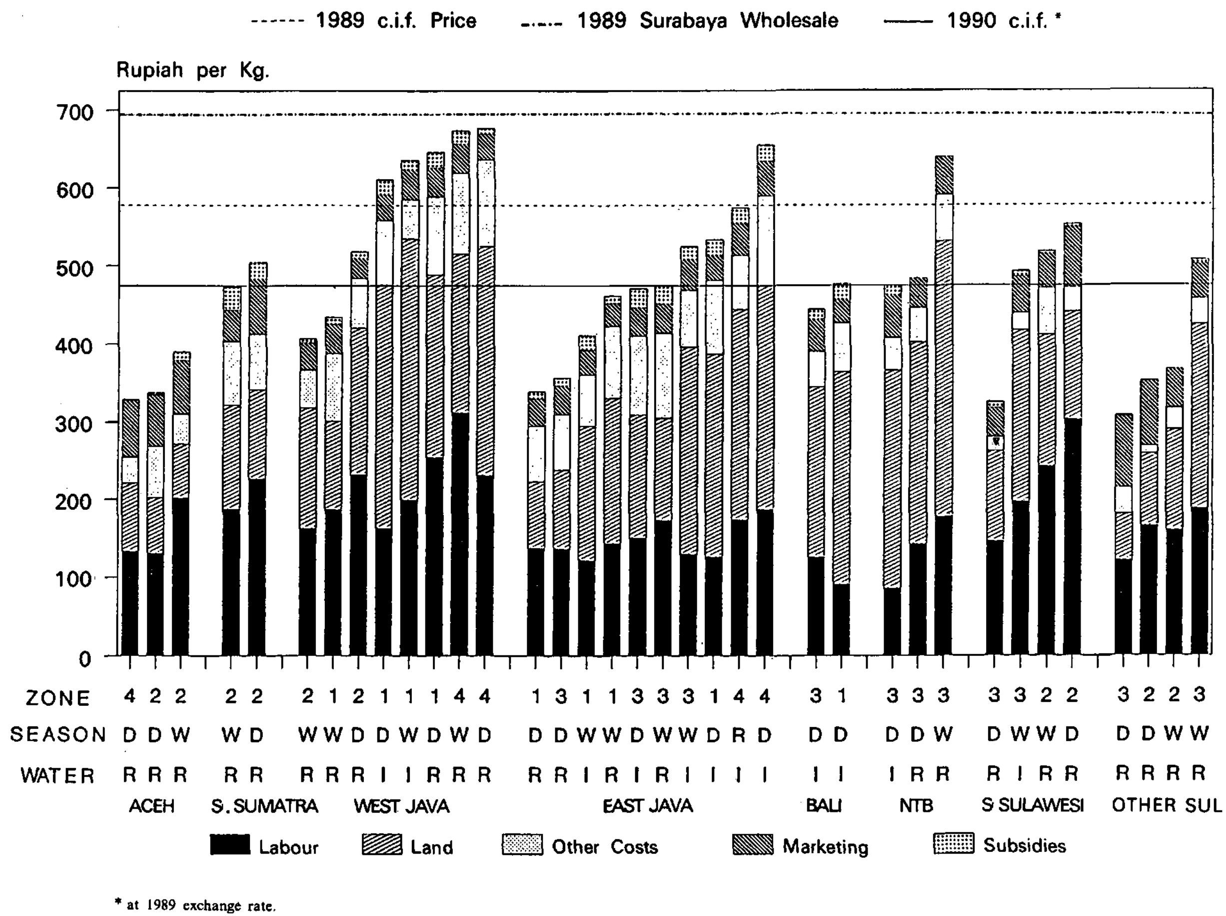

Figure 8. Soybean Production Costs

systems would have either just covered costs or been engaged in producing alternative crops if this price had prevailed at the 1989 exchange rate. However, soybean systems would have continued to generate positive profits in Aceh and many rainfed lowland systems of Java and, perhaps, Sulawesi (see below).

The relationship between soybean productivity and costs (Figure 9) is much stronger than that seen for maize. Yields are surprisingly high in the Sulawesi systems, but we discount this result since most sample sizes are quite small. Despite very low yields, the upland system of Aceh is among the lowest in cost because of very low land rental rates. On Java, however, the uplands again stand out as high cost regions. Relatively low yields are obtained in systems on Bali, NTB, and in many of the irrigated regions on Java. Irrigated, rice-based cropping systems are being targeted in current soybean research and extension efforts. Despite the low yields, Java's irrigated soybean systems would be marginally efficient if domestic prices declined to a world market trend level of $ 290-300 per ton. But one must ask whether this can be the case in the less profitable systems of Java, Bali, and NTB.

Cassava

Judged by domestic resource costs in proportion to 1989 world prices, the production of cassava and export of gaplek pellets were highly profitable activities in lowland areas of Southern Sumatra and throughout Java, Bali, and NTB (Figure 10)[17]. This was true despite large margins for transportation and processing over and above costs at the farm level. However, the uplands of Southern Sumatra, all of NTT, and most systems in Sulawesi appear to have been beyond the hinterland of the export trade. Average export prices for gaplek pellets are subject to wide fluctuations between years due to changes in the balance between Indonesian export supply and the import quota limit imposed by the European Community. In 1989, f.o.b. prices averaged Rp. 167 per kg., but the 1990 average had risen to Rp. 226, with the result that exports were feasible in almost all regions and production systems.

With the exception of the provinces of Java and Lampung, few chemical inputs are used in cassava production. Cassava never receives full irrigation, although it is occasionally planted on partially irrigated soils late in the rainy season. For these reasons, the subsidy costs of cassava production are negligible

[17] Gaplek pellets are usually processed by medium to large-scale firms, as compared to gaplek chips, which are peeled, sliced, and dried mainly by farmers and small traders. During the late 1970s, Indonesian chips usually sold at a premium in importing countries since buyers deemed them to be freer of adulteration and dust in comparison to pellets (Nelson, 1984). Since the mid-1980s, however, f.o.b. prices for pellets have risen significantly with respect to chips. During this time, Indonesia's pellet exports declined as a share of total gaplek exports. The reasons for these trends warrant investigation since it may be that capacity constraints in the pelletizing industry now limit potential income from Indonesian production and trade in cassava. The use of chip prices would have complicated our present analysis, since marketing and processing costs differ from those for pellets. The conclusions would be similar, however. Chip production costs compare very favourably with 1990 f.o.b. chip prices, but socially profitable exports at average 1989 prices would have been limited primarily to Java, Sumatra, and NTB.

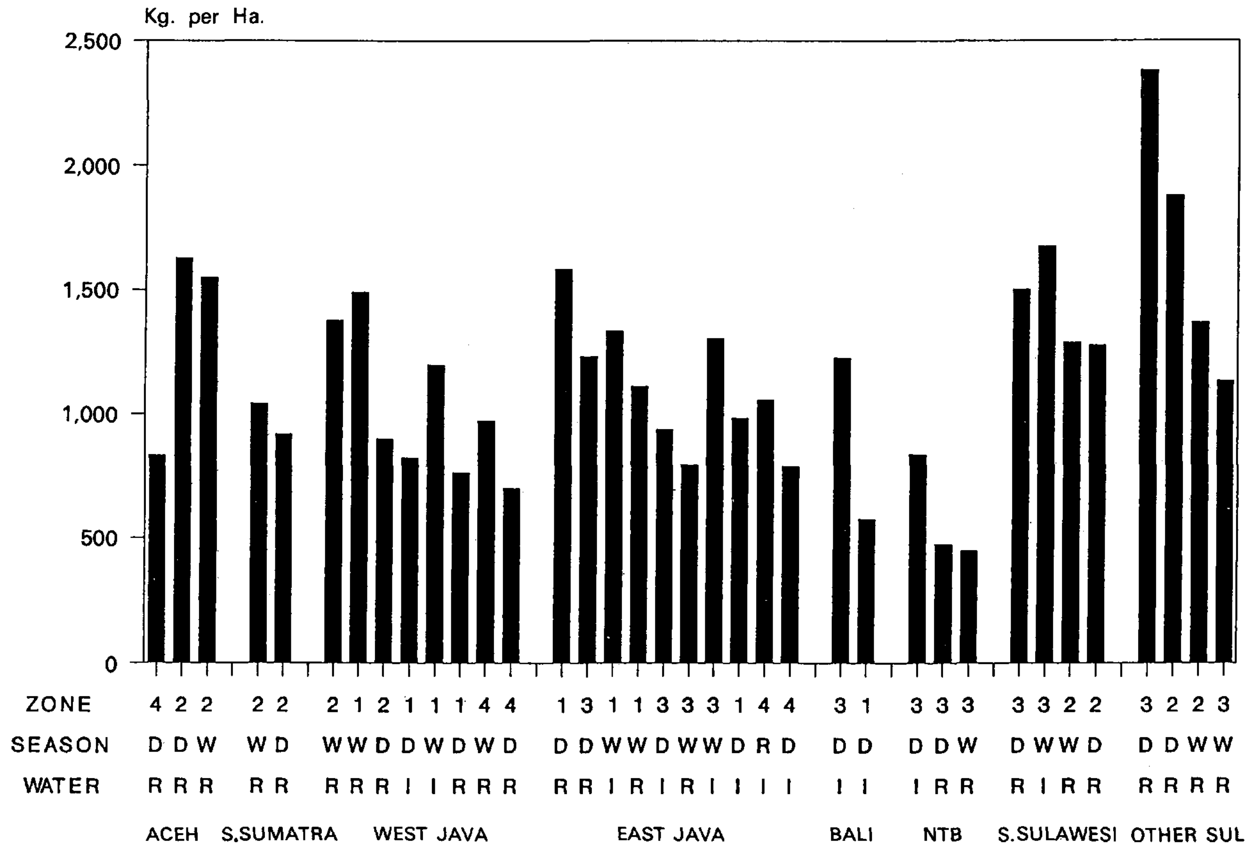

Figure 9. Soybean Yields (Ranked by Production Costs)

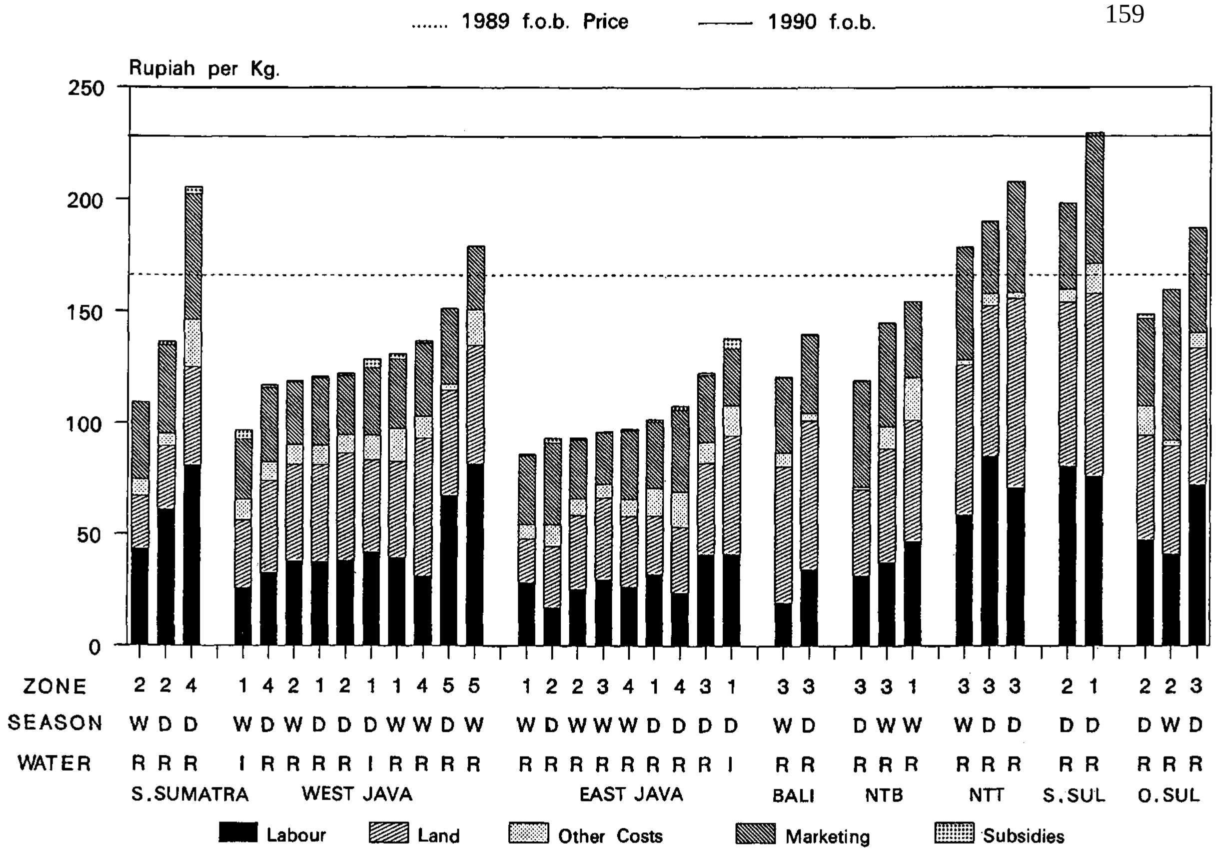

Figure 10. Gaplek (Pellet) Production Costs

Cassava yields vary widely among regions and show a strong relationship with per-unit production costs (Figure 11). From the standpoint of yields and efficiency, Java's uplands compare favorably with the lowland systems. The highest yield average is seen in the lowland irrigated and rainfed systems of Java, where cassava is harvested early in the year prior to the planting of rice and other crops. At the other extreme NTT can produce efficiently for export in years of high prices despite having Indonesia's lowest yields. Yields are somewhat higher in NTB, which would produce efficiently for export at either 1889 or 1990 prices. Yields in Sulawesi are similar to those of NTB, but high costs, combined with high prices for fresh cassava in local markets, imply that potential exports would be limited even in years of high f.o.b prices.

Due to rapid expansion of gaplek exports during the last five years, Indonesia' quota within the European Community has been binding since 1988. In August 1989 the Indonesian government introduced a 2-for-1 system under which exporter's were permitted to ship two tons of gaplek (either pellets or chips) to the EC if one ton w also exported to non-EC countries. Hence, average prices received under this system represented a weighted average of EC and non-EC prices (Fane, 1991). 1989 prices in non-EC markets, primarily China, averaged about one-third of those in Europe Indonesia's export supply declined by about ten percent in 1990, while f.o.b. prices rose. The 2:1 regulation was allowed to lapse in early 1991.

Regardless of regulations that might replace it, future growth in Indonesia's export supply must be directed increasingly to lower-priced Asian markets. In 1989, the f.o.b price for pellets shipped to non-EC countries was Rp. 64 per kg. According to Figure: 10, f.o.b. price of about Rp. 100 per kg. sets a lower limit below which little gaplek could be exported from even the lowest cost regions of Java. Such low prices will not be reached in the short run given present EC policies, but downward price movement are likely if the non-EC market share grows in importance. Given very low production costs in present systems, however, moderate price declines would create little immediate pressure for greater efficiency in the regions that contribute the bulk of Indonesia's export supply.

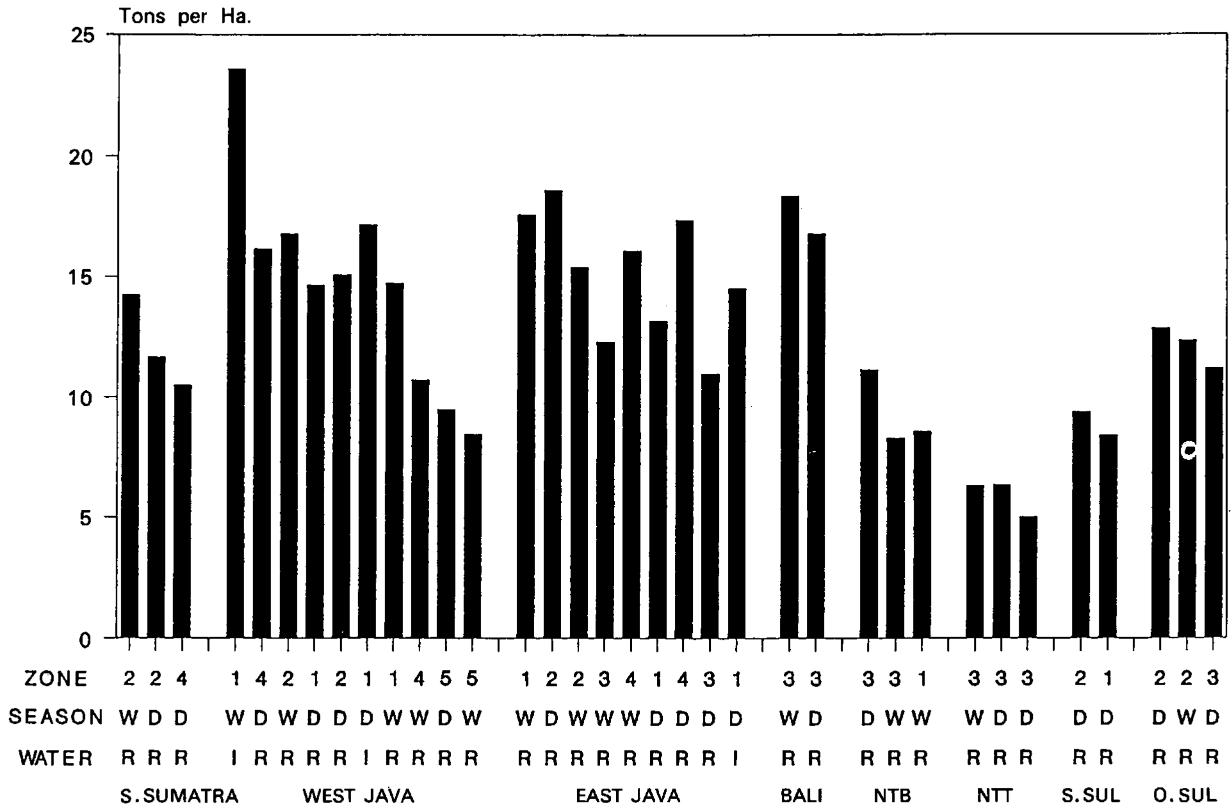

Figure 11. Cassava Fresh Root Yields (Ranked by Production Cost)

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Potential Efficiency in High-Cost Systems

The efficiency of secondary crop production can only be increased by reducing the unit costs of production and marketing. What agronomic potential exists to increase yields and efficiency in regions where farm production costs are currently high? to answer this question, we review the results of research undertaken at the food crop institutes of Indonesia's Agency for Agricultural Research and Development (AARD)[18]. With estimates of yields and costs that could be attained with available technology, it is possible to infer the relative importance of technology, extension, and markets as constraints to higher productivity and efficiency.

Maize

It is estimated that about four-fifths of Indonesia's maize is grown under rainfed and upland agroclimatic conditions, with the remainder more or less equally divided between rainfed and irrigated lowland sawah. Perhaps 55 percent is planted in intercropping systems, while the rest is grown in monoculture (Subandi and Manwan, 1990). Efforts to raise maize yields must consider how environmental and socioeconomic characteristics will shape the potential adaptability of new varieties and cultivation practices.

The agronomic constraints to higher productivity vary considerably by agroclimatic zone and season (Table 4). Under rainfed, upland conditions where maize is planted early in the rainy season, water stress may occur soon after emergence, while excessive moisture later in the season will tend to hamper root growth and yields. Rats, termites, heavy winds, and soil pH toxicity are further problems that primarily affect rainfed systems. Flooding is occasionally a serious difficulty in lowland, irrigated areas, where early maturing maize varieties may be essential so that maize can be followed promptly by paddy in maize rice-rice cropping systems. In many maize systems, evening humidity and dry daytime heat cause downy mildew early in the growth cycle of maize (Mink and Dorosh, 1987).

[18] In a companion piece to this study, Hutabarat (1992) provides a more comprehensive review of varietals and crop management recommendations presently made by Indonesian research institutes.

Table 4. Constraints and Required Technology to Improve Maize Yields

Agro-ecosystem location	Representative	Constraints	Required technology
A. Dryland/upland (79 percent)*			
1. Mixed-cropping (55 percent)			
a. High production (16 percent)	Malang, Kediri	1. Unstable and low yield 2. Medium maturity 3. Pests and diseases 4. Water stress 5. Post-harvest handling	1. High-yielding varieties 2. Crop management 3. Pests and diseases control 4. Water management
	Karo, Asahan	1. Unstable and low yield 2. Pests and diseases	1. High-yielding varieties 2. Crop management 3. Pests and diseases control
b. Low production (39 percent)	Bone, Madura, Central Java	1. Unstable and low yield 2. Medium maturity 3. Grain color 4. Soil fertility 5. Water stress 6. Pests and diseases 7. Post-harvest handling	1. High-yielding varieties 2. Fertilizer application 3. Water management 4. Upland crop management 5. Pests and diseases control
2. Monoculture (24 percent)			
a. High production (4 percent)	Lampung, Kediri	1. Unstable and low yield 2. Medium maturity 3. Pests and diseases 4. Soil fertility 5. Water stress 6. Low pH	1. High-yielding varieties 2. Pests and diseases control 3. Fertilizer application 4. Water management 5. Liming
b. Low production (20 percent)	Wonogiri, NTT, Gunungkidul	1. Unstable and low yield 2. Medium maturity 3. Grain color 4. Soil fertility 5. Water stress	1. High-yielding varieties 2. Pests and diseases control 3. Fertilizer application 4. Water management

Adapted from: Subandi and Manwan (1990).
* Figure in parenthesis designates percentage out of total national planted area.

Table 4. Constraints and Required Technology to Improve Maize Yields (Continued)

	Agro-ecosystem location	Representative	Constraints	Required technology
B.	**Rainfed land (10 percent)**	Central Java, East Java, South Sulawesi	1. Unstable and low yield 2. Medium maturity 3. Grain color 4. Soil fertility 5. Pests and diseases 6. Weeds 7. Water stress or logging	1. High-yielding varieties 2. Fertilizer application 3. Pests, diseases and weed control 4. Water management 5. Transplanting system
C.	**Irrigated wetland (11 percent)**	Kediri, Malang	1. Unstable and low yield 2. Maturity 3. Pests and diseases 4. Weeds	1. High-yielding or hybrid varieties 2. Pests, diseases and weed control
D.	**New opened land**	Transmigration areas	1. Unstable and low yield 2. Low soil productivity 3. Shortage of organic matter 4. Soil toxicity 5. Pests and disease 6. Weeds 7. Water stress or logging	1. High-yielding varieties 2. Fertilizer application 3. Liming 4. Pest, disease and weed control 5. Water management

Adapted from: Subandi and Manwan (1990).

Socioeconomic and institutional constraints must also be eased in efforts to develop maize and other secondary crops. Farmers growing maize for their consumption have a strong preference for white varieties in areas such as Central Java and South Sulawesi, yet the most successful improved varieties produce yellow grains. Even for the new yellow varieties, multiplication and distribution of seed often lag well behind the field trials and recommendations of agronomists. Extension workers, trained primarily in rice management techniques, are typically less knowledgeable about new secondary crop technology. Finally many find it difficult to pay the additional cash costs of fertilizer and fungicide that improve varieties often enquire to ensure high yields.

Despite these problems, maize research and extension efforts provide the major success stories in Indonesian secondary crop development. The agronomists have achieved encouraging results with a number of improved varieties (Appendix Table 5). Arjuna, an open-pollinated yellow variety, has been adopted widely since its release 1980. Bromo, also released in 1980, produces white grains. Bromo's yield potential appears to fall below that of Arjuna due to lower fertilizer response. Adoption by farmers has been more limited. Finally, there is optimism about the potential acceptability of hybrid maize seed. The C-1 hybrid has been adopted rapidly intensive production areas such as East Java, but farmers in remote regions have shown reluctance to pay the recurrent cash costs for seed and pre-emergence chemical treatments (Mink, 1987). More than one-fourth of the sample maize farmers obtained relatively high yields in 1989 from either improved open pollinated or hybrid seed. Average yields are shown below in kg. per hectare, albeit without control for the effects of fertilizer use and other management practices[19].

Maize *Variety*	Average *Yield*	*% of Sample*
Arjuna	3,018	12.3
Other Improved Non-Hybrid	2,770	3.9
Hybrid	3,566	11.5
Local	2,330	72.3

These figures lend support to the view that existing technology is rapidly raising the average productivity of maize in Indonesia, estimated officially at just 2.1 tons per ha 1989. Appendix Table 6 summarizes results of corn varietals trials from the major provinces. Depending upon agroclimatic zone, AARD scientists expect that average yields of 2.5-5.0 tons per ha. can be obtained with better varieties and cultivation practices (Table 5).

As measured by total costs in relation to world prices, maize production 1-presently an efficient, profitable activity in many regions. Wider adoption of new varieties could raise efficiency. In many maize systems of Java, it is possible that efficiency can also be increased by reducing current levels of urea application on the varieties now being planted. AARD field trials of Arjuna have generally used nitrogen

[19] Appendix Table 6 presents a regional desegregation of varietals use by farmers.

at a rate of 46 kg. per ha. (100 kg. urea), but the figures in Appendix Table la show that farmers now greatly exceed this level in many maize systems. There is evidence that East Java's rice farmers often use urea at very high levels that are economically irrational even at current subsidized prices (Roche, 1991). The question of whether this is the case in maize production is being addressed in ongoing work at Bappenas. The Struktur Ongkos survey provides evidence of fertilizer use that greatly exceeds extension service recommendation in some maize systems. Field demonstration efforts should attempt to demonstrate the economic benefits of urea used in correct amounts.

Table 5. Recommendations to improve maize yields

Recommendation package	Agro-ecosystem		
	Dryland/upland	Rainfed land	Irrigated Wetland
Varieties	Pioneer-1, C-1, Bromo, Nakula	Kalingga, Aijuna Sadewa	Arjuna, Kalingga, Wiyasa, Muneng Sintetik 3
Plant density (plant ha)	80,000	80,000	100,000
Fertilizer (kg/ha)			
N	135	67.5-135	135
P	90	45	30-45
K	30-60	30-60	30-60
Pest control (kg active material/ha)	0.15	0.15	0.15
Weed control (1/ha) Herbicide	3.00	3.00	2.00
Expected yield (t/ha)	2.50	3.00	5.00

Adapted from: Subandi and Manwan (1990).

The tabulation below compares total fertilizer costs at present and economic prices in the high-cost irrigated systems of eastern Java:

System	Fertilizer (Kg/Ha)			Present Cost	Cost Without Subsidy
	N	P	K	('000 Rp. per Ha)	
2131	196	5	0	76.4	87.3
4131	224	43	15	106.3	135.4
4 W I	144	41	48	84.9	116.6
AARD	46	92	60	71.0	119.4

At present subsidized prices, fertilizer expenditures in the above systems would decrease if AARD recommendations were adopted. Even at world prices, which would greatly increase costs for phosphorous and potassium, total fertilizer expenditures would decline in one of the three high-cost systems. Depending upon local soil conditions, optimal levels of P and K will often be lower, however, since the above figures show the highest rates used in AARD's eastern Java field trials[20].

In the currently efficient systems of eastern Indonesia, adoption of AARD'' experimental practices would require greater use of fertilizer and other inputs that raise production costs on a per-hectare basis. To examine the balance between productivity and costs in these regions, Table 6 estimates the incremental costs and returns to adopting AARD input recommendations for the Arjuna variety. Given marginal cost' and existing marketing margins, it is possible to solve for the "break even" yields required so that producing maize for export becomes an efficient activity. Labor requirements in harvest and post-harvest activities are assumed to increase in proportion to yields. We also assume that labor costs for weeding and maintenance will grow by one-half the proportional yield increase. Chemical inputs are valued a: economic opportunity costs in the calculation of break-even yields and farm profit, but the non-labor cost column in Table 6 includes only the incremental costs that farmer's would incur at the subsidized prices of fertilizer.

Several simplifying assumptions must be noted. First, the Arjuna variety matures in 90 days, which may be too long for farmers in some irrigated systems. AARD has had good results with earlier maturing varieties (e.g., Nakula, Sadewo, and Abimanyu) that could substitute for Arjuna, although they have not yet been field tested as widely. Second, this analysis implicitly assumes that Arjuna produces grain of similar quality as compared to current varieties. This would not be the case in regions where white maize is preferred, in which case the Bromo variety, with somewhat lower yield potential, would be an alternative. Finally, we assume constant prices and marketing margins. This seems reasonable for farm inputs, as well as for prices of maize produced for export. However, the marketing system's capacity to handle a greatly increased maize supply at constant cost may, in the short run, be unrealistic in regions such as Sulawesi and Nusa Tenggara. Similar caveats apply to the "break even" analyses of soybeans and cassava.

Table 6 shows that yield increases necessary to reduce supply costs to export parity level vary from 10 to 305 percent by region and agroclimatic zone. If these productivity levels can be achieved, efficient gains in net farm income would occur in most systems. Input costs will also increase on a per hectare basis, with the exception of eastern Java where cash non-labor costs decline at present subsidized prices because AARD urea recommendations are far lower than current farm practices.

As compared to other regions, the required yield increases tend to be small in eastern Java, where input use and yield are already relatively high. In the case of zone 2-D-I (the irrigated dry season crop in the humid lowlands), the break-even yield of 3,675 kg. per ha. amounts to 87 percent of the 4,221 kg. yield average obtained in the dry season by AARD. In zone 4-W-I (irrigated wet season upland), the break-even yield of 3,780 kg. is 96 percent of the AARD average. Since it is unlikely that farmers will be able to obtain yields similar to those at research stations, the technical feasibility of reaching these break-even points may be limited in both systems.

[20] Potassium amendments are often unnecessary, since many of Java's soils are naturally well-supplied with this nutrient. Water soluble forms of phophorous such as TSP tend to be fixed by many soils, a process which ensures that applications of phosphorous have residual benefits beyond the period of initial application. Hence, optimal TSP levels depend, upon the history of fertilizer use on previous crops. (In 1989, domestic prices for urea, TSP, and KCL were, respectively, 12, 93, and 72 percent lower than world price equivalents).

Table 6. Prospect and Implication for Efficient Maize Technology

Region	Zone[2]	Yields			AARD Trials (Kg/Ha)	Changes in			
		Present (Kg/Ha)	Break-Even (Kg/Ha)	Required Increase (%)		Non-Labor Costs ('000 Rp/Ha)	Labor Use (%)	Unit Costs (Rp/Kg) (%)	Profit[1] (%)
Eastern Java	2 D 1	3,335	3,675	10	4,221	-8	1	-5	9
	4 W 1	2,738	3,780	38	3,943	-13	3	-25	95
	4 D 1	3,733	4,285	1S	4,221	-37	10	-14	27
Bali	I W R	3,460	4,840	40	n.a.	70	13	-8	30
	3 W 1	3,304	5,125	55	n.a.	48	8	-23	60
	3 W R	2,608	4,080	56	n.a.	58	11	-17	53
NTT - Mono.	3 W R	1,714	2,450	43	2,630	49	9	-5	20
NTT - Mixed	3 W R	1,758	2,520	43	2,630	49	10	-5	19
South Sulawesi	I W R	2,212	4,530	105	3,605	86	16	-24	131
	1 D R	2,295	3,520	53	n.a.	85	7	-5	4
	2 W R	1,710	5,050	195	3,605	81	22	42	506
	3 W R	2,011	3,420	70	3,605	82	39	-14	-71
	4 W R	1,200	4,050	238	3,605	88	62	-42	335
Other Sulawesi	2 W R	2,414	3,630	50	4,000	81	17	-4	26
	3 W R	2,122	4,650	119	4,000	87	36	-22	103
	3 D R	2,419	9,800	305	n.a.	88	97	-33	341

• AARD trial results are for the Arjuna open pollinated variety. East Java figures are an average over 13 trials for the wet season and 14 trials in the dry season. The NTT result is from a single intercropping experiment, while only one wet season trial has been published for Southeast Sulawesi. The South Sulawesi figure is an average over 5 wet season trials. "N.A." indicates no applicable AARD results are available for comparison. Farm-level production costs include subsidies. Cost assumptions include fertilizer use as per regional trials ranging from 40-110 kg. N, 35-92 kg. P, and 30-60 kg. K. Hutabarat (1992) provides a comprehensive review of AARD research on secondary crop yields.

' Profit is the return to land and management after deducting cash costs, input subsidies, and the value of family and hired labor from the gross value of output.

2 Numbers refer to agroclimatic zones as outlined in Table 3. W and D are, respectively, wet and dry season. I and R refer to irrigated and rainfed. The AARD figures are illustrative of agronomic results in each region and season, but it was not possible to match the agroclimatic and irrigation characteristics.

Required yield increases are larger in Bali, where, in two systems, it is estimated that yields of more than 4,800 kg. are needed to reach export parity. AARD field trial results are not yet available for Bali. If the figures from eastern Java are used as a rough guide, it will be difficult to attain break-even yields with the present Arjuna technology. The maize systems of Bali and East Java show comparable levels of productivity at present, but Bali's maize is produced at greater total cost due to higher wages and land rental rates in the principal maize systems.

NTT is believed to be one of Indonesia's poorest provinces. Levels of food crop productivity are among the lowest in the Struktur Orngkos sample. The maize yields necessary to make NTT an efficient maize exporter also appear to be low relative to yields in other provinces, as well as when compared to present productivity in NTT itself. The single published AARD trial implies a technical yield ceiling only about five percent greater than break-even yield levels. Field observations suggest that agroclimatic conditions should not constrain even higher experimental yields with more widespread field testing. However, NTT's dryland farmers engage in a primitive, swidden-like agriculture that uses almost no modern inputs, so AARD's fertilizer recommendations would constitute a major departure from current practices. Hence, greater efficiency in NTT may be technically feasible, but will require aggressive demonstration and extension efforts.

In most maize systems of Sulawesi, marketing costs constrain the potential for international and interregional trade in maize and other crops. Estimated marketing margins for Sulawesi maize farmers as a group are from 14 to 63 percent higher than in other regions. This is true for South Sulawesi, where we have some confidence in the margin estimates, and for the other provinces, where the margin estimates should be validated in the field. The maize yield increases required to attain export parity are among largest in the regions considered here. In all cases, export parity yields are close to or exceed the yields obtained by AARD. While AARD's results make it clear that average maize yields can be raised in Sulawesi, it appears unlikely that significant quantities of maize can move outside local markets unless margins are reduced b% public and private investments in infrastructure and transport facilities.

Soybeans

Approximately 60 percent of Indonesia's soybeans are planted on irrigated soils. with the remainder being rainfed (Table 7). On technically irrigated land, soybeans are typically the least remunerative component of an annual rice-rice-legume sequence and farmers demand varieties that mature in no more than 90 days. Even faster maturing varieties are highly desirable in some systems, but it has proven difficult to breed for both early maturity and high, stable yields. Timeliness is less of a constraint in upland areas, where soybeans may perform poorly under conditions of either drought or excessive moisture. In almost all environments, soybeans are prone to a variety of tropical disease and pest vectors that introduce considerable risk into planting decisions. Poor seed quality and germination are common problems. Soil aluminum toxicity is a further constraint in areas of Southern Sumatra.

AARD agronomists have searched for better varieties and management practices to overcome these problems. The primary focus in recent years has been on lowland systems in which soybeans follow irrigated rice. Under recommended cultivation practices, soybean yields of 1.5-2.0 tons per hectare are to be expected depending upon agroclimatic conditions (Table 8). Selected varieties are a key part of these recommendations (Appendix Table 7). For the benefits of this research to be widespread, extension and seed delivery systems must be strengthened.

Introduced in 1983, the Wilis variety has undergone extensive field testing (Appendix Table 8) and has been adopted by a third of farmers in the Struktur Ongkos sample, most commonly on Java and Bali:

Soybean *Variety*	Average *Yield*	*% of Sample*
Wilis	1,107	33.7
Early (pre-1985) AARD Release	1,117	3.3
Named Non-AARD Varieties	1,251	7.9
Local	1,071	55.1

Table 7. Constraints and required technology to improve soybean yields

Agro-ecosystem	Constraints	Required technology
A. **Dryland/upland (41 percent)***		
1. First wet-season (October/November-January)	l. Uncertain rainfall during growing season 2. Seed quality 3. Pests and diseases 4. Weeds 5. Erosion and nutrient deficiency	1. Effective drainage 2. Crop management 3. Pest, disease, and weed control 4. Fertilizer and manure application 5. Post-harvest handling
2. Second wet-season (February-May)	1. Water logging 2. Soil fertility and management 3. Pests and diseases	1. Ditch construction 2. Fertilizer application and amelioration 3. Pest and disease control
B. Irrigated wetland (59 percent)		
1. First dry-season (March-June)	1. Short cropping season 2. Water logging 3. Low quality seed 4. Pests and diseases 5. Weeds 6. Soil fertility	1. Cultivation technology 2. Water management 3. High-yielding varieties 4. Pest, disease, and weed control 5. Fertilizer application 6. Post-harvest handling
2. Second dry-season (July-October)	1. Water stress 2. Pests and diseases 3. Weeds	1. Water management 2. Pest, disease and weed control
C. New opened land	1. Seed viability 2. Soil toxicity 3. Nutrient deficiency	1. Rhizobium application 2. High-yield toxic tolerable variety 3. Micro element fertilizer annlication

Adapted from: Manwan et. Al (1990).
*Figure in parentheses designates percentage out of total national planted area.

Table 8. Recommendations to improve soybean yields

Recommendation package	Agro-ecosystem			
	Dryland/upland		Irrigated Wetland	
	First wet-season	Second wet-season	First dry-season	Second dry-season
Varieties	Wilis, Lokon, Kerinci, Raung, Tidar, Dempo, Galunggung, Local HYV	Wilis, Lokon, Raung, Tidar, Local Variety	Wilis, Lokon, Kerinci, Merbabu, Tidar, Raung, Lompobatang, Rinjani, Local HYV	Lokon, Guntur, Tidar
Seed (kg/ha)	45	45	45	45
Plant density (crops/ha)	290,000	290,000	290,000	290,000
Fertilizer range (kg/ha)				
N	25-50	25-50	25-50	25-50
P	25-50	25-50	0-35	0-50
K	30-45	30-45	0-60	0-60
Pest control (I active formula/ha	0.5-1.0	0.5-1.0	0.5-1.0	0.5-1.0
Weed control (1/ha Herbicide	2.00	2.00	2.00	2.00
Expected yield (t/ha)	1.50	1.50	1.60	2.00

Adapted from: Subandi and Manwan (1990).

Wilis matures in 88 days with trial yields generally in the range of 1.5-2.5 tons per ha. under AARD's cultivation practices. These trials have involved modest fertilizer amendments, with lime being beneficial on some acid outer island soils. Although not always the top yielding variety in comparative trials, Wilis has performed well in a range of environments on Southern Sumatra, Java, Nusa Tenggara, and Kalimantan. As a result, it appears to be the most widely adopted new variety available at present.

As compared to AARD's expected productivity, the low yield average shown above for Wilis farmers suggests that improved seed alone will not bring the same benefits as full adoption of a set of practices involving seeding rates, pre-emergence treatments, pesticides, and fertilizers. Extension programs must make this clear to farmers. Even for the new varieties, seed quality at the farm level is often much lower than that used in agronomic trials, thus increasing the gap between experimental yields and farmer performance.

Table 9 shows the break-even yields required to lower soybean production costs to import parity level in regions that are presently inefficient. Dry season irrigated systems are of primary policy concern since it is in such lands that recent extensification efforts have been concentrated. In the lowland irrigated dry season system of western Java, a break-even yield of 1,327 kg., at 93 percent of the AARD trial average, might be difficult to achieve under farm conditions. There is greater reason for optimism in the same system of eastern Java, where the break-even yield is lower and the AARD trial average is much higher. Prospects for efficient improvements in Java's upland systems appear mixed. Import parity costs would technically be easiest to achieve in the dry season irrigated system of eastern Java, but more difficult elsewhere. However, it must be borne in mind that AARD reports do not allow us to categorize trials fully among the upland and lowland zones of the agroclimatic map.

NTB is currently an efficient producer of dry season soybeans on both irrigated and rainfed soils. Because land and labor costs are relatively low in NTB, a yield of just 1,057 kg. in the wet season dry land system would imply import parity. Such a yield seems achievable under farm conditions in view of AARD results and farmer performance elsewhere, but further field testing must substantiate this. Table 9 shows the only published AARD trial for NTB, one which was undertaken in the dry season.

In Sulawesi, average soybeans yields are the highest recorded in the Struktur Ongkos survey and, indeed, are far higher than those obtained by AARD. Given the required yield increase in relation to AARD's result, there would appear to be very limited prospects for reaching the import parity cost level in the single inefficient system of South Sulawesi (2-D-R). However, in view of the limited number of field trials and the small sample sizes for most of Sulawesi's soybean systems, conclusions about efficiency in these systems are tentative.

Table 9. Prospects and Implications for Efficient Soybean Technology*

Region	Zone[2]	Yields: Present (Kg/Ha)	Yields: Break-Even (Kg/Ha)	Required Increase (%)	AARD Trials (Kg/Ha)	Changes in: Non-Labour Costs ('000 Rp/Ha)	Labour Use (%)	Unit Costs (Rp/Kg) (%)	Profit[1] (%)
Western Java	1 W I	1,201	1,875	56	1,747	77	22	-20	56
	1 D I	824	1,327	61	1,429	75	16	-17	54
	1 D R	766	1,412	84	1,429	69	37	-21	96
	4 W R	975	1,695	74	1,747	61	28	-25	112
	4 D R	702	1,263	80	1,429	69	15	-25	98
Eastern Java	1 D I	986	1,293	31	1,791	68	12	-4	19
	4 R I	1,058	1,500	42	1,580	70	15	-11	35
	4 D I	791	1,405	78	1,791	72	24	-23	84
NTB	3 W R	450	1,057	135	1,617	88	67	-21	72
South Sulawesi	2 W R	1,290	1,660	29	880	83	6	-1	8
	2 D R	1,279	1,930	51	780	83	18	-8	47

* AARD trial results are for the Wilis variety. West Java figures are an average over 7 trials for the west season and 23 trials for the dry season. East Java results are averaged over 11 and 12 trials, respectively, in the wet and dry seasons. The South Sulawesi wet season figure is averaged over 4 trials. Published results exist for only a single trial for the South Sulawesi dry season and for NTB, with the latter having been undertaken in the dry season. No trials have yet been published for the rest of Sulawesi. Cost assumptions include recommended pesticides, plus fertilizer use at 46 kg. N, 69 kg. P, and 45 kg. K.

[1] Profit is defined in Table 6.

[2] Numbers refer to agroclimatic zones as outlined in Table 3. W and D are, respectively, wet and dry season. I and R refer to irrigated and rainfed. The AARD figures are illustrative of agronomic results in each region and season, but it was not possible to match the agroclimatic and irrigation characteristics.

Cassava

Relative to maize and soybean, research activities on cassava move at a slower pace, reflected both in the number of new released varieties and in the level of field testing. Cassava is prone to comparatively few agronomic problems and is well adapted to a range of dry land environments. It has a flexible growing period normally 8-12 months in duration, but is not subject to the timeliness constraints that maize and soybeans face in irrigated cropping systems. Hence, high yield and taste (determined by hydrocyanic acid content in the roots) have been the primary objectives of varietals selection efforts. AARD has released three variants of the improved Adira variety during the last 13 years (Appendix Table 9), but distribution of planting materials to farmers has been slow, as shown below for the 1989 sample:

Cassava *Variety*	Avarage *Yield*	*% of Sample*
Adira I, II, and IV	17,028	1.6
San Pedro Petro	15,517	1.6
Mentega	11,297	9.7
Valencia	15,421	4.4
Other Local Varieties	13,625	82.6

Both Adira and most traditional varieties are believed to respond well to moderate fertilizer amendments (Falcon, et al., 1984). Nitrogen, phosphorous, and, less frequently, potassium are the major elements of most recommendations to increase cassava yields[21]. The annual Struktur Ongkos publications indicate that use of chemical fertilizer on cassava has grown steadily during the last decade. However, average application rates remain low as compared to the major cereal crops. Rates of use approaching agronomic recommendations are generally observed only in intercropping systems and in localities where cassava cultivation is highly specialized.

Despite extensive cultivation practices, the previous section showed that Indonesia's major cassava systems are highly efficient, with few or no subsidy costs incurred in production. Inefficient systems are limited mainly to the uplands of Southern Sumatra and to the islands of Sulawesi and NTT. In most cases, the productivity levels necessary to achieve efficiency fall well below the yields that AARD agronomists deem feasible with available technology. Unfortunately, the limited number of field trials for these regions permits a comparison with AARD results only in the case of Southern Sumatra (Table 10). If, as shown in Appendix Table 9, average yields of 25-50 tons per ha. can be expected with the Adira 2 and 4 varieties, then strong comparative advantage should exist in all cassava systems at 1989 prices. At an average yield of 25 tons, the presently efficient systems of Java and Sumatra could continue to produce profitably for export at f.o.b. prices up to 35 percent lower than those of 1989 (Roche, et al., forthcoming 1992).

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[21] AARD's recommendations for cassava generally involve little more than fertilizer at the rate of 46 kg. each of nitrogen and phosphorous per hectare. Potassium, up to 60 kg. per ha., may be profitable on some soils. CIAT's cassava program has demonstrated the benefits of careful selection and preparation of cassava cuttings, but these CIAT results have not yet been incorporated into Indonesian recommendations.

Table 10. Prospects and Implications for Efficient Cassava Technology*

Region	Zone[2]	Yields			AARD	Changes in			
		Present	Break-Even	Required Increase	Trials	Non-Labour Costs	Labour Use	Unit Costs (Rp/Kg)	Profit[1]
		Kg/Ha		(%)	(Kg/Ha)	('000 Rp/Ha)	(%)	(%)	(%)
Southern Sumatra	4 D R	10,526	23,250	121	26,417	91	44	-25	544
NTT	3 D R	6,329	12,375	96	n.a.	133	24	-21	26
South Sulawesi	1 D R	8,405	20,500	144	n.a.	133	15	-37	178
	2 D R	9,397	16,900	80	n.a.	133	49	-24	76
Other Sulawesi	3 D R	11,191	20,250	81	n.a.	133	29	-18	70

* AARD trials are for the Adira variety in Lampung. No trial results have been published for the other regions. Break-even costs assume fertilizer application of 46 kg. N, 46 kg. P, and 60 kg. K.

[1] Profit is defined in Table 6.

[2] Numbers refer to agroclimatic zones as outlined in Table 3. W and D are, respectively, wet and dry season. I and R refer to irrigated and rainfed. The AARD figures are illustrative of agronomic results in each region and season, but it was not possible to match the agroclimatic and irrigation characteristics.

6

Conclusions

Desegregation by agroclimate, season, and irrigation status reveals considerable variability in the efficiency of secondary crop production in Indonesia. Clearly, one should not ask whether "Indonesia" has a comparative advantage in a crop such as soybeans, but rather, which production environments will profitably produce soybeans in the absence of trade protection? In contrast to past soybean studies, our analysis shows that efficient production presently occurs in a variety of systems, primarily in rainfed regions on and off Java. There is also technical potential to increase the efficiency of soybeans and the other crops in a wide range of systems that are now less profitable.

Policy makers concerned with regional poverty should be encouraged by the low yields required for efficient secondary crop production in the poorer eastern provinces of Nusa Tenggara. However, more widespread field testing and intensive extension efforts will be needed to realize the agronomic potential of region like NTT. Investments in market infrastructure will reduce costs in all regions, but appear crucial for integrating the regions of Sulawesi into national and international markets.

Efficiency and equity objectives may be well served by a development focus on land that has low opportunity costs even though potential productivity is also low in comparison to the best agricultural land on Java. Efficiency is closely related to productivity, but we have seen examples of productive, yet high-cost maize systems in Java's irrigated areas. The concepts of efficiency and comparative advantage are relative rather than absolute. Soybeans area a reasonably efficient crop on Java's irrigated soils, but policy makers and analysts must nonetheless ask whether even higher net returns could be provided by crops not considered in this study (mungbeans or vegetables, for example).

Time constraints forced us to cut several corners in preparing for the analysis. Exact cost measurements are difficult for no tradable factors such as labor and land. Our procedures for valuing these inputs were, at times, ad hoc, although not unusually so for studies such as this. The Struktur Ongkos data would allow more sophisticated methods of evaluation, such as statistical estimation of marginal productivity. In addition, our information on regional marketing margins is largely secondary. Although we believe that the relative magnitudes of regional marketing costs have been captured accurately, these data would benefit from further validation.

The agroclimatic map proved useful in distinguishing productivity and cost differentials in a few domains. The most consistent pattern was the tendency toward high costs in Java's uplands, a somewhat surprising result given the diversity of the uplands. Patterns emerged less consistently in the lowland zones, however, in part because of variation in the composition of the farm sample by season and location. The linkage of more detailed land maps with the sampling design of surveys such as Struktur Ongkos could be a fruitful area for future cooperation between BPS and other agencies. If sampling units - farms, households, or census blocks - could be located more precisely with respect to agro ecological zones, it would be possible to quantity the environmental characteristics associated with productivity, incomes, and poverty Such information could be valuable for more efficient targeting of a variety of public programs in agriculture, health, and nutrition.

Appendices

Appendix Table la. Costs and Returns in Maize Production
(Figures per Hectare Except Where Indicated; Sorted by Production Costs)

Region	Zone	Sample Size (N)	Yield (Kg)	Value ('000 Rp)	Fertilizer N	Fertilizer P (Kg)	Fertilizer K	Labor Use (Days)	Net Income Profit ('000 Rp)	Net Income 2 Labor	Costs per Ton Output: Land	Others	Marketing ('000 Rp)	Subsidy	Total	Distance to Market (Km)
South Sumatra	2 D R	44	2,789	558	60	41	5	126	315	67	38	20	58	10	194	134
	2 W R	53	2,477	393	45	54	11	113	166	69	57	23	40	12	200	64
West Java	3 W R	17	2,411	425	49	1	0	108	285	45	49	13	33	3	143	74
	2 D R	35	3,285	622	61	6	1	237	320	78	51	14	28	3	174	56
	1 W R	47	3,285	541	56	16	0	192	267	68	52	15	36	4	175	87
	4 D R	38	2,842	496	72	10	0	196	283	58	73	17	33	4	184	76
	1 D R	36	3,489	688	90	16	1	227	351	76	51	21	35	5	188	85
	3 D R	14	2,718	480	93	25	9	216	179	84	42	27	34	8	195	80
	2 D I	21	2,925	597	104	18	0	152	326	62	70	3I	33	8	204	76
	1 D I	50	3,811	651	126	33	1	218	281	70	67	27	34	10	209	81
	4 W R	28	2,386	376	71	19	0	141	167	60	83	24	38	7	211	97
	4 D 1	22	2,737	504	80	0	0	I83	247	64	83	30	30	5	212	64
	1W I	17	3,968	620	91	1	0	217	300	64	102	17	37	5	224	92
East Java	I W I	47	4,122	574	98	16	0	172	290	48	56	21	31	6	162	81
	3 W R	109	2,035	346	71	6	0	104	165	63	52	26	35	4	180	100
	3 W I	25	3,427	536	112	24	1	132	307	43	73	24	35	9	183	97
	1 D I	142	3,684	738	132	19	2	125	454	45	70	32	33	8	187	87
	3 D I	82	3,318	709	111	18	2	I64	394	65	45	30	39	9	188	120
	4 W R	39	2,672	533	107	15	0	138	312	54	63	29	42	7	194	132
	1 W R	153	2,861	443	90	25	4	132	213	55	73	25	34	7	195	95
	1 D R	141	2,296	444	56	16	2	138	208	76	59	27	32	5	199	86
	3 D R	93	1,931	381	43	6	0	128	180	84	64	20	32	3	203	83
	4 D R	30	2,284	428	102	7	0	132	211	70	63	25	43	6	207	137
	2 D I	18	3,335	671	196	5	0	121	437	35	I10	36	32	10	223	85
	4 D I	32	3,733	947	224	43	15	169	6I7	40	96	49	42	16	242	132
	4 W 1	14	2,738	509	144	41	48	145	236	56	104	44	44	21	269	142

Appendix Table 1a. Costs and Returns in Maize Production
(Figures Per Hectare Except Where Indicated; sorted by Production costs) **Continued**

Region	Zone	Sample Size (N)	Yield (Kg)	Value ('000 Rp)	Fertilizer N (Kg)	Fertilizer P (Kg)	Fertilizer K (Kg)	Labor Use (Days)	Net Income Profit 2 ('000 Rp)	Costs per Ton Output: Labor ('000 Rp)	Land	Others	Marketing	Subsidy	Total	Distance to Market (Km)
Bali	I W R	16	3,460	770	17	0	0	206	392	98	85	11	35	0	230	52
	3 W R	55	2,608	502	40	4	1	127	238	85	102	16	43	2	248	102
	3 W 1	22	3,304	711	50	13	10	117	453	61	132	17	47	7	264	126
NTT (Mixed)	3 W R	270	1,758	324	0	0	0	121	194	69	90	5	57	0	221	151
NTT (Mono)	3 W R	81	1,714	338	0	0	0	132	205	70	93	8	52	0	222	120
South Sulawesi	3 D R	17	2,349	432	26	0	0	139	188	91	60	12	35	1	220	87
	1 D R	27	2,295	354	6	0	0	133	133	86	76	10	48	1	221	153
	3 W R	94	2,011	243	14	1	0	121	32	95	100	10	36	1	242	90
	I W R	25	2,212	402	6	0	0	158	126	116	81	9	56	0	262	199
	4 W R	16	1,200	267	0	0	0	86	96	139	111	4	65	0	319	244
	2 W R	74	1,710	327	8	2	0	138	69	129	104	22	63	3	321	233
Other Sulawesi	2 D R	24	2,582	508	19	9	0	90	242	84	68	19	32	2	205	47
	2 W R	47	2,414	500	12	5	0	108	262	88	74	10	47	2	221	106
	3 W R	52	2,122	448	1	0	0	123	242	85	95	11	65	1	256	180
	3 D R	18	2,419	463	0	0	0	155	221	93	59	8	107	0	266	355

Appendix Table lb. Costs and Returns in Soybean Production
(Figures per Hectare Except Where Indicated; Sorted by Production Costs)

Region	Zone	Sample Size	Yield (Kg)	Value ('000 RP)	Fertilizer N	P (Kg)	K	Labor Use (Days)	Net Income Profit 2 ('000 RP)	Costs per Ton Output Labor	Land	Others	Marketing ('000 RP)	Subsidy	Total	Distance to Port (Km)
Aceh	4 D R	20	834	488	0	0	0	78	348	134	87	34	74	0	329	410
	2 D R	16	1,629	882	16	1	2	129	560	131	71	67	67	2	338	316
	2 W R	17	1,551	882	3	S	0	167	509	202	70	38	69	11	390	343
South Sumatra	2 W R	21	1,045	586	42	58	25	136	304	188	134	81	39	30	473	61
	2 D R	21	921	635	25	32	3	134	361	227	115	70	71	21	505	279
West Java	2 W R	9	1,380	900	35	6	2	176	608	163	155	48	35	S	407	81
	1 W R	33	1,494	965	30	20	2	240	556	188	114	86	37	9	434	91
	1 W 1	18	1,201	724	16	8	0	175	528	199	336	50	38	12	635	94
	2 D R	22	901	641	15	4	1	130	374	233	187	64	26	9	519	45
	1 D 1	30	824	638	14	9	8	119	434	163	311	84	32	20	611	70
	1 D R	17	766	578	13	26	0	161	305	255	233	100	37	20	646	88
	4 W R	7	975	744	37	23	8	200	340	312	203	103	38	17	673	94
	4 D R	7	702	459	47	0	0	120	218	232	294	111	33	7	676	73
East Java	I D R	32	1,555	1,001	51	16	1	224	669	137	86	72	35	9	339	113
	3 D R	21	1,234	775	31	16	0	117	518	137	101	71	37	10	357	125
	3 W 1	40	1,307	835	20	21	0	130	570	130	266	73	40	16	525	141
	1 W R	79	1,114	693	27	16	0	132	432	143	188	91	29	10	461	81
	1 W 1	64	1,337	847	1S	31	6	117	596	122	173	66	31	20	411	90
	3 D 1	102	940	675	13	29	1	111	439	151	1S8	100	36	25	471	120
	3 W R	26	797	536	43	34	0	122	311	174	132	109	37	25	475	122
	1 D 1	136	986	679	29	16	0	104	462	126	260	94	33	20	534	104
	4 D 1	22	791	568	27	5	6	146	329	187	287	115	45	21	655	166
	4 W 1	11	1,058	716	16	10	11	140	458	174	269	70	41	20	575	147

Appendix Table lb. Costs and Returns in Soybean Production
(Figures per Hectare Except Where Indicated; Sorted by Production Costs) Continued

Region	Zone	Sample Size (N)	Yield (Kg)	Value ('000 Rp)	Fertilizer (Kg) N	Fertilizer (Kg) P	Fertilizer (Kg) K	Labor Use (Days)	Net Income Profit 2 ('000 Rp)	Labor	Land	Costs per Ton Output ('000 Rp) Others	Marketing	Subsidy	Total	Distance to Port (Km)
Bali	3 D 1	20	1,228	774	7	3	4	74	565	126	219	45	41	13	444	74
	I D 1	7	577	312	0	0	0	22	224	91	273	62	30	20	476	29
NTB	3 D 1	27	840	540	S	0	0	S1	433	86	280	41	55	12	474	165
	3 W R	9	450	241	0	0	0	81	133	178	353	60	48	0	639	105
	3 D R	8	477	262	0	0	0	66	173	143	259	43	38	0	484	23
South Sulawesi	3 D R	4	1,505	722	0	0	0	193	475	146	116	18	37	8	326	99
	3 W 1	3	1,677	755	0	0	0	180	389	197	220	21	47	7	493	161
	2 W R	9	1,290	669	0	0	0	192	278	243	168	60	45	3	S19	146
	2 D R	4	1,279	895	0	0	0	221	467	304	137	31	78	4	553	340
Other Sulawesi	3 D R	10	2,382	1,292	0	0	0	133	922	121	60	34	93	0	308	187
	2 D R	7	1,880	1,065	0	0	0	200	737	166	93	9	85	0	353	166
	2 W R	9	1,369	601	0	0	0	111	345	160	130	28	50	0	367	74
	3 W R	26	1,133	550	7	7	0	131	301	188	237	33	44	6	507	58

Appendix Table lc. Costs and Returns in Cassava Production
(Figures per Hectare Except Where Indicated; Sorted by Production Costs)

Region	Zone	Sample Size (N)	Yield (Kg)	Value ('000 RP)	Fertilizer N	P (Kg)	K	Labor Use (Days)	Net Income Profit 2 ('000 Rp)	Labor	Land	Costs per Ton Output Others	Marketing ('000 Rp)	Subsidy	Total	Distance to Market (Km)
South Sumatra	2 W R	55	14,261	514	0	0	0	146	222	44	23	8	35	0	110	155
	2 D R	67	11,692	468	11	9	5	202	155	61	29	6	40	2	136	189
	4 D R	17	10,526	475	21	21	2	223	45	81	44	21	56	3	206	315
West Java	I W 1	6	23,604	868	78	31	11	211	534	26	30	9	28	4	97	73
	4 D R	70	16,163	597	31	13	0	193	329	33	41	8	33	1	117	100
	2 W R	13	16,793	767	3S	0	0	195	451	38	43	9	28	0	119	77
	2 D R	52	15,092	613	15	11	0	179	332	38	48	8	27	1	122	69
	1 D R	87	14,652	732	19	6	0	163	460	38	43	9	30	1	121	85
	4 W R	27	10,739	463	13	7	0	99	286	31	62	10	33	1	137	96
	1 W R	23	14,737	857	72	15	0	143	536	39	43	15	31	2	131	89
	1 D 1	7	17,167	1,033	135	0	0	189	667	42	41	11	30	4	129	85
	5 D R	4	9,505	333	0	0	0	148	66	68	47	3	34	0	151	101
	S W R	4	8,471	673	0	0	0	191	342	82	53	16	28	0	179	77
East Java	2 D R	19	18.621	604	97	13	0	106	403	17	27	10	37	2	93	145
	1 W R	38	17,590	830	20	7	0	163	587	28	20	6	31	1	86	114
	2 W R	6	15,407	558	24	7	0	132	354	26	33	7	27	1	94	90
	3 W R	22	12,321	633	6	S	0	115	456	30	37	6	24	0	96	71
	4 W R	I5	16,081	568	50	1	0	136	349	27	32	7	31	1	98	113
	4 D R	30	17,349	755	10	3	0	128	479	24	29	16	37	2	108	146
	1 D R	123	13,207	581	24	7	6	140	346	32	26	12	30	1	102	108
	3 D R	99	10,987	536	14	3	0	148	313	41	41	10	30	1	122	107
	1 D I	11	14,535	730	56	11	0	189	411	41	53	13	25	4	138	81

Appendix Table lc. Costs and Returns in Cassava Production

(Figures per Hectare Except Where Indicated; Sorted by Production Costs) Continued

Region	Zone	Sample Size (N)	Yield (Kg)	Value ('000 Rp)	Fertilizer N	Fertilizer P (Kg)	Fertilizer K	Labor Use (Days)	Net Income Profit 2 ('000 Rp)	Costs per Ton Output: Labor	Land	Others	Marketing ('000 Rp)	Subsidy	Total	Distance to Market (Km)
Bali	3 W R	11	18,369	918	32	0	0	101	729	20	61	6	34	0	121	135
	3 D R	10	16,797	1,175	35	0	0	148	922	34	67	3	35	0	140	146
NTB	3 W R		8,297	440	0	0	0	98	281	38	51	10	46	0	145	135
	3 D R		11,146	748	0	0	0	117	668	32	38	1	48	0	119	146
	1 W R	6	8,571	469	0	0	0	153	244	47	55	19	34	0	155	50
NTT	3 W R	28	6,309	615	0	0	0	163	461	59	67	2	50	0	179	189
	3 D R	13	6,329	299	0	0	0	232	69	85	67	5	32	0	190	556
	3 D R	88	5,008	366	0	0	0	154	219	71	85	3	50	0	208	184
South Sulawesi	2 D R	6	9,397	497	0	0	0	190	170	81	73	6	38	0	198	153
	1 D R	5	8,405	1,261	0	0	0	123	887	76	82	13	58	0	230	299
Other Sulawesi	2 D R	12	12,866	577	25	17	0	126	264	48	47	13	39	2	149	121
. .	2 W R	12	12,367	723	0	0	0	119	507	41	49	3	67	0	160	256
	3 D R	15	11,191	907	0	0	0	213	555	72	61	7	47	0	187	160

Table 1. Average Farm Wage Rates in Secondary Crop Production* (Rupiah per Day)

	Region	Hoeing	Plowing	Planting	Weeding	Harvest	Other Tasks**
1.	Northern Sumatra	2,374	2,369	2,135	2,339	2,298	2,065
2.	Southern Sumatra	2,063	2,731	1,608	1,659	1,990	1,897
3.	Western Java	1,568	1,958	1,157	1,211	1,428	1,307
4.	Eastern Java	1,437	1,786	1,074	1,156	1,356	1,314
5.	Bali	1,782	2,285	1,421	1,730	1,960	1,653
6.	West Nusa Tenggara	1,183	1,493	1,062	1,080	1,303	1,322
7.	East Nusa Tenggara	1,144	1,247	945	1,009	1,099	1,214
8.	South Sulawesi	2,007	2,370	1,882	1,673	1,784	1,826
9.	Other Sulawesi	2,135	2,080	1,790	1,649	2,502	1,815

* Actual wage rates used for estimating production costs were calculated at the district *(kahupaten)* level. The secondary crops include upland rice, maize, cassava, sweet potato, soybeans, and groundnuts.

** Primarily post-harvest activities.

Appendix Table 2. Land Rental Rates
('000 Rupiah per Ha. per Season)

Region/Zone	Irrigated Rice		Irrigated		Rainfed		Cassava	
	WS	DS	WS	DS	WS	DS	Irrigated	Rainfed
Northern Sumatra								
I. Lowland	-	147	-	-	-	-	-	-
2. Wet Rainfed	252	190	-	-	108	116	-	-
3. Dry Rainfed	-	-	-	-	-	-	-	-
4. Upland	283	417	-	-	73	73	-	-
Southern Sumatra								
1. Lowland	-	-	-	-	-	-	-	-
2. Wet Rainfed	323	306	-	-	140	106	-	134
3. Dry Rainfed	-	-	-	-		-	-	-
4. Upland	143	171	-	-	102	-	-	186
Western Java								
1. Lowland	327	445	403	257	170	179	284	255
2. Wet Rainfed	300	420	-	-	214	169	269	292
3. Dry Rainfed	381	280	300	-	119	114	-	-
4. Upland	424	519	186	226	198	206	-	266
5. Tidal/Swamp Land	-	-	-	-	-	-	-	180
Eastern Java								
1. Lowland	350	332	231	257	209	136	310	138
2. Wet Rainfed	799	-	-	368	349	148	-	203
3. Dry Rainfed	467	422	348	149	105	124	-	180
4. Upland	342	314	285	227	168	144	238	203
Bali								
1. Lowland	569	686	225	158	294	-	428	-
2. Wet Rainfed	789				125		-	389
3. Dry Rainfed	749	533	437	269	265	200	-	449
4. Upland	-	-	-	-	-	-	-	
Nusa Tenggara								
1. Lowland	483	-	-	124	-	-	-	188
2. Wet Rainfed	-	-	-	-	-	-	-	
3. Dry Rainfed	370	261	-	235	159	124	-	170
4. Upland	-	-	-	-	-		-	-
South Sulawesi								
1. Lowland	509	453	-	-	178	175	-	275
2. Wet Rainfed	457	271	-	-	217	175	-	275
3. Dry Rainfed	595	313	369	-	201	142	-	218
4. Upland	435		-	-	134	-	-	-
Other Sulawesi								
1. Lowland	-	-	-	-	-	-	-	-
2. Wet Rainfed	260	318	-	-	210	175		241
3. Dry Rainfed	246	480	-	-	268	142	-	275
4. Upland	-	-	-	-	-	-	-	-

Appendix Table 3. Marketing Cost Assumptions**

(Figures are Rupiah per Kg. Except as Indicated)

Storage & Processing	Aceh	Southern Sumatra			Western Java			Eastern Java			Bali		
	Soybean	Maize	Soybean	Cassava	Maize	Soybean	Cassava	Maize	Soybean	Cassava	Maize	Soybean	Cassava
Storage Losses	25.2	6.6	18.9	16.6	3.6	14.1	4.3	3.8	13.5	4.1	6.3	12.1	5.1
Village Drying & Peeling		4.0		12.5	2.0		3.5	2.0		3.5	2.0		4.2
Oven Drying		11.0			8.0			8.0			8.0		
Peeling & Palletizing				43.9			14.6			14.6			14.6
Transport & Handling													
Transport within Region	27.5	25.0	25.0	25.0	19.2	19.2	19.2	20.0	20.0	20.0	15.0	15.0	15.0
Transport to Port &	2.3	1.5	1.5	1.5	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.2	1.2
Transport Port-to-Surabaya											10.0	10.0	10.0
Transport Port-to-Jakarta	15.0		10.0										
Total Margin	70.0	48.1	55.4	39.8	33.8	34.3	42.6	34.8	34.5	43.3	42.5	38.3	50.1
Farmer Price	630.3	165.2	630.8	55.2	181.0	706.3	53.5	187.6	672.6	51.7	209.7	603.5	63.6
Margin as % of Farm Price	11%	29%	9%	72%	19.%	5.%	80%	19%	5%	84%	20%	6%	79%
f.o.b./c.i.f. location*	a	c	a	c	b	a	b	e	d	e	e	d	e

*(a) c.i.f. Jakarta; (b) f.o.b. Jakarta; (c) f.o.b. Bandar Lampung; (d) c.i.f. Surabaya; (e) f.o.b. Surabaya; (f) f.o.b. Ujung Pandang (g) c.i.f. Ujung Pandang.

** Source: Derived from data presented in Rosegrant, et al., 1987; Tabor, et al.; 1988, Timmer, ed., 1987; and Falcon, et al., 1984. These data were updated to 1989 by assuming that fuel and labor costs have followed trends shown in the disaggregated price indices used to compute the BPS 9-good indexes of prices in rural Java and rural areas off-Java. Where possible, these figures have been checked against unpublished figures on official provincial land transport rates from the ministry of transportation. Field surveys of Nusa Tenggara reported in IPB, 1990, were also useful as a cross-check.

Appendix Table 3. Marketing Cost Assumptions**
(Figures are Rupiah per Kg. Except as Indicated) **Continued**

Storage & Processing	NTB		NTT		South Sulawesi			Other Sulawesi		
	Soybean	Cassava	Maize	Cassava	Maize	Soybean	Cassava	Maize	Soybean	Cassava
Strorage Losses	18.6	10.9	7.7	13.2	6.9	18.2	15.6	8.0	19.5	15.5
Village Drying & Peeling		3.5	2.0	4.2	4.0		4.5	4.0		4.5
Oven Drying			6.0		6.0			6.0		
Peeling & Pelletizing		14.6		14.6			14.6			14.6
Transport & Handling										
Transport within Region	15.0	15.0	23.0	23.0	30.0	30.0	30.0	37.5	37.5	37.5
Transport to Port & Loading	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0
Transport Port-to-Surabaya	15.0	15.0	15.0	15.0						
Transport Port-to-Jakarta										
Total Margin	50.6	61.0	55.5	72.0	48.9	50.2	66.7	58.5	60.0	75.1
Farmer Price	620.7	72.5	188.3	87.8	171.9	605.4	103.7	200.9	486.4	103.4
Margin as % of Farm Price	8%	84%	29%	82%	28%	8%	64%	29%	12%	73%
f.o.b./c.i.f. location*	d	e	e	e	f	g	f	f	g	f

*(a) c.i.f. Jakarta; (b) f.o.b. Jakarta; (c) f.o.b. Bandar Lampung; (d) c.i.f. Surabaya; (e) f.o.b. Surabaya; (f) f.o.b. Ujung Pandang (g) c.i.f. Ujung Pandang.

Appendix Table 4. Regional Aggregation of Provinces

Region	Provinces	Characteristics
Aceh	Aceh	High marketing margins, sample sufficient for soybeans only
Southern Sumatra	South Sumatra Lampung	Red-yellow podzolic soils, rainfed land is primarily long wet season (>6 mos).
Western Java	West Java, 18 Western districts of Central Java, and most of Yogyakarta	Rainfed land is primarily long wet season or upland (>700 meters a.s.l.)
Eastern Java	East Java, 11 eastern districts of Central Java, Gunung Kidul in Yogyakarta	Rainfed land has primarily short wet season (>6 mos.)
Bali	Bali	
NTB	NTB	Sample sufficient for cassava and soybeans
NTT	NTT	Sample sufficient for maize and cassava
South Sulawesi	South Sulawesi	
Other Sulawesi	North and Southeast	High marketing margins

Appendix Table 5. Characteristics of Maize Varieties Released by AARD

Variety	Year released	Maturity (days)	Yield range (tons/ha)	Resistance to [a]	
				Downy mildew	Rust
Harapan Baru	1978	110	3.0 - 5.0	R	R
Arjuna	1980	90	4.0 - 6.0	R	R
Bromo	1980	90	4.0 - 6.0	R	R
Parikesit	1981	105	4.0 - 6.0	R	MR
Abimanyu	1983	80	3.0 - S.0	R	
Nakula	1983	85	4.0 - 5.0	R	R
Sadewo	1983	86	4.0 - S.0	MR	
C-1	1983	100	5.0 - 7.0	MR	
Pioneer-1	1985	100	S.0 - 7.0	MR	
CPI-1	1985	100	S.0 - 7.0	MR	
IPB-4	1986	100	S.0 - 6.0	R	
Pioneer-2	1986	100	S.0 - 7.0	MR	
Kalingga	1986	96	5.0 - 6.0	R	
Wiyasa	1986	96	5.0 - 6.0	R	
C-2	1989	92	S.0 - 7.0	R	
Rama	1989	100	5.0 - 7.0	R	R

Source: CRIFC (1991).
[a] R =Resistant; MR = Moderately Resistant.

Appendix Table 6. AARD Yields in Varietal Trials of Maize (Kg/Ha)

Rainy Season	Planting Season	High-yielding							Local	
		Arjuna (a)	Bromo (b)	Abimanyu (a)	Kalingga (a)	Bayu (b)	Hibrida C-1 (c)	Harapan (a)	Kretek (a)	Penjalinan (a)
Lampung (c)										
Tamanbogo	1976/77	3270	3054					3328		
Tamanbogo	1978/79	1017						1425		
Tamanbogo	1985/86	2320	2600			1910				
Tamanbogo	1986/87	3450	2670			3460				
Sukadana	1987/88	2944	1904	2135		2000				
Sukadana	1987/88	2475			2191		2383			
Tamanbogo	1987/88	2920	1860			1910				
Tamanbogo	1987/88	2680	3040			3250				
Tamanbogo	1988/89	3820	3980			2860				
West Java(c)										
Citayam	1976/77	5561	4134					3478		
Cikeumeuh	1978/79	3678	2933					3600	2478	1889
Cikeumeuh	1979/80	4469							2523	
Cikeumeuh	1979/80	6090	5480					5063		3576
Muara	1979/80	3504	2914							
Citayam	1985/86	5050	3870			4570				
Citayam	1986/87	5100	3990			3680				
Citayam	1987/88	5070	6190			5810				

Source: Sudjana et al. (1980a, b); Balitan Maros (1989); Ponidi et al. (1989); Sudjana and Subandi (1990); and Sudjana (1991)
[a] Yellow maize; [b] White maize.
[c] Fertilizer dosage: 300 kg Urea, 100 kg TSP; 50 kg KCI per ha.
[d] Fertilizer dosage: 100 kg Urea, 200 kg TSP; 100 kg KCI per ha.

Appendix Table 6. AARD Yields in Varietal Trials of Maize (Kg/Ha) **Continued**

Rainy Season		High-yielding							Local	
	Planting Season	Arjuna (a)	Bromo (b)	Abimanyu (a)	Kalingga (a)	Bayu (b)	Hibrida C-1 (c)	Harapan (a)	Kretek (a)	PenjaGnan (a)
Central Java/Yogyakarta (c)										
Yogyakarta	1978/79	3248	3123						2176	2144
Banguntapan	1979/80	3457	2237					3330		2396
Mertoyudan	1979/80	5467	4058					2875		3050
Soropadan	1979/80	6956								3637
Jakenan	1985/86	2030	1810			2510				
Jakenan	1986/87	4650	3060			4710				
Grobogan	1987/88	2945	2754	1621		4710				
Purbalingga	1987/88	4470	3887	3375		4940				
Purbalingga	1987/88	4022			4673		3472			
East Java (d)										
Mojosari	1978/79	3705	3372						2650	2619
Muneng	1978/79	3820	4093						2347	2227
Muneng	1979/80	5279	4167					741		3179
Pare	1979/80	5552	5186						3926	3797
Sambungrejo	1979/80	3644								1983
Sumberregjo	1979/80	1790	1165							281
Sumberrejo	1979/80	1777	2908	2215						
Bojonegoro	1987/88	3077	2908	2215						
Mojokerto	1987/88	4276	3750	3333						
Bojonegoro	1988/89	4196	3413	2330						
Bojonegoro	1988/89	2763		1406						
Lamongan	1988/89	3568	3577	2804						
Mojokerto	1988/89	6635		4632						

Source: Sudjana et al. (1980a, b); Balitan Maros (1989); Ponidi et al. (1989); Sudjana and Subandi (1990); and Sudjana (1991)
[a] Yellow maize; [b] White maize.
[c] Fertilizer dosage: 300 kg Urea, 100 kg TSP; 50 kg KCI per ha; [d] Fertilizer dosage: 100 kg Urea, 200 kg TSP; 100 kg KCI per ha.
[e] dosage: 240 kg Urea, 180 kg TSP; 50 kg KCI per ha.

Appendix Table 6. AARD Yields in Varietal Trials of Maize (Kg/Ha) **Continued**

Rainy Season				High-yielding					Local	
	Planting Season	Arjuna (a)	Bromo (b)	Abimanyu (a)	Kalingga (a)	Bayu (b)	Hibrida C-1 (c)	Harapan (a)	Kretek (a)	Penjalinan (a)
South Sulawesi										
Bontobili (e)	1979/80	5376	5410							4296
Bone (e)	1987/88(e)	2250	1840				2400			
Luwu (e)	1987/88(e)	4400	3670				5250			
Soppeng (f)	1987/88(f)	2000	1850				2300			
Wajo (e)	1987/88(e)	4000	2800				4480			
Southeast Sulawesi										
Wawotobi (e)	1987/88(e)	4000	3200				4300			
Lampung (c)										
Tegineneng	1978	4242	3094					3676		
Tegineneng	1979	4325	3858					3325		2442
Tamanbogo	1985	3540	1820			3520				
Tamanbogo	1987	2180	2070			2560				
West Java(c)										
Muara	1975	5099						4532		
Cikeumeuh	1978	4616							2994	2703
Citayam	1978	3150							2685	2114
Kuningan	1979	3108	2850					2292		1825
Kuningan	1979	7151						4908		
Plumbon	1979	1145	1663					295		626
Citayam	1985	7120	6260			7910				
Kuningan	1985	3650	2090			3650				
Citayam	1986	4190	4810			5330				
Citayam	1988	5260	4410			4790				

Source: Sudjana et al. (1980a, b); Balitan Maros (1989); Ponidi et al. (1989); Sudjana and Subandi (1990); and Sudjana (1991)
[a] Yellow maize; [b] White maize.
[c] Fertilizer dosage: 300 kg Urea, 100 kg TSP; 50 kg KCI per ha; [d] Fertilizer dosage: 100 kg Urea, 200 kg TSP; 100 kg KCI per ha.
[e] dosage: 240 kg Urea, 180 kg TSP; 50 kg KCI per ha.; [f] Fertilizer dosage: 80 kg Urea, 180 kg TSP; 50 kg KCI per ha.
[f] Fertilizer dosage: 80 kg Urea, 180 kg TSP; 50 kg KC I per ha.

Appendix Table 6. AARD Yields in Varietal Trials of Maize (Kg/Ha) **Continued**

Rainy Season		High-yielding							Local	
	Planting Season	Arjuna (a)	Bromo (b)	Abimanyu (a)	Kalingga (a)	Bayu (b)	Hibrida C-1 (c)	Harapan (a)	Kretek (a)	Penjalinan (a)
Central Java/Yogyakarta (c)										
Yogyakarta	1978	4368							3002	3856
Soropadan	1987	4790	3330			5040				
Blora	1988	5500	4500	4420		5290				
Grobogan	1988	3470	2440	2810		2480				
Grobogan	1988	4346	3967	3315		4077				
Grobogan	1988	3112			3644		3276			
Pati.	1988	3440	2310	3130		3260				
Soropadan	1988	5390	4630			5600				
Blora	1989	5500	5340			5220				
Blora	1989	3530	3690			3930				
Grobogan	1989	5472	4652	3208		4838				
Grobogan	1989	5585			5501		5896			
Grobogan	1989	4630	4310			3600				
Grobogan	1989	3622	3293	3100		3824				
Grobogan	1989	3518			3645		3772			
Pati	1989	3510	5300			3690				
Rembang	1989	3970	3960			4280				
East Java (d)										
Muneng	1978	4563								
Bojonegoro	1988	4382	3312	2235					2551	2481
Lamongan	1988	5244	4974	4000						
Mojokerto	1988	4201	3923	3273						
Average		4075	3497	2963	3931	3997	3753	3062	2733	2506
Standard deviation		1271	1154	852	1114	1232	1174	1388	466	954
Number of observation		79	62	18	5	23	10	14	10	20
Minimum		1017	1165	1406	2191	1910	2300	295	217	281
Maximum		7151	6260	4632	5501	7910	5896	5063	3926	4296
CV		31	33	29	28	31	31	45	17	38

Source: Sudjana et al. (1980a, b); Balitan Maros (1989); Ponidi et al. (1989); Sudjana and Subandi (1990); and Sudjana (1991)
[a] Yellow maize; [b] White maize.
[c] Fertilizer dosage: 300 kg Urea, 100 kg TSP; 50 kg KCI per ha; [d] Fertilizer dosage: 100 kg Urea, 200 kg TSP; 100 kg KCI per ha.

Appendix Table 7. Characteristics of Soybean Varieties Released by AARD

Variety	Yield released	Maturity (days)	Yield (t/ha)*	Resistance to** Rust	Virus
Orba	1974	85	1.5 - 2.5	T	
Galunggung	1981	85	1.5 - 2.5	MS	
Lokon	1982	76	l.1 - 2.0	MS	
Guntur	1982	78	1.1 - 2.0	MS	
Wilis	1983	88	1.5 - 2.5	T	MR
Dempo	1984	90	1.5 - 2.5	R	
Kerinci	1985	87	1.5 - 2.5	T	
Merbabu	1986	90	1.5 - 2.5	T	
Raung	1986	85	1.5 - 2.5	T	
Tidar	1987	75	1.4 - 2.5	T	
Rinjani	1989	88	1.5 - 2.5	T	
Petek	1989	80	1.0 - 2.5		MR
Tambora	1989	85	1.5 - 2.0	T	
Lompobatang	1989	86	1.5 - 2.5	T	
Lumajang Bewok	1989	80	1.2 - 1.7	T	
Lawu	1991	74	1.2 - 1.7	T	
Dieng	1991	78	1.5 - 1.7	T	
Jayawijaya	1991	87	1.2 - 1.7	T	
Tengger	1991	79	1.0 - 1.7	T	

Source: CRIFC (1991).

* Dry Grain; ** T= Tolerance; MS = Moderately susceptible; R = resistant; and MR = moderately resistant.

Appendix Table 8. AARD Yields in Varietal Trials of Soybean (Kg/Ha)

Rainy Season	Planting Season	Wilis (a)	Tidar (b)	Orba (a)	Kerinci (a)	Lokon (b)	lompobatang (c)	Rinjani (a)
Aceh	1986/87	1982						2483
West Sumatra Sitiung	1990/91[a]	755	1071		958	637		800
South Sumatra	*1986/87*	1750	1000	1480			1890	
Lampung	1980/81	1458		1633				
	1983/84	1900		1200	1400			
	1986/87	1200					1205	1742
	1987/87	1462					1283	1267
	1986/87	1620					1430	1600
	1987/88	1360					1290	1470
	1990/91[d]	710	590		890	310		540
West Java Cirebon	1980/81	1710		1688				
Bogor	1982/83			1580			1854	1549
Citayam	1986/87				1871			2275
Garut	1986/87			974				
Pacet	1986/87			1085				
Purwakarta	1986/87	1423						1737
Garut	1987/88			1278				1716
Pacet	1987/88			1125				
Garut	1988/89	2100						2200
Ciamis	1990/91	1320						1530
Indramayu	1990/91	2100						
Central Java/Yogyakarta		2188						1907
Banjarnegara	1986/87							
Pemalang	1986/87	1387						1484
Wonosari	1986/87	1999					1853	2347
Grobogan	1988/90	1900	2700					2000
Wonogiri	1988/89	2000	2000					2300
Grobogan	1990/91	810						660
East Java Lamongan	1980/81	1077		780				
Lawang	1980/81	1800		1667				
Genteng	1985/86	1908	2183		2506			
Ngale	1985/86	1335	1148		1135			
Pasuruan	1985/86	1153	1096		1495			
Genteng	1990/91	1400						
Mojosari	1990/91	2100						

Sources: Sumarno et al. (1983, 1986, and 1988); Balittan Sukamandi (1988); Sumarno and Sutrisno (1988); Balittan Maro' (1989, 1990); Balittan Bogor (1990); Arsyad and Asadi (1991).

Fertilizer dosage (normally): 50-100 Urea; 100-150 TSP; and 75-125 KCI per ha

[a] Added with lime.
[b] No fertilizer and lime applied.
[c] Added with 2,000 kg of lime per ha.
[d] Added with 1800 kg of lime: 5000 kg of manure; and Rhizobium.
[e] Fertilizer dosage: 150 kg Urea; 200 kg TSP; 165 kg KCI per ha..

Appendix Table 8. AARD Yields in Varietal Trials of Soybean (kg/Ha) **Continued**

Rainy Season	Planting Season	Wilis (a)	Tidar (b)	Orba (a)	Kerinci (a)	Lokon (b)	lompobatang (c)	Rinjani (a)
South Kalimantan	1980/81	1177		1428				
South Sulawesi								
Maros	1987	780			760			
Gowa	1987/88	400		580				
Wajo	1987/88	850		240				
Bone	1989/90	1670	1710		2450			
Wajo	1989/90	600	670		590			
North Sumatra	1981	1600		583				
Jambi	1986	726	1372	648	1018	667		
Lampung	1986 [b]	954	1298	806	1180	593		
	1986 [c]	1023	1279	907	1183	632		
West Java								
Cikeumeuh	1979	1404		931				
Garut	1980	1215		1585				
Cirebon	1980/81	1710		1688				
Bogor	1982			1620			2280	1998
Kuningan	1982	1775		510				
Sukamandi	1982	2744		2674				
Sukamandi	1983 [c]	1600		1500	1900			
Kuningan	1983 [e]	900			1100			
Citayam	1984 [e]	1400		1200	1600			
Bogor	1985				1239		1547	1320
Bogor	1986				1444		1332	1607
Citayam	1986 [e]	2056	1977		1931		1792	1863

Sources: Sumarno et al. (1983, 1986, and 1988); Balittan Sukamandi (1988); Sumarno and Sutrisno (1988); Balittan Maro (1989, 1990); Balittan Bogor (1990); Arsyad and Asadi (1991).

Fertilizer dosage (normally): 50-100 Urea; 100-150 TSP; and 75-125 KCI per ha

[a] Added with lime.
[b] No fertilizer and lime applied.
[c] Added with 2,000 kg of lime per ha.
[d] Added with 1800 kg of lime: 5000 kg of manure; and Rhizobium.
[e] Fertilizer dosage: 150 kg Urea; 200 kg TSP; 165 kg KCI per ha..

Appendix Table 8. AARD Yields in Varietal Trials of Soybean (kg/Ha) Continued

Rainy Season	Planting Season	Wilis (a)	Tidar (b)	Orba (a)	Kerinci (a)	Lokon (b)	lompobatang (c)	Rinjani (a)
Muara	1986`	1329	1326		1444			1600
Subang	1986[b]	61S	688	683	606	66S		
Subang	1986`	741	694	730	632	818		
Kuningan	1987	1167	1604			1167		
Sukamandi	1987	1219		1009				
Sukamandi	1987	1049	930			879		
Citayam	1988	1026					1203	1523
Kuningan	1988	1365	2140	1167		1520		
Plumbon	1988				1395			1415
Plumbon	1988				1127			1227
Sukamandi	1988	1827	1776				2102	1473
Sukamandi	1988	1616	1496				1720	1382
Central Java/yogyakarta	1981	1160	1342					
Kebumen	1982	1525	788					
Brebes	1983	1700		1800				
Brebes	1987	1998	1278		940			
Jakenan	1987	1437		1371				
Jakenan								
East Java								
Jambegede	1979	2107		1595				
Jambegede	1980	2574		2199				
Mojosari	1982	1004		680				
Mojosari	1982	2161		1819				
Ponorogo	1984	1300		1000	1100			
Pasuruan	1985	1751	1769		1850			
Ponorogo	1985	1380	1125		1310			
Sukorejo	1985		1509		1706			
Bojonegoro	1986	2293	2787					
Jambegede	1986	1793	1333		1528			
Pasuruan	1986		1567		1717		1480	1597
Pasuruan	1986		1452		1698		1727	1725
Ponorogo	1986		1027		1578		1628	1408
Ponorogo	1986		1398		1538		1427	1502
Mojosari	1987	1630					2050	2370
Mojosari	1988	1920					2480	2360
Ngale	1990	1580						
South Kalimantan	1981	1035						
South Sulawesi				453				
Maros	1987	780			760			
Nusa Tenggara	1980	1617						
Average		1473	1415	1174	1405	807	1668	1663
Standard Deviation		484	526	507	453	309	360	455
Number of observation		75	34	37	35	11	19	36
Minimum		400	590	240	590	310	1203	54.1
Maximum		2744	2787	2674	2506	1520	2480	2483
CV		33	37	43	32	39	22	27

Sources: Sumarno et al. (1983, 1986, and 1988); Balittan Sukamandi (1988); Sumarno and Sutrisno (1988); Balittan Maro' (1989, 1990); Balittan Bogor (1990); Arsyad and Asadi (1991).

Fertilizer dosage (normally): 50-100 Urea; 100-150 TSP; and 75-125 KCI per ha

[a] Added with lime.

[b] No fertilizer and lime applied.

[c] Added with 2,000 kg of lime per ha.

[d] Added with 1800 kg of lime: 5000 kg of manure; and Rhizobium.

[e] Fertilizer dosage: 150 kg Urea; 200 kg TSP; 165 kg KCI per ha..

Appendix Table 9. Characteristics of Cassava Varieties Released by AARD

Variety	Year Released	Maturity (days)	Yield Range	Resistant to
Adira - 1	1978	215	20-45	wilt
Adira - 2	1978	250	40-45	wilt
Adira - 4	1987	240	25-50	wilt

Source: CRIFC (1991)

Appendix Table 10. Crop varieties Used in Struktur Ongkos Sample (Percent Regional Samples)

Region	Maize				
	Local (Unnamed)	Arjuna	Other Open-Poll. Improved	Hybrid	Total
Northern Sumatra	88.6	11.4	0.0	0.0	100.0
Southern Sumatra	72.7	7.4	2.8	17.0	100.0
Western Java	66.0	7.4	12.0	14.6	100.0
Eastern Java	58.2	22.0	3.0	16.8	100.0
Bali	49.7	31.3	6.8	12.2	100.0
Nusa Tenggara	99.5	0.0	0.5	0.0	100.0
South Sulawesi	97.0	0.6	0.6	1.8	100.0
Other Sulawesi	98.0	0.0	0.0	2.0	100.0

Appendix Table 10. Crop varieties Used in Struktur Ongkos Sample (Percent Regional Samples)

Region	Soybean				
	Local (Unnamed)	Early (Pre-1985) AARD	Wilis	Named Non-AARD Relases	Total
Northern Sumatra	87.1	3.5	2.4	7.1	100.0
Southern Sumatra	80.7	0.0	4.5	14.8	100.0
Western Java	62.7	7.7	23.6	5.9	100.0
Eastern Java	47.4	0.1	47.6	4.8	100.0
Bali	25.6	2.3	44.2	27.9	100.0
Nusa Tenggara	57.0	0.0	32.6	10.5	100.0
South Sulawesi	66.7	18.2	0.0	15.2	100.0
Other Sulawesi	47.4	28.1	1.8	22.8	100.0

Appendix Table 10. Crop Varieties Used in Struktur Ongkos Sample (Percent of Regional Samples) Continued

	Cassava					
Region	SSP I	Mentega	Valencia	Other Local (Unnamed)	Adira	Total
Northern Sumatra	0.0	0.0	0.9	94.6	15.4	100.0
Southern Sumatra	3.1	3.6	0.4	91.5	1.3	100.0
Western Java	0.5	9.5	5.6	83.8	0.7	100.0
Eastern Java	1.1	10.2	4.5	82.1	2.0	100.0
Bali	0.0	0.0	12.2	87.8	0.0	100.0
Nusa Tenggara	6.9	12.7	0.0	80.3	0.0	100.0
South Sulawesi	0.0	0.0	0.0	100.0	0.0	100.0
Other Sulawesi	0.0	31.2	15.6	46.8	6.5	100.0

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