APPLICATION OF A GENERAL EQUILIBRIUM MODEL FOR AGRICULTURAL POLICY ANALYSIS: A CASE STUDY OF FERTILIZER INPUT SUBSIDY IN RICE PRODUCTION FOR INDONESIA

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I dedicate this dissertation to my mother, Sumiati.

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INTRODUCTION

Need for the Study

Agriculture in the Indonesian economy contributes about 30 percent of Gross Domestic Product (GDP) and absorbs about 54.8 percent of the labor force. At constant 1973 market price, agriculture's contribution to GDP has increased from 3,255.6 billion rupiahs in 1979 to 3,845.6 billion rupiah in 1983 but the share has decreased from 32 percent to 30 percent (Table I). Food crops, particularly rice, account for about 59 percent of the contribution of the agricultural sector GDP in 1979.

Problems of poverty and declining welfare within the rural sector, particularly on Java, were magnified in the early 1960s by the inability of the agricultural economy to grow at a rate equal to the needs of feeding a large and growing population. Until the late 1970's, rice imports were used to fill the gap generated by shortfalls in domestic rice production and growing food demand. From 1955 to 1958 the ratio of rice imports to total production averaged about 6.5 percent annually -- ranging from 1.7 percent in 1955 to 11.5 percent in 1958. However, in the more current years, rice imports as a proportion of production have tended to decrease. For example, during the four years 1980 to 1983 the ratio of rice imports to total production averaged 3.25 percent.

TABLE I

SECTORAL COMPOSITION OF GROSS DOMESTIC PRODUCT (GDP) AT CONSTANT 1973 MARKET PRICES FOR SELECTED YEARS, INDONESIA (BILLION RUPIAHS)

Number	Sector	1979	1980	1981	1982	1983
1	Agriculture	3255.6	3424.9	3593.5	3669.8	3845.6
2	Mining & Quarrying	1046.9	1034.6	1069.1	939.8	956.5
3	Industry	1395.3	1704.6	1877.8	1900.7	1942.5
4	Elect., Gas, Water	68.6	77.9	89.9	105.5	112.8
5	Construction	562.8	639.3	720.2	757.8	804.5
6	Transport & Comm.	559.8	609.4	676.9	716.6	752.5
7	Others	3275.9	3678.5	4027.2	4235.2	4427.8
Gross Domestic Product		10164.9	11169.2	12054.6	12325.4	12842.2

Source: Central Bureau of Statistics (1985). National Income for Indonesia 1979-1983, Jabarta-Indonesia.

To address the problem of rural poverty and growing food imports, Indonesia's government embarked upon a widespread campaign in the late 1960's to promote adoption of improved technologies among the country's many smallholder cultivators including the new high yielding rice varieties (HYVs). This campaign, commonly known as the "Bimas Program" (Mass Guidance), continues as an active component of government's current development effort, with Java constituting the primary target area in addition to some locations on the islands of Sumatera and Sulawesi. The major goal of the campaign is to increase food production with the intent of achieving self-sufficiency in rice. Emphasis of the Bimas program is placed on food production, particularly rice. Rice farmers who take part in the Bimas program are supplied farm inputs consisting of seeds, fertilizers, insecticides, and small amounts of credit to meet part of the remaining operating costs. The farmers repay credit in kind after harvesting.

Efforts to increase rice production in Indonesia during the first fifteen years of the Bimas program, 1968 to 1982, were remarkably successful by comparison with Indonesia's previous history of rice production and by comparison with rice intensification programs in other countries. The well documented increase in rice production was from 11.67 million tons in 1968 to 17.53 million tons in 1978, and 23.97 million tons in 1983. Table II shows the harvested area, average yield, total production, total imports, and price of rice in Indonesia, 1968-1983.

The increased production resulting from the intensification program contributed to Indonesia's development goals in several ways. The real income of rice producers grew with increased production, imports as a percentage of consumption reduced, and the price of rice remained relatively stable.

TABLE II

HARVESTED AREA, AVERAGE YIELD, TOTAL PRODUCTION, TOTAL IMPORTS, AND PRICE OF RICE IN INDONESIA, 1968-1983

Year	Harvested Area (million ha)	Average Yield (ton/ha)	Total Production (million tons)	Total Imports (million tons)	Real Price (Rp/kg)
1968	8.02	1.46	11.67	0.63	62.36
1969	8.01	1.53	12.25	0.60	47.78
1970	8.14	1.62	13.14	0.96	46.77
1971	8.32	1.65	13.72	0.50	44.74
1972	8.90	1.67	13.18	0.75	44.58
1973	8.40	1.74	14.61	1.64	58.82
1974	8.51	1.80	15.28	1.06	51.96
1975	8.50	1.79	15.20	0.67	49.13
1976	8.37	1.89	15.85	1.29	51.64
1977	8.30	1.90	15.88	1.99	46.97
1978	8.93	1.96	17.53	1.83	43.89
1979	8.80	2.03	17.87	1.91	47.40
1980	9.00	2.24	20.16	2.00	44.73
1981	9.38	2.38	22.29	0.48	52.69
1982	8.98	2.60	23.84	0.30	NA
1983	8.96	2.67	23.97	1.16	NA

Sources: 1. Directorate of Agricultural Development Program, Ministry of Agriculture, 1982.
2. Mears. "Rice and Food Self-Sufficiency in Indonesia," Bulletin of Indonesian Economic Studies. Vol. 20, No. 2, August 1984.

Note: Real Price = Nominal Price/CPI
CPI = GDP deflator for consumption expenditure, 1970=100
NA = not available

The effect on aggregate employment of increased rice production, however, remains uncertain. Collier and Sajogyo (1972) found that the new high yielding varieties used in the Bimas program in the Java region required 24 percent more man-days of labor per hectare than did traditional varieties. Moreover, larger harvests required more labor for processing. In contrast, a study done by Montgomery in Central Java found less labor was required for high yielding varieties than for traditional varieties, the difference explained by a reduction in care taken in growing the new IR5 variety (Montgomery, 1981). However, in general, improved irrigation methods, adoption of new varieties with shorter growing seasons, and the fertilizer subsidy program permitted more double and even triple cropping of irrigated land (sawah) with the resulting employment gains. Real wages for agricultural laborers also increased for the first time in many years (Nataatmadya, 1982).

Impact of the fertilizer subsidy program was recently evaluated by Timmer (1986). His results show a benefit-cost ratio of 1.88 to the government subsidized fertilizer price at Rp80 per kilogram. This implies that Rp1.00 of fertilizer subsidy creates Rp1.88 of domestic resources in the country. Other economists, however, state that the distributional gains of fertilizer subsidy among poorer farmers in rural areas have been doubtful (Mubiyarto, Sajogyo and Tjondronegoro, 1982). This is due to the irrigated farm areas most suited to increased production using the new technologies have generally been operated by higher income farmers and rarely by poorer farmers.

Up till now, little study has been given to the analysis of the direct and downstream effects of the Bimas program on income distribution and other sector output. The Bimas program may generate substantial indirect effects, or pecuniary external economies. These effects stem partly from production linkages. First, the Bimas program will generate demand for intermediate goods. Second, the rise in output due to the Bimas program may cheapen supplies to the other sectors, and so increase the profitability of investment in those sectors. Moreover, consumption linkages also result if the extra income flowing from the Bimas program boosts the level of final demand in the economy.

It is also of interest to ascertain how the indirect or downstream effects of the Bimas program affect the distribution of income. For example, while the Bimas program may generate a strong rise in the income of all farm households, the resulting downstream benefits may be reaped by richer nonfarm households. There is also a regional dimension to this issue. Therefore, as Mellor (1976) has emphasized, income disparities among agricultural regions will be increased all the more, even though the income gap between industrial regions and those receiving the project will narrow.

This study is specifically designed to address these distributional effects of the Bimas program. A major reason for studying the income distribution is its effect upon the level and mix of output of the economy. As Engel first demonstrated in the nineteenth century, the types and quantities of goods and services consumed by an individual or a household are highly dependent upon the consuming unit's income. Secondly, the degree of income inequality is often considered to be an important component in the social welfare function of an economy.

It is widely accepted that marginal propensity to spend on necessity goods falls as income rises. To the extent this is true, a change in household income will have a greater effect upon the demand for basic food commodity output, the lower the income of households experiencing the change in income. In the case of a regional economy, the differential effect will be magnified if the marginal propensity to consume locally produced goods and services falls as household income rises. If, on the other hand, the marginal propensity to spend on regionally produced goods and services rises with household income, the differential effect will be reduced.

Objectives of the Study

The general objective of this study is to develop and apply a criterion for evaluating the Bimas program utilizing a general equilibrium framework.

Specific objectives are the following:

(1) To develop a social accounting matrix (SAM) for Indonesia identifying agriculture and the Bimas program and disaggregated by:

  (a) socio-economic and institutional groups

  (b) production and commodity activities

  (c) resource and factor income payments

  (e) trade and other economic variables

(2) To estimate the general equilibrium results of reduced fertilizer subsidies to Bimas rice producers on socio-economic groups and government revenue.

(3) To estimate the general equilibrium results of alternative government programs such as government revenue transfers, increased agricultural employment, and increased agricultural non-food exports on socio-economic groups.

(4) To evaluate the general equilibrium results of alternative policy formulations of the Bimas program and of the alternative government programs on variables affecting social and rural welfare such as commodity prices, household real incomes, and basic nutrition.

Hypotheses

Three hypotheses are proposed for testing in this study. One hypothesis refers to the extent of the general equilibrium production (sectoral) and consumption (household and institutional) linkages of the Bimas program. The production linkages of the Bimas program refer to the derived demand for farm inputs, i.e. fertilizer, produced in various agricultural and non-agricultural sectors, and the supply of agricultural output as intermediate inputs to the agricultural and non-agricultural sectors. The consumption linkages of the Bimas program refer to the derived commodity demands from increased or decreased household incomes. The other hypotheses deal with alternative government policies which encourage labor intensive programs in the agricultural sector, expansion of agricultural non-food exports, and the distribution of income.

The following three hypotheses are tested in this study:

1. The development of rice intensification programs such as Bimas have significant direct and indirect (down-stream) effects on sector outputs, domestic prices, consumption, and incomes.

2. Economic growth in Indonesia can be induced and accelerated at this time by encouraging a reduction in the fertilizer subsidy program to Bimas rice producers and promoting other programs for maintaining and expanding incomes of producers and consumers.

3. Government policies which encourage labor expansion programs in the agricultural sector have significant impacts on lower income groups, thus narrowing the income gap between the poor and the rich.

In order to test these hypotheses, it is necessary to model both production and consumption linkages and income distribution. This leads to the use of an applied general equilibrium model as the tool of analysis.

The Organization of the Study

Past and current food production programs in Indonesia are described in Chapter II. Evaluations of food production programs and the proposed methodology for the current study are discussed in Chapter III. Methodology of an applied general equilibrium model (GEM) is described in Chapter IV in three parts: (1) framework of a Social Accounting Matrix (SAM); (2) relationships between the SAM and the applied GEM; and (3) model development for this study. Estimating aggregate demand functions using the Frisch method is presented in Chapter V. Construction and validation of the applied General Equilibrium Model is presented in Chapter VI. Model Simulations are presented in Chapter VII. Policy implications, summary and conclusions are presented in Chapter VIII. Appendices contain data sources and supplementary information.

CHAPTER II

FOOD PRODUCTION PROGRAMS IN INDONESIA

Increasing food production and improving income of small farmers have been the primary goals of agricultural development in Indonesia. The major instrument used to achieve these goals is the efficient provision of new technology packages implemented in conjunction with price support programs. The packages of new technology are formulated in the country's rice intensification program called the Bimas, whereas the rice price support program is implemented through stock management. Components of the total rice intensification program are: (1) fertilizer price subsidy designed to encourage greater use of fertilizer by farmers; and (2) price stabilization designed to encourage farmers to adopt improved technology and thus increase food production and at the same time benefit consumers by reasonable prices.

The purpose of this chapter is to present a review of food production programs including the Bimas program. This chapter discusses: (1) a brief history of food production in Indonesia; (2) description of the Bimas program; and (3) price policy in Indonesia.

History of Food Production Programs in Indonesia

During the pre-Bimas era, food production increased slowly, limited improvement in production technology occurred, and irrigation systems essentially constructed during the colonial period were deteriorating. There was a shortage of farm inputs and there lacked a viable social and economic institutional capability to support high rates of growth in food production.

To stimulate increased food production, the government introduced rice intensification and extensification programs. The intensification program was designed to overcome shortages of rice through increased production by providing improved seed varieties, improved water management, fertilization, pest control, and overall better management practices. The extensification program, on the other hand, was designed to increase rice production through the expansion of agricultural lands. Such activities included removing lands from natural forests, opening of unused lands for large-scale mechanized dry-land rice production, conversion of tidal swamp lands to rice production, and expansion of irrigation projects.

The first program of intensification was called the Paddy Center Program. It was initiated in 1959 and lasted for three years (Sajogyo, 1973). This program had three elements: (1) improvement of rice cultivation, (2) mechanical cultivation of dryland rice production, and (3) reclamation and cultivation of tidal swamp lands. However, this program failed, primarily due to low prices for paddy. Other contributing factors to its failure included abuse of credit and insufficient number of trained technicians to assist farmers (Afiff and Timmer, 1971). Failure of this program gave some important lessons for guiding subsequent programs. The adoption of improved technologies is not dependent only on the availability and low prices of modern inputs. Rather it is a result of a long, and often fragmented, development process before the adoption cycle has been fully completed (Soewardi, 1976). To accelerate the process of adoption, an increase in the demand for technology should be supported by the development of agricultural research, human resource development, infrastructure, and rural institutions.

The so-called Green Revolution in itself created problems. On the one hand, the supply of new inputs, including knowledge and management services, were not made available to the farmers at the right time, in the right amount, and in the right places (Falcon, 1970). On the other hand, expanded production required adequate processing, transportation, and storage facilities for outputs and inputs, and which were generally not available in Indonesia (Mubyarto and Fletcher, 1966).

A second program of intensification, implemented in 1964, was called the Demas (mass demonstration) program. It was based on research conducted by the Institute Pertanian Bogor (Bogor Agricultural University) in the wet season of 1963 in West Java, partly in response to the failure of the earlier efforts. The result of this research showed that by optimally combining high-yielding varieties (HYV), fertilizer, pesticides, better cultural practices, adequate irrigation, and supportive extension, yields could be increased by more than 50 percent (Roekasah and Penny, 1967).

In 1965, this pilot program was expanded into a nationwide intensification program called Bimas (mass guidance). Location sites for the program were based on the availability of irrigation and rural infrastructure. As a result, the Bimas program was heavily concentrated on the island of Java. The Bank Rakyat Indonesia (State People's Bank) and the P.N. Pertani (State Agricultural Enterprise) were utilized to administer credit and distribute new inputs, respectively. In addition, farmers were encouraged to form "farm coops" to serve as village level marketing institutions. A predominant feature of the Bimas program was its group credit approach. Farmers received credit through their village cooperative.

Since many paddy farmers were being exposed to the beneficial use of technology, a third program called Inmas (mass intensification) was initiated in

1967. The objective of Inmas was to make new inputs available for cash purchase by farmers not already participating in the Bimas program. The Inmas program embraced farmers who were self-financing and voluntary participants. It was assumed that farmers assisted under the Bimas program would increase their production and incomes substantially. Further, it was assumed that farmers under Bimas would progress to where they no longer needed credit and would be assisted only by technical advice. Therefore, any farmer who financed his own farm supplies and used improved varieties was considered an Inmas farmer.

During the wet season of 1968-1969, Bimas Gotong Royong was introduced. It was designed to undertake a large-scale operation to create a dramatic impact on rice production. To carry out the plan, the government entered into contract with seven foreign companies, mostly manufactures, for the supply of fertilizers, pesticides, and some equipment on a one year deferred payment basis. These foreign companies were to be paid a fixed price for every hectare they supplied with production inputs. Repayments collected from the farmers were to acrue to BULOG, the government's Agency of Logistics. BULOG opened letters of credit in favor of these companies which were paid by the Bank of Indonesia on maturity. Coordination of the entire program was undertaken by the same institutions charged with coordinating the Bimas program. As a credit operation, however, the program was a failure. The repayment rate was far below any acceptable level. However, the Bimas Gotong Royong program made definite contributions to Indonesia's agriculture. Farm supplies were, in fact, widely available in the countryside. While some inputs may have been used on non-rice crops, a large proportion were used for rice. The program contributed substantially to an improvement in technology. It would have taken a longer time to attain the same level of technological development in Indonesia had the program not been carried out (Teken and Soewardi 1982).

In an attempt to find solutions to the problem of credit repayment, an improved Bimas program was developed in 1970. This program is discernible from its precursors by its method in providing services to farmers through clusters of three or more villages, called "village unit areas". In each village unit area four delivery institutions were created, namely: (1) the agricultural extension managed by a field extension worker, (2) the private kiosk (a small store) for channeling farm inputs (fertilizers, pesticides, seeds, etc.), (3) the village unit bank to make credit arrangements with the farmers, and (4) the village unit cooperative, called KUD (koperasi unit desa), assigned to be purchaser of outputs from the farmers. The four delivery institutions were basically a new creation, or at least a significant improvement over the existing ones. The village unit bank and the private kiosk were purely new creations, while the field extension worker and the village unit cooperative were significant improvements over their precursors.

The day to day operations of the improved Bimas program were guided by institutions established at all levels of administration. At the national level, the guiding institution is called Satuan Pengendali Bimas, which is "Bimas Steering Unit". At the provincial level it is called Satuan Pembina Bimas (Bimas developing unit), and at the district and village levels they are called Satuan Pelaksana Bimas (Bimas implementation units). The guiding institutions are coordinating bodies of various government and semi-government offices in charge of the Bimas operations. As a whole, these institutions have to function well to obtain full and sincere participation of the farmers in the area. In the improved Bimas program farmers willingness to practice improved technologies is important to continually have increased rice production.

Description of the Bimas Program

The Bimas program is a government effort to increase food production in Indonesia, particularly rice. Rice farmers who participate in the Bimas program are supplied farm inputs consisting of seeds, fertilizers, insecticides, and small amounts of credit to meet part of the remaining operation costs.

There are three alternative technology and credit packages available to farmers (Table III). Package A provides the least amount of inputs and the least amount of credit. Package C provides the most amount of inputs and the most amount of credit. Package B is intermediate to packages A and B.

In addition to the credit package mentioned above, the extension and demonstration programs are intensified in an area. These programs involve an effort to encourage farmers to adopt recommended practices for the production of major crops through the use of the packaged technology (improved seeds, fertilizer, etc.). The adoption of these recommended practices coupled with the use of other agricultural services (i.e. credit, irrigation, etc.) are expected to bring about substantial increases in food production for Indonesia.

Intensification programs such as Bimas increased the national production of rice. As shown in Table IV, yields in the Bimas areas during 1974-1980 averaged 4.8 tons of paddy per hectare which is about 52 percent higher than yields in the non-intensification areas. Results of the program must be considered more a fertilizer revolution than a HYV revolution. The rates of fertilizer application, in terms of both quantity and area covered, were greater than the results of HYV adoption. With increased fertilizer application, yields per hectare have continued to increase.

TABLE III

THE ALTERNATIVE BIMAS CREDIT
PACKAGES IN INDONESIA

Description	Package A		Package B		Package C	
	Amount	Value (rp)	Amount	Value (rp)	Amount	Value (rp)
Urea	100 kg	7,000	200 kg	14,000	250 kg	17,500
Triple Super Phosphate	35 kg	2,450	50 kg	3,500	75 kg	5,250
Insecticides	2 lt	2,460	2 lt	2,460	2 lt	2,460
Rodenticides	100 gr	400	100 gr	400	100 gr	400
Seeds	--	5,000	–	5,000	–	5,000
Cash	--	12,000	–	12,000	–	12,000
Fertilizer KCL/K20	50 kg	3,500	50 kg	3,500	50 kg	3,500
Total Credit		32,810		40,860		46,110

Source: Sekretariat Badan Pengendalian Bimas (1981). Pedoman Paket Kredit Bimas Padi Sawah per Hektar, Jakarta-Indonesia.

TABLE IV

COMPARATIVE RICE YIELDS PER HECTARE IN BIMAS AND NON-BIMAS PROGRAMS, 1974-1980, INDONESIA

Year	Bimas Program (ton/hectare)	Non-Bimas Program (ton/hectare)
1974	4.5	2.9
1975	4.4	2.8
1976	4.7	3.1
1977	4.6	3.0
1978	4.7	3.1
1979	5.5	3.6
1980	5.5	3.7
Average	4.8	3.2
Index (%)	152	100

Source: Sekretariat Badan Pengendalian Bimas, Department Pertanian, Indonesia. (1981). Laporan Tinjauan Hasil Pelaksanaan Program Intensifikasi Tanaman Pangan dan Prayek Bimas Selama Pelita II, Buku I, Departemen Pertanian, Jakarta-Indonesia.

Impact of the Bimas program on farm income is presented in Table V. Income of farmers in the Bimas program is 19.9 percent higher than their counterparts in the non-intensification program. Another study (Kasryno, 1983) compared farmers in the Bimas program across all size land holdings in eight predominantly irrigated villages during 1976/1977 and again in 1983. Results show that real family income levels grew substantially on average among all land holding groups. These income increases were relatively large in the small and medium farm size categories, suggesting a narrowing of income differentials between land-owning groups. Part of this increase, however, is from non-farm activities. Studies have also indicated that real wages increased by 20-25 percent in rural Java as a whole between 1979 and 1983.

The effect of rice intensification programs on aggregate employment is presented in Table VI. With the introduction of modern rice technology, labor use per hectare has tended to increase while labor per kilogram of rice produced has tended to decrease. It is shown that employment of hired labor has risen dramatically in those areas adopting modern technology.

Price Policy in Indonesia

The objectives of price policy set by the government of Indonesia are the following: (1) welfare protection for consumers; (2) income generation for farmers; (3) price stability both intra- and inter-seasonally; (4) reduce reliance on uncertain foreign markets for basic foodstuff (self-sufficiency); (5) regional development and equity; and (6) provision of adequate nutrition.

The first comprehensive and operational price support program was developed in 1969 (Mears and Afiff, 1969). The price support program called "rumus tani" was thought to be a necessary complement to the rice

TABLE V

THE EFFECT OF RICE INTENSIFICATION PROGRAMS ON FARM INCOME, 1974-1982, INDONESIA

Year	Intensification		Non
	Bimas	Inmas	Non Intensification
	(Rp/ha)		
1974	132,720	127,830	109,910
1975	146,280	130,660	126,420
1976	188,870	172,830	155,580
1977	195,090	196,530	181,280
1978	199,680	194,710	193,420
1979	246,560	237,280	215,650
1980	291,885	245,220	232,028
1981	308,075	270,595	261,100
1982	444,143	363,550	320,780
Average	239,256	215,467	199,574
Index (%)	119.9	108.0	100.0

Sources: (1) Sekretariat Badan Pengendalian Bimas. (1981). Laporan Tinjauan Hasil Pelaksanaan Program Intensifikasi Tanaman Pangan dan Proyek Bimas Selama Pelita II, Buku I, Departemen Pertanian, Jakarta-Indonesia.

(2) Sekretariat Badan Pengendalian Bimas. (1986). Laporan Tinjauan Hasil Pelaksanaan Program Intensifikasi Tanaman Pangan dan Proyeh Bimas Selama Pelita III, Buhu I, Departemen Pertanian, Jakarta-Indonesia.

TABLE VI

LABOR USED PER HECTARE BY FARMERS GROWING MODERN RICE VARIETIES COMPARED WITH LABOR USED BY FARMERS GROWING LOCAL VARIETIES, INDONESIA

Location	Man-days/ha MV	Man-days/ha LV	Ratio MV/LV	Kg/man-day MV	Kg/man-day LV	Ratio MV/LV
West Java	340	218	1.6	15.3	13.3	1.2
Central Java	244	187	1.3	24.4	14.9	1.6
East Java	224	209	1.1	20.1	16.3	1.2

Note: MV = Modern Varieties, LV = Local Varieties

Source: Adapted from Randolph Barker et al. (1985). The Rice Economy of Asia.

intensification scheme which sought to stimulate increased adoption of new technologies and to provide a stable economic environment for agricultural development.

The main components of the program were price subsidies for fertilizers and pesticides and determination of a floor price for rice farmers and a ceiling price for rice consumers to protect low-income groups. Implementation of these policies involved two aspects. One was to commission the private market to sell urea at the village level at not more than Rp 26.6 per kilogram, a price which included a subsidy of about Rp 7 to 8 per kilogram (Afiff and Timmer, 1971). Another was to establish BULOG and commission it to buy enough paddy (rice) from the mills to maintain the price of rice to producers at about Rp 36 per kilogram. This price was assumed to fulfill the "rumus-tani" and would permit farmers to receive Rp 13.2 per kilogram for their dry stalk paddy.

The implementation of this policy was considered to be unsuccessful because the private traders tended to buy rice far below the floor price (Afiff and Timmer, 1971). Therefore, in response to this situation, the government in 1973 developed another marketing institution called KUD (koperasi unit desa) so that there would be competition between institutional and private traders. Under this new system, the farmers were assured at least the floor price, since BULOG was authorized to pay the floor price plus commission. As a result, although returns to farmers were below the floor price because of transportation costs, they nonetheless were able to avoid the economic power of the private traders. On the other hand, whenever the market price was higher than the floor price, the farmers could still sell their products to the private traders. Thus, this new marketing system secured the floor price to the farmers and therefore greatly reduced the uncertainty for rice production.

The floor and ceiling prices are maintained through buffer stock management by the BULOG. When prices drop at harvest season, the BULOG enters the market to make the necessary purchases to maintain the floor price. During lean months when prices are high, the BULOG releases its stock to keep prices below the ceiling price. This is a benefit to the majority of low income consumers who generally are landless farm laborers and small farmers in rural areas not able to maintain sufficient rice stock for their own consumption needs. As a result, annual rice stocks managed by BULOG increased substantially ranging from 151 thousand tons in 1967 to 2,217 thousand tons in 1981 (Table VII).

The prevailing level of floor prices and ceiling prices from 1969 through 1982 are listed in Table VIII. The floor and ceiling prices increased respectively from Rp 37 and Rp 50 per kilogram in 1969 to Rp 214 and Rp 240 per kilogram in 1982. The government (through BULOG) has thus successfully stabilized the ceiling price of rice since 1974. This improvement was facilitated by the increased world supply of rice, a surplus of foreign exchange generated through oil exports, substantially increased domestic production, and effectiveness of BULOG's buffer stock and rice market operations. Price indices for rice from 1966 to 1981 (Table IX) show effects of the government price stabilization policy. The terms of trade for rice fell from 115 in 1973 to 67 in 1979 and to 65 in 1981. Furthermore, the increasing rice to fertilizer price ratio indicates a favorable result to rice producers, particularly those in the rice intensification program. As shown in Table X, the rice to fertilizer price ratio increased form 139 percent in 1969 to 306 percent in 1982.

Declining marketing margins have shifted the holding of rice stocks from the private sector to the public sector. Between 1973 and 1981, for example,

TABLE VII

BULOG'S RICE OPERATION, 1967-1981, INDONESIA (IN THOUSAND TONS)

Year	Beginning Stock	Domestic Procurement	Imports	Total Stock Available	Sales	Ending Stock
1967	176	514	354	1,044	893	151
1968	151	598	628	1,377	861	516
1969	516	204	604	1,324	1,062	262
1970	262	493	955	1,710	1,380	530
1971	530	617	493	1,641	1,110	531
1972	531	160	735	1,425	1,257	168
1973	168	263	1,657	2,087	1,508	579
1974	579	530	1,071	2,181	1,334	847
1975	847	530	673	2,050	1,319	731
1976	731	392	1,281	2,403	1,862	541
1977	541	424	1,964	2,929	2,533	462
1978	462	866	1,838	3,166	2,091	1,075
1979	1,075	331	1,,929	3,335	2,552	783
1980	783	1,585	2027	4,395	2,728	1,667
1981	1,667	2,014	525	4,206	1,990	2,217

Source: Amang, Bedu. (1985). "The Price of Rice and Inflation in Indonesia 1967-1981." Ph.D. Thesis, University of California, Davis.

TABLE VIII

THE PREVAILING FLOOR AND CEILING PRICE OF RICE, 1969-1981, INDONESIA

Period (Date)	Floor Price (Rp/kg)	Ceiling Price: Major Surplus Areas (Rp/kg)	Ceiling Price: Deficit Areas (Rp/kg	Major Surplus Areas: Rice Price Margin (Rp/kg)	Major Surplus Areas: Floor to Ceiling Price Margin (%)
April 1969	37.00	50.00	50.00	13.00	35
Late 1972	37.00	floating	floating	--	--
May 1973	52.50	100.00	120.00	47.50	90
Mar. 1974	68.50	100.00	120.00	31.50	46
Feb. 1975	97.00	125.00	135.00	28.00	29
Feb. 1976	108.00	125.00	135.00	17.00	16
Feb. 1977	110.00	127.50	140.00	17.50	16
Feb. 1978	119.50	135.00	145.00	15.50	13
Feb. 1979	140.00	175.00	185.00	35.00	25
Feb. 1980	175.00	190.00	230.00	15.00	9
Feb. 1981	195.00	220.00	245.00	25.00	13
Jan. 1982	214.00	240.00	245.00	26.00	12

Source: Leon A. Mears and Sidik Moeljono, "Food Policy," in Anne Boot and Peter McCawley (eds.), The Indonesian Economy During Suharto Era, Oxford University Press, 1981, and from BULOG.

TABLE IX

RICE PRICE INDICES, 1969-1981, INDONESIA
(ANNUAL AVERAGES)

Year	Current Price Index (Sept. 1966=100)	Real Price Index*
1966	83	112
1967	232	117
1968	673	165
1969	498	89
1970	605	99
1971	554	84
1972	639	92
1973	992	115
1974	1050	80
1975	1301	84
1976	1515	82
1977	1492	70
1978	1556	73
1979	1777	67
1980	2059	65
1981	2259	65

Source: Leon A. Mears and Sidik Moeljono, "Food Policy," in Anne Booth and Peter McCawley (eds.), The Indonesian Economy During Suhart Era, Oxford University Press, 1981, and from BULOG.

*Real Price Index = Current Price Index/General Cost of Living Index

TABLE X

FLOOR PRICE OF RICE AND CEILING PRICE OF FERTILIZER (UREA), 1969-1982, INDONESIA

Period (date)	Rice Floor Price (Rp/kg)	Urea Ceiling Price (Rp/kg)	Rice to Urea Price Ratio (%)
April 1969	37.00	26.60	139
April 1973	45.00	26.60	169
March 1974	68.50	40.00	171
Feb. 1975	97.00	60.00	162
Feb. 1976	108.00	80.00	135
Feb. 1977	110.00	70.00	157
Feb. 1978	119.50	70.00	171
Feb. 1979	140.00	70.00	200
Feb. 1980	175.00	70.00	250
Feb. 1981	195.00	70.00	279
Jan. 1982	214.00	70.00	306

Source: Leon A. Mears and Sidik Moeljono, "Food Policy," in Anne Booth and Peter McCawley (eds.), The Indonesian Economy During Suharto Era, Oxford University Press, 1981, and from BULOG.

the floor price for rice was raised from Rp 52.50 to Rp 195 per kilogram, or a 271 percent increase. At the same time, the ceiling price (in major surplus areas) was increased less, from Rp 100 to Rp 220 per kilogram, or a 120 percent increase (see Table VIII). This decline in margin between the floor price and the retail price discouraged private traders from holding stocks to balance supply and demand between harvests. As a result, privately held rice stocks have fallen while BULOG's rice stocks have increased substantially.

The annual growth rate of rice and fertilizer subsidies in current prices from 1969 to 1982 are presented in Table XI. Since 1969, rice and fertilizer subsidies have increased at annual rates of 18.6 percent and 25.5 percent, respectively. During the period 1973-1978, the fertilizer subsidy was deliberately decreased because of the decline in international fertilizer prices.

The purpose of the fertilizer subsidy is to reduce farmers' incremental cost of production, increase farmers' demand for fertilizer, and, in turn, increase rice production. It was claimed that the key to explaining growth in rice production in Indonesia was the level of fertilizer use (Timmer, 1986). Timmer estimated the price elasticity of demand for fertilizer at -0.66, holding gabah constant. If both gabah and fertilizer prices are constant, fertilizer use grows annually by 10.6 percent. To complement this input policy, the government set the floor price so that farm-gate prices at harvest would not fall below incentive levels. However, this policy depends on the price elasticity of output supply. That is, the higher the supply elasticity, the greater the output response obtained from a given price level.

The degree of supply responsiveness is basically an empirical question. A study done by Suprapto (1984) found that the short-run and long-run elasticities of acreage to price were about 0.034 and 0.036, respectively. In

TABLE XI

ANNUAL GROWTH RATE OF RICE SUPPORTS AND FERTILIZER SUBSIDIES IN CURRENT PRICES, 1969-1982, INDONESIA

Period	Rice Supports (Percent)	Fertilizer Subsidies (Percent)
1969-1973	-1.4	34.1
1973-1978	28.8	-43.9
1978-1982	20.3	42.5
1969-1982	18.6	25.5

Source: Aliraham (1985). "Alternative Approaches to Farmer Cost Sharing of Irrigation Development in Indonesia." Ph.D. Thesis, Colorado State University, Fort collins, Colorado.

addition, yield with respect to price was about 0.127 and 0.128, respectively. Theoretically, the sum of the acreage and yield elasticities make up the elasticity of output. This study suggests that yield per hectare is a key factor to increase the total production of rice in Java, and government, therefore, should emphasize the efforts to increase yield through fertilizer and biological improvement rather than opening new cultivation in Java.

For agricultural policy analysis, it is important to know not only the price elasticity of supply but also demand elasticities. The latter indicate the sensitivity of rice demand to its price variation and to the strength of its relationship to rice substitutes. The first estimate of own price elasticity was -0.3 (Mubyarto, 1965). It indicates that a 10 percent increase in rice price would result in a 3 percent reduction in quantity of rice demanded. The direct price elasticities for rice and cassava as a close substitute and cross-price elasticities for a more recent study by Timmer and Alderman (1979) are presented in Table XII.

The elasticities are substantially larger in absolute magnitude than most estimates reported in earlier literature. Although the appropriate interpretation in Table XII is only for long-run responses, the results indicate that, through price policy, one could increase the price of rice while keeping the prices constant for secondary commodities such as maize and cassava to benefit the poor. This policy would work because low-income people consume those secondary commodities that are no longer attractive to higher income groups. With this kind of policy, government could avoid the large subsidy on rice consumption for the entire population. However, some economists suggest that the short-run response to rice price changes is likely to be about -0.6, based on

TABLE XII

DIRECT PRICE AND CROSS-PRICE ELASTICITIES OF RICE AND CASSAVA BY INCOME CLASS, INDONESIA

Income Class (Rp)	Direct Price Elasticities Rice	Direct Price Elasticities Cassava	Cross-Price Elasticities, Rice and Cassava
Low (< 2000)	-1.921	-1.284	0.996
Low-Mid (2000-3000)	-1.475	-0.818	0.709
Mid-High (3000-5000)	-1.156	-0.943	0.787
High (> 5000)	-0.743	-0.780	0.685
Average	-1.105	-0.804	0.765

Source: Timmer and Alderman, American Journal of Agricultural Economics, Vol. 61, No. 5, 1979.

the 1976 Susenas[1] data (Afiff, Falcon and Timmer, 1980). This price elasticity is only about half the magnitude of the average coefficient in Table XII.

In general, it could be concluded that the government can increase total food production by encouraging farmers to use inputs closer to the optimal level and through further development of irrigation, seeds, and pest management. Yields on Java are approximately 600 kilograms more per hectare where irrigation systems exist and where chemical fertilizer use is high. Under fully controlled irrigation systems and where 150 kilograms of urea are applied, the yield per hectare was about 4.05 tons per hectare in Java. In contrast it was 3.17 tons per hectare for the non-intensification program.

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[1]Susenas stands for Survey Social Ekonomi National (National Survey of Social Economics).

CHAPTER III

EVALUATION OF FOOD PRODUCTION PROGRAM

The purpose of this chapter is to present a literature review and theoretical foundation for evaluating the food production program in Indonesia. This chapter discusses: (1) past program evaluations in Indonesia; (2) the income distribution dimension in program evaluation; and (3) the methodology proposed for the current study.

Past Program Evaluations in Indonesia

As discussed earlier, under the Bimas program extensive government intervention has occurred, particularly in the form of explicit agricultural input price subsidies. Land, farm labor, and animal power were relatively unaffected by government policy but at various times between 1968 and 1985 cost of seeds, water, pesticides, and fertilizers have been reduced to farmers by specific price subsidies covered through direct allocations from the national budget. Moreover, farmers have received credit subsidies, thus reducing further their costs of production.

By the mid 1980's, for example, the pesticide subsidy was very large. Farmers paid only 10 to 20 percent of full economic cost of the most widely used pesticides, and their extremely low price led to widespread and heavy application. Between 1979 and 1983, pesticide use increased by 35 percent per year, to an annual level of over 14 thousand tons. Consequently the pesticide subsidy was large in absolute budgetary terms, exceeding $100 million in 1984-1985 (Timmer, 1986). The benefits of this pesticide subsidy have not been studied and are still unknown and questioned.

In contrast, the fertilizer subsidy has been extensively studied. A recent study by Timmer (1986), for example, found that the fertilizer subsidy is a socially profitable program. His results show a benefit-cost ratio of 1.88 for a government subsidy of Rp 80 per kilogram of fertilizer. This implies that a Rp1.00 of fertilizer subsidy generates Rp1.88 of domestic resources in the country.

Another study by Birowo (1981), which focused on the intensification program as a whole, found that the program as carried out by the Indonesian government is favorable with a benefit-cost ratio ranging from 1.7 in 1976 to 9.9 in 1973 (Table XIII).

Soejono (1976) conducted a survey of eight villages in irrigated areas of Central Java in 1968-1969 and again in 1973-1974. Thirty farmers were chosen in a stratified random sampling procedure that over-represented large farmers and those participating in intensification programs. He found that, in 1968-1969, 32 percent of the farmers sampled used fertilizer and local varieties, and 38 percent used fertilizer and modern varieties. By 1973-1974, all farmers in six of the villages were using fertilizer and modern varieties. The income distribution was found highly skewed in the initial period, with the lowest quintile receiving 1.1 percent of the net returns from rice and the highest quintile receiving 66.3 percent. In the second period, the share of the lowest income groups was 2.7 percent while that of the highest income groups was 61.8. Based on his analysis, he further concluded that while paddy farm incomes have increased in the sample areas due mainly to extension of HYV technology, incomes also became moderately more evenly distributed among

TABLE XIII

BENEFITS AND COSTS OF RICE INTENSIFICATION PROGRAM, 1971-1977, INDONESIA

Year	Benefits (billion rupiah)	Costs (billion rupiah)	B/C ratio
1971	56.3	17.6	3.2
1972	122.9	15.8	7.7
1973	323.1	32.6	9.9
1974	245.5	75.7	3.2
1975	290.2	90.0	3.2
1976	343.0	198.2	1.7
1977	350.8	143.4	2.5

Source: Adapted from Birowo (1981). The Economics of New Technology: The Case of Indonesia.

farmers.

Another study comparing two villages in the Subang regency of West Java provides useful insight into dynamic forces at work in somewhat similar villages (Hayami and Kikuchi, 1981). Survey data were available for periods before and after the introduction of modern rice varieties in each village. Both villages were located in rice-dominated areas. The South Subang village had an older history of settlement and a more cohesive structure, while the North Subang village, which was nearer the coast, was newer, had a higher land-man ratio, and had a greater diversity of social classes, with at least one large landowner. The South Subang village had a long-established irrigation system, while the North village did not become irrigated until 1972.

The intensification of double cropping was made possible with the availability of short duration modern varieties and irrigation. In the North Subang village, the modern varieties spread rapidly. In 1968-1971, about 7 percent of farmers grew modern varieties, and this increased to 100 percent in 1978-1979. Fertilizer application increased, and yields rose from 2.3 to 3.2 tons per hectare. This yield improvement, along with an increase in cropping intensity from 1.5 to 2.0, resulted in a 80 percent increase in output per hectare over the decade. The South Subang village, on the other hand, had a cropping intensity of 1.9 before the introduction of new technology, and it remained constant. In that village, farmers tried to grow the modern varieties but found them unsuited to production under their conditions. By 1978, only 14 percent were growing the modern varieties. Fertilizer was in common use even in 1978-1979. Thus, over the study period, little technological change occurred in the South village, and yields increased a modest 300 kilogram per hectare, compared with three times that increase in the North village. The distribution of

TABLE XIV

INCOME FROM RICE PRODUCTION AND ITS DISTRIBUTION AMONG PARTICIPANTS IN THE PRODUCTION PROCESS, TWO VILLAGES IN WEST JAVA, INDONESIA

			Income (kg/ha) Distributed To				
Period	Percent Area in MVs	Yield (kg/ha)	Current Inputs	Capital	Family Labor	Hired Labor	Operator's Surplus
North Subang Village							
1968-1971	7	2,342	151	47	117	830	1,197
1978-1979	100	3,237	334	154	252	1,070	1,427
Percent change	93	38	21	70	15	29	19
South Subang Village							
1968-1971	n.a.	2,600	345	136	427	830	862
1978-1979	14	2,956	307	125	438	863	1,223
Percent change	--	14	-11	-8	3	4	42

Note: n.a. = not available MV = modern varieties

Source: Hayami and M. Kikuchi (1981). Asian Village Economy at the Crossroad. An Economic Approach to Institutional Change. Tokyo University Press, Tokyo.

income from rice output to current inputs, capital, family labor, hired labor, and residual surplus assigned to the farm operator is shown in Table XIV. In the North Subang village, where the introduction of technology was successful, there were significant gains to all claimants, and in particular to hired labor. In the South Subang village, the small gain in yield and income was captured by the farm operator. This study suggests that intensification programs, as carried out by the Bimas, effects farmer income significantly in rural areas. Farm operators as well as hired labor benefit from the Bimas program.

Income Distribution Dimension in Program Evaluation

The most important conclusion to be drawn from the preceding discussion of past program evaluation is that improved seeds and fertilizer subsidy as well as the intensification program indicated a significant impact not only on farmer income but also on income distribution at the rural area. As concluded by Soejono (1976) income became more evenly distributed among farmers. At the aggregate level, however, distributional impact of the Bimas program on income of all socio-economic groups is still unknown since all previous studies have been carried out in a partial equilibrium framework. Therefore, linkages of the agricultural sector with other sectors in the economy have been ignored. In the context of a general equilibrium framework, the Bimas program may generate substantial indirect effects, or pecuniary external economies. These effects stem partly from production linkages. Moreover, consumption linkages also exist if extra income flowing from the Bimas program boosts the level of final demand in the economy.

Hence, it is important to discuss the theory of income distribution including the evidence of cross-country studies. The purpose of this discussion is to capture the income distribution dimension in program evaluation.

The Evidence of Cross-Country Studies

The effect of economic growth in most less developed countries (LDC) has been decidedly uneven. Some groups have managed to increase their standard of living substantially, while others have gained little or, in some cases, even experienced an absolute decline in standards. Ahluwalia et al. (1979) estimate that almost 40 percent of the population in the LDCs in 1975 were living in absolute poverty. Most of the poor are found in Southern Asia, Indonesia, and Sub-Saharan Africa.

The interest in cross-country studies was initiated by Kuznets in 1955, in which he advanced the hypothesis that income inequality first increases and then decreases with development. The reason for this inverted U pattern is that growth in the early stage of development tends to be concentrated in the modern part of the economy, which is initially small in terms of employment. In the pre-industrial society, where agriculture predominated, there was little differentiation; with the introduction of capitalistic industries the degree of differentiation increased, again causing an increase in inequality.

Karvis (1960) and Oshima (1962) presented data supporting Kuznets' hypothesis that early growth increases inequality, and they argued as well that changes in the economic structure caused the increase in inequality. Swamy (1967) showed that an increase in intersectoral differences in India during the 1950s accounted for 85 percent of the increase in the inequality of site distribution of consumer expenditures, while just 15 percent of the increase was caused by changes within sectors.

Adelman and Morris (1971, 1973) did a cross-sectional analysis of personal income distribution in 74 less developed countries, and showed that over a very long period of the modernization process inequality increases, unless there is planning for equity. They found that, with respect to the share of income accruing to the poorest 20 percent of households, the most important explanatory factors are dualism and various aspects of foreign trade and agricultural policy. They claimed that economic development was associated with increases in the share going to the bottom 20 percent only after relatively high levels of socio-economic development were attained. At the early stages of the development process economic development works to the relative disadvantage of the lowest income groups (Adelman and Morris, 1971).

A number of studies have been devoted to the evolution of income distribution in Brazil. The standard conclusion is that inequality increased, and that the rapid growth in the late 1960s and early 1970s mainly benefited the top 5 percent (Fishlow, 1972). This standard conclusion was challenged by Fields (1977), who argued that growth reached persons at all income levels and that the incomes of the poor grew faster than the incomes of non-poor. However, Fields' analysis has been criticized by several authors, and his conclusion about the growth rate of the poor being higher than that of the rich appears to be incorrect and a consequence of misinterpretation of the data (Ahluwalia and Duloy, 1980; Pyatt and Srinivasan, 1980; Fishlow, 1980; and Bacha and Taylor, 1978).

Another Latin American Country whose income distribution has been thoroughly analyzed is Colombia. Berry and Urrutia (1976) have made a very comprehensive study. Urrutia (1976) gave a concise summary of how the Colombian income distribution has developed. He pointed out that income distribution was very uneven, but no worse than in Mexico and Brazil.

Ahluwalia (1978) has presented a systematic time-series analysis of the Indian National Sample Survey (NSS) data which covers more years than most other studies. He found that the percentage of the rural population in poverty declined from over 50 percent in the mid 1950s to around 40 percent in 1960-1961, then rose drastically through the mid 1960s, reaching a peak in 1962-68, and then declined again. There is no significant time trend over this period, although a constant percentage in poverty implies that the absolute number of poor families has increased.

King and Weldom (1977) analyzed household budget survey data on income distribution in Java during the period 1963-1970. They found little change in the relative distribution of income in rural areas, but a worsening distribution in urban areas. The largest cities accounted for most of the deterioration. The richest 10 percent of the urban dwellers increased their income share. They concluded there was a deterioration in real levels of living for approximately the bottom 40 percent of the population, a widening gap between the rich and the poor in urban areas, and an increasing imbalance between the capital city and other areas of Java.

A few countries in Asia have recently been able to achieve very rapid growth through industrialization for exports. One of these countries is South Korea. A study done by Adelman and Robinson (1980) showed that South Korea has been able to achieve a very rapid economic growth since the mid 1960s through a labor and skill intensive export development strategy. The high growth rate has been brought about without any deterioration in income distribution.

Miyazawa (1976) was interested in the incorporation of the distribution of income and its expenditure into the input-output model. An empirical application of his model is made for a three region view of the Japanese economy by utilizing the large 1960 inter-regional input-output table published in 1966 by the Ministry of International Trade and Industry (MITI). He was able to show the degree to which the middle region of Japan (including Tokyo) had an 83.5 percent self-sufficiency ratio for income, whereas the northeast and western regions were dependent on the middle regions for 40 percent and 35 percent, respectively, of their incomes.

Clive Bell et al. (1982) used a social accounting matrix (SAM) framework to analyze the impact of the Muda River Irrigation Project in Malaysia on socio-economic groups. They found that for each dollar created directly in agriculture by the project, an additional 80 cents of value added was created indirectly in the non-farm economy. They also report that about two-thirds of the 80 cents of indirect income in the Muda project was due to increased rural household demand for consumer goods and services and only one-third was due to agriculture's increased demand for input processing, transport, and marketing services.

From the evidence of cross-country studies it is clear that the problems of inequality and poverty in the Third World or LDCs remain grave in spite of considerable increases in total production since the 1950s. There are, however, a few countries that have managed to decrease poverty considerably, which shows that it can be done, but the majority of the poor in LDCs have experienced only marginal improvements.

Normative and Positive Approach to Income Distribution

To study the distribution of income, it is important to remember how deeply neoclassical economics is rooted in the utilitarian philosophy. There has been a major analytical dichotomy between the utilitarian view of society as essentially individualistic and the classical view of society as composed of a few competing social classes. This dichotomy has resulted in the growth of two quite different approaches within the field of economics to the analysis of income distribution. The first concentrates on both the normative and positive analysis of the income distribution to atomistic individuals or households -- the "size distribution." The second focuses on the distribution of a few aggregate groups. In the classical and Marxist traditions, these groups control or own aggregate factors of production (labor, capital, and land) and are defined by their function in the economy. Hence, the "functional distribution."

The welfare analysis of income distribution is most strongly rooted in the utilitarian philosophy. Although much of the work has sought to free economics from some of the perceived weakness of utilitarianism, the analysis has retained a narrow view of society as essentially individualistic. Therefore, welfare economics has concentrated largely on the size distribution and has not been particularly concerned with the distribution of income among groups, no matter how defined.

The major modern work in the "size distribution" has attempted to separate the question of equity from efficiency. The notion of Pareto optimal, for example, has been used to separate equity questions from efficiency questions. Therefore, according to this view, economics should be concerned with "efficiency" and the "equity" question should be left to sociologists or philosophers. Normative judgments require inter-personal comparisons of utility, something economists should scrupulously avoid (Dervis et al., 1982).

More recent studies have tried to incorporate equity judgments into economic analysis. In the development literature, for example, there is a major debate about whether or not economists should include equity criteria directly in cost-benefit analysis by giving different weights to benefits depending upon who receives them. One side argues that this approach unnecessarily mixes separable criteria, resulting only in confusion. The other side sees it as a practical way to incorporate equity judgment into policy analysis (Squire and Van Der Tak, 1975; Harberger, 1971).

Concern with the functional distribution, that is the distribution of income to aggregate factors of production, goes back to Smith, Ricardo, Marx, and the Neo-Keynesian Cambridge School (i.e., Robinson, Sraffa, and Kaldor). According to these theories, there is a strong tendency to assume that increasing the income share of aggregate labor improves the distribution, i.e., reduces poverty and inequality, an assumption the neoclassicists tend to reject. For example, if organized labor is the only group strong enough to challenge the status quo and reduce the share of the capitalist elite, an increase in its share will be welcomed by neo-Marxists. Neoclassicists and conservatives, in contrast, tend to argue that an increased share by organized labor need not improve the size distribution and may hurt groups with incomes below that of organized labor.

Factor shares are also interesting because they reflect a fundamental division of society into socio-economic groups with distinct political interest and power. The division of society into distinct classes that can easily be associated with aggregate factors of production is not important in neoclassical theory, and concern immediately reverts to the size distribution via an atomistic decomposition of society into individuals or households. This neglects the fact that in a world where aggregate factors do reflect coherent, significant political and economic entities, the functional distribution is of interest in its own right (Dervis et al., 1982).

It is difficult to reconcile the different perspectives on income distribution. However, empirically, there is still room to reconcile the pure "size distribution" and "functional distribution" approaches to analyzing income distribution. To do so economists must build more complete models that generate both. Such models are necessary if economists are to consider both the welfare implications of their policies on member of society as an individual or a group.

This lead to the use of applied general equilibrium models as a framework for analyzing income distribution.

The first effort to incorporate the distribution of income into the framework of a general equilibrium model was the Adelman-Robinson model of Korea. More recent efforts are the Lysy-Taylor model of Brazil and the Ahluwalia-Lysy model of Malaysia (Adelman and Robinson, 1978; Ahluwalia and Lysy, 1979; Lysy and Taylor, 1980). In all three models, the aggregate price is endogenous. All three models found that the overall size distribution of income is stable and difficult to change through policy intervention.

Proposed Methodology for the Current Study

In much of the literature, applied general equilibrium modeling has been dominated by macroeconometric systems. The applied general equilibrium model by means of a social accounting matrix (SAM) originated only very recently and was pioneered by Stone (1961). Other streams in the area of applied general equilibrium modeling, i.e., the input-output analysis, capture only simple general equilibrium relationships.

Most macroeconometric models emphasize macroeconomic variables, i.e., variables which are thought to play an important role in the economy of a country, such as employment, income, and growth. Careful econometric estimation is most important for models with high empirical content. In these models, however, only a few balances are imposed. What is of importance is how well the model performs. This may lead to a situation where the model may not be realistic. As a result, one may not be able to understand or interpret the model when used for purposes other than forecasting. In summary, it is quite true that macroeconometric estimation of traditional general equailibrium model (GEM) is potentially valuable, but, given empirical content of the models, the applications of highly sophisticated techniques to obtain estimates from data that include complicated elements as well may have a high opportunity cost. Other limitations of the macroeconometric models include apparent acceptance of inconsistencies among model relationships and the requirement of time series data which are often very difficult to obtain. These are differences from the applied general equilibrium models using the SAM framework.

A major characteristic of input-output models is that of balance for each production sector. In the input-output matrix there are as many sectors as commodities (square matrix). Analyses using input-output models, however, generally assume fixed technology coefficients. This is sometimes called zero substitution in technology, since changes in price of inputs will not change the input component used in production. Moreover, no income distribution aspect is involved because input-output generally considers households as one sector. The later problem can be overcome, however, by extending the input-output analysis using SAM information (Bell et al., 1982).

Introducing activity analysis production functions in the general equilibrium model is one way of solving the problem of zero substitution. If one commodity can be produced by more than one activity, one can introduce additional columns in the input-output matrix. The additional columns represent the input components required by the alternative technologies. Having these additional columns, normative models such as mathematical programming can be used to solve for the optimal technology.

Recent innovations by Norton et al. (1981, 1986) exhibit the usefulness of activity analysis and the social accounting framework as methodologies in the analysis of policy not only for developing countries but also for developed countries. They also demonstrate that grid linearization of nonlinear relationships is a method of solving general equilibrium models for the optimal technology.

As an organizing framework, Norton et al. (1986) used the device of a social accounting matrix (SAM), which presents in one unified set of accounts a picture of the "circular flow" of a market economy. The SAM provides a consistent picture of the flow-of-funds accounts of the separate institutions in the economy that one may wish to distinguish. Moreover, in this model, within the full balances, the value and volume accounts for commodities are explicitly represented. It allows for alternative technologies in production of some activities, and simply fixed input-output coefficients in others. The commodity demands are endogenously described, and budget constraints for household classes are explicitly stated.

The present study uses general equilibrium modeling and the social accounting methodology to analyze the impact of the Bimas program on the economy of Indonesia. The work of Norton et al. (1981, 1986) represents an important input to this study, both in the systematic formulation of applied general equilibrium models and in their application to policy problems. For purposes of evaluating the Bimas program, however, the theoretical framework of applied general equilibrium models has been adapted to include applications of reducing fertilizer subsidy, increasing government transfers, increasing agricultural employment, and increasing agricultural non-food exports.

CHAPTER IV

METHODOLOGY OF APPLIED GENERAL EQUILIBRIUM MODEL FOR PROGRAM EVALUATION

The purpose of this chapter is to discuss methodology of the applied general equilibrium model within the context of a social accounting matrix as used in this study. This chapter discusses: (1) the framework of a Social Accounting Matrix; (2) relationships between the SAM and a General Equilibrium Model (GEM); and (3) model development for this study.

Framework of a Social Accounting Matrix (SAM)

A Social Accounting Matrix is an accounting system where each identified agent (household account, government account, production account, etc.) in the economy is assigned a row and column. The natural implication is that a SAM is always square. The column records all outlays and the row records all receipts of the agent. Following accounting conventions, total receipts have to be equal to total outlays. Hence, each row sum in the matrix is equal to the corresponding column sum. An entry in row i, column j, represents receipts by account i from account j or, alternatively, expenditures by account j which are paid to account i. Within such a general scheme, SAMs can take on a wide variety of forms, depending on how the constituent accounts are defined. A particular and most important variant is provided by the United Nations System of National Accounts (SNA) which has set down guidelines for deriving the national income statistics as a part of a more comprehensive social accounting system.

In recent years, attempts have been made to extend a SAM for purposes of evaluating government programs and policies under various criteria and of studying various distributional issues. Pyatt et al. (1973) developed a model for Iran where income and factor payments were endogenized. Pyatt and Roe (1977) produced a social accounting matrix for Sri Lanka. Other recent work in this area includes Adelman and Robinson (1978) on Korea, McCarthy and Taylor (1977) on Pakistan, and Lysy and Taylor (1978) on Brazil.

The structure of a SAM for Indonesia in aggregate level is shown in Figure 1. The accounts in the SAM can be grouped into four major categories: (1) factors of production; (2) institutions; (3) production activities; and (4) others.

It is clear that the SAM describes the full circular flow of money and goods in an economy. The conventions of double-entry bookkeeping guarantee that there will be no leakages or injections into the system, and there is no room for any statistical discrepancy. Every flow must go from some actor to some other actor. Figure 1 illustrates that each cell containing (T_{ij}) represents a subsystem containing the transactions between various accounts. For example, $T_{1.3}$ is a subsystem containing the income distribution (value added) according to the types of factors of production in each economic sector. With reference to Figure 1, to produce total output of y_3 production sectors must pay for factor costs of $T_{1.3}$. For the factors of production account, the values of $T_{1.3}$ are incomes, whereas for the production sectors account these values are expenditures. As another example consider the $T_{2.1}$ sub-matrix. This subsystem contains household income distribution from the ownership of factors of production, whereas $T_{2.2}$ are transfer payments between households

EXPENDITURES ↓ / RECEIPTS →			Endogenous Accounts			Exogenous Accounts	Total
			Factors of Production	Institutions	Production Sectors		
			1	2	3	4	5
Endogenous Accounts	Factors of Production	1	0	0	$T_{1.3}$	$T_{1.4}$	y_1
	Institutions	2	$T_{2.1}$	$T_{2.2}$	0	$T_{2.4}$	y_2
	Production Sectors	3	0	$T_{3.2}$	$T_{3.3}$	$T_{3.4}$	y_3
Exogenous Accounts		4	$T_{4.1}$	$T_{4.2}$	$T_{4.3}$	$T_{4.4}$	y_4
Totals		5	y_1'	y_2'	y_3'	y_4'	

Figure 1. The Scheme of an Aggregated SAM

or institutions. Sub-matrix $T_{3.3}$ contains transactions between production sectors, which constitute the main matrix for the analyses of the input-output tables. And $T_{3.2}$ is a subsystem which contains the composition of consumption expenditures of household classes or other institutions, classified according to the type of goods and services produced by the production sectors.

Social accounts for Indonesia have been estimated by Central Bureau Statistics (CBS) using the input-output matrix, national accounts, and other data for 1980. For this study, the aggregate SAM, developed by Central Bureau Statistics has been disaggregated into more detail to capture the Bimas program. For example, the food sector in the aggregate SAM is disaggregated into three sectors: (1) paddy (Bimas), (2) paddy (Non-Bimas), and (3) food non-paddy. Similarly, the chemical and fertilizer sector is separated from the mining and industry sector. Disagregation of the aggregate SAM is necessary since government subsidizes chemicals and fertilizers to the farmers who participate in the Bimas program. The disaggregate SAM 1980 is presented in Table XV. Discussion of the SAM components is in the following sections.

Relationships Between the SAM and Applied GEM

The applied GEM requires base year SAM data. More precisely, it needs base year figures for endogenous and exogenous variables from the SAM. The principal difference between SAM and modelling is clear: construction of a SAM is a statistical data exercise for one year, while constructing a GEM means specifications of the behavior of people, of technical and institutional features, and of the working markets in order to describe the development of the economy given certain policy or government intervention.

The contribution of the SAM becomes clear with model development. The GEM requires a way of allocating income to institutions (social classes).

TABLE XV

SOCIAL ACCOUNTING MATRIX FOR INDONESIA, 1980 (BILLION RUPIAH)

Expenditures / Receipts	Factors of Production 1	2	3	4	5
FACTORS OF PRODUCTION:					
1. Agricultural Laborers					
2. Production Workers					
3. Sales and Services					
4. Professional and Management					
5. Capital					
INSTITUTIONS:					
6. Agricultural Laborers	1051.91000	152.44000	122.63815	40.17417	163.07000
7. Agricultural Operators	4000.58000	416.02000	414.72000	89.47000	5957.82000
8. Non-agricultural Rural-low	228.01000	1890.17000	1505.45000	162.64000	1299.15000
9. Non-agricultural Rural-high	46.13000	129.72000	536.78000	813.59000	271.32000
10. Urban-low	22.70000	1796.92000	2112.84000	244.74000	1520.66000
11. Urban-high	6.75000	182.39000	1386.80000	1181.20000	701.03000
12. Private Companies					17546.85000
13. Government					123.40000
PRODUCTION SECTORS:					
14. Paddy (Bimas)					
15. Paddy (Non-Bimas)					
16. Food Non-paddy					
17. Agriculture Non-food					
18. Mining, Industrial, Construction, Elgaswater					
19. Chemical and Fertilizer					
20. Trade, Hotel, Transportion, and Comm.					
21. Banking, Real Estate, and Services					
22. TRADE AND TRANSPORT MARGIN					
COMMODITIES:					
23. Rice					
24. Food Non-Rice					
25. Agriculture Non-food					
26. Mining, Industrial, Construction, Elgaswater					
27. Chemical and Fertilizer					
28. Trade, Hotel, Transportation, and Comm.					
29. Banking, Real Estate, and Services					
OTHERS:					
30. CAPITAL ACCOUNT					
31. INDIRECT TAXES MINUS SUBSIDY					
32. REST OF THE WORLD					2393.03000
COLUMN TOTAL	5356.08000	4567.66000	6079.22815	2531.81417	29976.33000

SOURCE: Based on aggregate 1980 SAM developed by Central Bureau Statistics, October 1986.

TABLE XV (Continued)

Receipts \ Expenditures	Institutions 6	7	8	9	10	11
FACTORS OF PRODUCTION:						
1. Agricultural Laborers						
2. Production Workers						
3. Sales and Services						
4. Professional and Management						
5. Capital						
INSTITUTIONS:						
6. Agricultural Laborers	4.23000	7.98000	3.48000	1.01000	5.03000	3.15000
7. Agricultural Operators	7.57000	61.32000	21.85000	6.25000	30.49000	18.75000
8. Non-agricultural Rural-low	3.61000	23.54000	17.91000	2.92000	14.68000	9.19000
9. Non-agricultural Rural-high	0.24000	1.93000	1.65000	0.56000	5.10000	1.99000
10. Urban-low	6.91000	43.84000	18.66000	5.43000	36.23000	18.10000
11. Urban-high	0.78000	8.64000	1.29000	2.56000	3.56000	8.50000
12. Private Companies		0.00000	0.00000		0.00000	
13. Government	34.57000	226.67000	98.12000	37.47000	158.11000	155.04000
PRODUCTION SECTORS:						
14. Paddy (Bimas)						
15. Paddy (Non-Bimas)						
16. Food Non-paddy						
17. Agriculture Non-food						
18. Mining, Industrial, Construction, Elgaswater						
19. Chemical and Fertilizer						
20. Trade, Hotel, Transportion, and Comm.						
21. Banking, Real Estate, and Services						
22. TRADE AND TRANSPORT MARGIN						
COMMODITIES:						
23. Rice	390.36020	1796.13710	708.97840	170.97840	441.29520	120.12200
24. Food Non-Rice	797.10980	4073.93290	1827.97160	629.66160	1714.60480	1007.99800
25. Agriculture Non-food	147.44000	582.42000	211.35000	42.81000	114.09000	46.06000
26. Mining, Industrial, Construction, Elgaswater	63.79000	940.80000	527.61000	226.67000	578.10000	464.72000
27. Chemical and Fertilizer	13.42000	319.57000	217.15000	106.02000	396.52000	264.08000
28. Trade, Hotel, Transportation, and Comm.	28.64000	782.05000	598.88000	244.45000	1295.33000	997.72000
29. Banking, Real Estate, and Services	76.70000	1136.39000	615.52000	209.65000	832.91000	548.18000
OTHERS:						
30. CAPITAL ACCOUNT	47.51000	1272.08000	500.06000	284.47000	711.36000	929.71000
31. INDIRECT TAXES MINUS SUBSIDY						
32. REST OF THE WORLD						
COLUMN TOTAL	1622.88000	11277.30000	5370.48000	1970.91000	6337.41000	4593.31000

TABLE XV (Continued)

Receipts / Expenditures	Private Companies 12	Government 13	Production Sectors 14	15	16
FACTORS OF PRODUCTION:					
1. Agricultural Laborers			1500.90773	230.84101	2659.55126
2. Production Workers			6.36158	0.97793	407.00049
3. Sales and Services			3.08545	0.48491	61.06964
4. Professional and Management			2.25342	0.34225	12.20433
5. Capital			805.74560	109.86688	3692.21752
INSTITUTIONS:					
6. Agricultural Laborers		58.90000			
7. Agricultural Operators		175.29000			
8. Non-agricultural Rural-low	93.16000	95.58000			
9. Non-agricultural Rural-high	128.92000	27.37000			
10. Urban-low	196.73000	285.82000			
11. Urban-high	935.69000	151.51000			
12. Private Companies	268.35000				
13. Government	7808.16000	1174.13000			
PRODUCTION SECTORS:					
14. Paddy (Bimas)					
15. Paddy (Non-Bimas)					
16. Food Non-paddy					
17. Agriculture Non-food					
18. Mining, Industrial, Construction, Elgaswater					
19. Chemical and Fertilizer					
20. Trade, Hotel, Transportion, and Comm.					
21. Banking, Real Estate, and Services					
22. TRADE AND TRANSPORT MARGIN					
COMMODITIES:					
23. Rice			55.58080	7.58000	198.13120
24. Food Non-Rice		3.52000	4.98960	0.68000	5045.77840
25. Agriculture Non-food		10.12000	0.20240	0.03000	1159.36760
26. Mining, Industrial, Construction, Elgaswater		573.10000	10.70960	1.47000	405.70040
27. Chemical and Fertilizer		127.43000	187.87000	21.34000	229.15000
28. Trade, Hotel, Transportation, and Comm.		919.12000	0.95920	0.13000	35.56000
29. Banking, Real Estate, and Services		2801.04000	25.33520	3.45000	116.91000
OTHERS:					
30. CAPITAL ACCOUNT	8314.24000	3113.02000			
31. INDIRECT TAXES MINUS SUBSIDY					
32. REST OF THE WORLD	145.03000	724.28000			
COLUMN TOTAL	17890.28000	10240.23000	2604.00058	377.19298	14022.64084

TABLE XV (Continued)

Receipts / Expenditures	Production Sectors 17	18	19	20	21
FACTORS OF PRODUCTION:					
1. Agricultural Laborers	964.78000				
2. Production Workers	48.67000	2271.32000	249.28000	1376.15000	207.90000
3. Sales and Services	34.19000	260.14000	52.53000	4102.43000	1565.31000
4. Professional and Management	10.37000	201.83000	40.53000	114.92000	2149.36000
5. Capital	2719.63000	14400.73000	1347.74000	4578.47000	2322.03000
INSTITUTIONS:					
6. Agricultural Laborers					
7. Agricultural Operators					
8. Non-agricultural Rural-low					
9. Non-agricultural Rural-high					
10. Urban-low					
11. Urban-high					
12. Private Companies					
13. Government					
PRODUCTION SECTORS:					
14. Paddy (Bimas)					
15. Paddy (Non-Bimas)					
16. Food Non-paddy					
17. Agriculture Non-food					
18. Mining, Industrial, Construction, Elgaswater					
19. Chemical and Fertilizer					
20. Trade, Hotel, Transportion, and Comm.					
21. Banking, Real Estate, and Services					
22. TRADE AND TRANSPORT MARGIN					
COMMODITIES:					
23. Rice		19.67000			
24. Food Non-Rice	6.90000	61.61000	25.42000	937.01000	94.65000
25. Agriculture Non-food	762.37000	1043.20000	62.67000	84.61000	1.54000
26. Mining, Industrial, Construction, Elgaswater	145.69000	5301.61000	1962.59000	673.98000	237.20000
27. Chemical and Fertilizer	173.71000	3492.30000	1027.96000	1129.93000	386.37000
28. Trade, Hotel, Transportation, and Comm.	99.99000	294.91000	56.80000	1081.71000	131.44000
29. Banking, Real Estate, and Services	69.04000	576.63000	74.23000	488.46000	218.90000
OTHERS:					
30. CAPITAL ACCOUNT					
31. INDIRECT TAXES MINUS SUBSIDY					
32. REST OF THE WORLD					
COLUMN TOTAL	5035.34000	27923.95000	4899.75000	14567.67000	7314.70000

TABLE XV (Continued)

Receipts / Expenditures	Margin 22	Domestic Commodities 23	24	25	26	27
FACTORS OF PRODUCTION:						
1. Agricultural Laborers						
2. Production workers						
3. Sales and Services						
4. Professional and Management						
5. Capital						
INSTITUTIONS:						
6. Agricultural Laborers						
7. Agricultural Operators						
8. Non-agricultural Rural-low						
9. Non-agricultural Rural-high						
10. Urban-low						
11. Urban-high						
12. Private Companies						
13. Government						
PRODUCTION SECTORS:						
14. Paddy (Bimas)		2604.00058				
15. Paddy (Non-Bimas)		377.19298				
16. Food Non-paddy			14022.64000			
17. Agriculture Non-food				5035.34000		
18. Mining, Industrial, Construction, Elgaswater					27904.28000	
19. Chemical and Fertilizer						4899.75000
20. Trade, Hotel, Transportion, and Comm.						
21. Banking, Real Estate, and Services						
22 = TRADE AND TRANSPORT MARGIN		760.58230	2055.43770	1470.38000	2027.16000	2239.56000
COMMODITIES:						
23. Rice						
24. Food Non-Rice						
25. Agriculture Non-food						
26. Mining, Industrial, Construction, Elgaswater						
27. Chemical and Fertilizer						
28. Trade, Hotel, Transportation, and Comm.	8608.09000					
29. Banking, Real Estate, and Services						
OTHERS:						
30. CAPITAL ACCOUNT						
31. INDIRECT TAXES MINUS SUBSIDY		40.87635	242.55365	51.88000	1023.49212	-1402.62212
32. REST OF THE WORLD		126.05400	460.42535	182.22000	4385.69788	3670.31212
COLUMN TOTAL	8608.09000	3908.70621	16781.05670	6739.82000	35340.63000	9407.00000

TABLE XV (Continued)

Receipts / Expenditures		Domestic Commodities 28	29	CAPITAL ACCOUNT 30	INDIRECT TAX 31	REST OF THE WORLD 32	ROW TOTAL
FACTORS OF PRODUCTION:							
1.	Agricultural Laborers						5356.08000
2.	Production Workers						4567.66000
3.	Sales and Services						6079.24000
4.	Professional and Management						2531.81000
5.	Capital						29976.43000
INSTITUTIONS:							
6.	Agricultural Laborers					8.87000	1622.88231
7.	Agricultural Operators					77.17000	11277.30000
8.	Non-agricultural Rural-low					24.47000	5370.48000
9.	Non-agricultural Rural-high					5.61000	1970.91000
10.	Urban-low					27.83000	6337.41000
11.	Urban-high					22.60000	4593.30000
12.	Private Companies					75.08000	17890.28000
13.	Government				402.24000	22.32000	10240.23000
PRODUCTION SECTORS:							
14.	Paddy (Bimas)						2604.00058
15.	Paddy (Non-Bimas)						377.19298
16.	Food Non-paddy						14022.64000
17.	Agriculture Non-food						5035.34000
18.	Mining, Industrial, Construction, Elgaswater						27904.28000
19.	Chemical and Fertilizer						4899.75000
20.	Trade, Hotel, Transportion, and Comm.	14567.67000					14567.67000
21.	Banking, Real Estate, and Services		7314.70000				7314.70000
22.	TRADE AND TRANSPORT MARGIN	54.97000	0.00000				8608.09000
COMMODITIES:							
23.	Rice			0.00000		0.00000	3908.83330
24.	Food Non-Rice			247.56000		301.66000	16781.05670
25.	Agriculture Non-food			60.84000		2410.70000	6739.82000
26.	Mining, Industrial, Construction, Elgaswater			11494.77000		11732.12000	35340.63000
27.	Chemical and Fertilizer			91.24000		1222.94000	9407.00000
28.	Trade, Hotel, Transportation, and Comm.			0.00000		463.92000	15639.69920
29.	Banking, Real Estate, and Services			0.00000		30.82000	7824.16520
OTHERS:							
30.	CAPITAL ACCOUNT						15172.45000
31.	INDIRECT TAXES MINUS SUBSIDY	356.31920	90.83000				402.24000
32.	REST OF THE WORLD	660.74000	418.47000	3278.04000			16426.11000
COLUMN TOTAL		15639.69920	7824.00000	15172.45000	402.24000	16426.11000	

This information is contained in the SAM sub-matrices. The GEM also requires the input-output coefficients. Production sectors require intermediate inputs to be used in the process of production. The SAM contains a sub-matrix from which input-output coefficients can be calculated. These coefficients specify which kinds of inputs are required in the production of each sector and the amount of each input required per unit of production.

The SAM data also provide information about government accounts, including consumption and investment. Therefore, given the target of government consumption and government investment, the GEM can determine what kind of commodities to buy and the amount needed.

Information about transfers from government and from the rest of the world to each institution or social class is also available. Information about indirect taxes paid and subsidies received for each commodity and direct taxes paid or subsidies received by each institution or social class is available as well. Generally, all of this information is required by the GEM for at least the base year. In conclusion, it is clear that to develop a GEM, base year data from a SAM are needed.

Model Development for This Study

The process of formulating a general equilibrium model from SAM information consists of three steps: (1) deciding which elements (cells) of the SAM are to be regarded as fixed (exogenous) and which should be variables (endogenous); (2) specifying equations or constraints for the model; and (3) deciding how to close the model, by omitting some equations or adding others.

For decision (1), most of the cells in the disaggregate SAM (32 x 32) in Table XV are made endogenous, such as quantities of goods purchased by each household group. Also, most row and column totals of the SAM are treated endogenously, such as total income for each household group.

The only cells in the disaggregated SAM treated as exogenous (fixed) variables are the entries in the "rest of world" column which are found in column 32; transfer payments among institutions (households, companies, and government); and international capital flows (intersection of columns 5 and 30 with rest of world, row 32).

Therefore, of the 294 entries in the aggregate SAM, 220 become endogenous variables and 74 are treated as exogenous variables. The latter include private transfers, remittances from abroad, government foreign borrowing, and capital foreign borrowing.

The equations of GEM are given in the following section. The commodity demand parameters needed in developing the GEM are presented in Chapter V. The remainder of this section discusses content of the GEM and sources of additional information apart from that provided by the aggregate SAM. The discussion is organized in terms of modules or model components.

Aggregate Identities

There are seven commodity balance restrictions in the model, three for agriculture and four for non-agriculture. Each provides for market-clearing behavior in its product market, abstracting from short-run inventory fluctuations. Total domestic production plus trade and transport margin, and plus indirect tax must be equal to the total source of demand: intermediate input-output demands, household consumption, government consumption, uses as capital goods, and exports. Each equation is expressed in real (constant-price) terms, even though it holds in current price as well, and each is expressed as an inequality which in principle allows free disposal of excess supply. However, to be acceptable a model solution should contain no excess supply.

Production Activities

It is assumed that production sectors will work under constant returns to scale. This implies that if one uses twice as many inputs, the output will also double. However, Bimas paddy production is assumed to be determined by a Cobb-Douglas production function which permits factor substitutions. For Bimas paddy production, discrete technological alternatives along an isoquant are computed with the aid of production function parameters, and the model chooses among those alternatives, or some linear combination thereof, and the scale at which they are to be operated.

Income Formation

The main objective of this module is to determine household income on the basis of domestic factor incomes, factor income from abroad, household transfer payments, company transfer payments, and government transfers. The pertinent equations are taken directly from the aggregate 1980 SAM, which is assumed to reflect patterns of asset ownership. For instance, row 6 of the aggregate SAM states that agricultural laborer households received 1,622.88 billion rupiahs, and of that total, 1,051.91 billion rupiahs were derived from earnings as agricultural laborers, 152.44 billion from earnings as production workers, 122.64 billion from employment earnings as sales and services, 40.17 billion from earnings as managers and supervisors, 163.07 billion as capital payments, 58.90 billion from government transfers, 8.87 billion as payments from abroad, and the rest as transfer payments from other households. To simplify the model, it is assumed that transfer payments from household to household, companies to household, and government to household are treated as exogenous variables (fixed, at least in the short-run, or set by government policy).

Demand Representation

Demand for commodities consists of household consumption, intermediate demand, investment, public demand (government consumption and investment), and exports. Investment demand is assumed exogenous for the current model. Intermediate demand is determined by the level of sector output and the fixed input-output coefficients, reflecting the constant returns to scale assumption.

The general equilibrium model described here utilizes a demand system which satisfies Cournot and Engel aggregation as well as the homogeneity condition. The latter condition states that the demand function must be homogenous of degree zero in prices and income. For this purpose, these demand parameters have been estimated using the Frisch method, and are discussed in Chapter V.

Government consumption is assumed exogenous for the current analysis and equal to the 1980 base SAM. With regard to saving identities, the level of household, company, and government savings are assumed to be a linear function of total size of household income, company revenue, and government revenue, respectively. The saving-investment identity in the aggregate SAM is presented in row 30. The total investment (the total row 30 and column 30) is a summation of household saving, company saving, and government saving.

Resource Use

The aggregate 1980 SAM specifies five types of resources: (1) agricultural laborers, (2) production workers, (3) sales and services, (4) professional and management, and (5) capital.

It has been assumed that the production function for each sector is determined by the Leontief production function except for Bimas paddy, where the production function is assumed to be a Cobb-Douglas type. The reason is the Cobb-Douglas production function permits factor substitution between capital and labor. Further, it has been hypothesized that input subsidies implemented by the Bimas program leads to the use of more capital and less labor. It is also assumed that labor and capital supplies are perfectly inelastic. Thus in the short-run, all resources are treated as exogenous (fixed) variables and fully employed.

Trade and Balance of Payments

Balance of payments considerations may impose severe constraints on policy. Elements of the balance of payments in the model are: (1) total imports, (2) total exports, (3) remittance from abroad, (4) capital payment to abroad, (5) company interest payment to abroad, and (6) government interest payment to abroad.

Imports are assumed non-competitive with domestic production for the 1980 SAM and dependent on domestic production levels. Thus, in the short-run model, imports are assumed a linear function of sector production level. The small country model is assumed for Indonesia and thus, expansion or contraction of domestic production will not influence world markets. The assumption is perfectly elastic import and export functions. Exports are kept at the 1980 base SAM except for policy simulations discussed later where agricultural exports are determined endogenously.

Foreign capital flows and expatriate earnings from abroad are assumed to be determined exogenously and at the levels in the aggregate 1980 SAM. This assumption is valid for the purpose of comparative statics analysis.

The Government Accounts

The aggregate 1980 SAM entries for government revenue (rows 13 and 31) imply certain coefficients of revenue collection with respect to corresponding column variables in Table XV. These coefficients are adopted for use in the government budget identity in GEM. Government expenditures are divided into transfer payments, government consumption, government saving, and government interest payment to abroad.

To simplify the model, transfer from government to households and to private companies are treated as exogenous variables except for policy simulations to be discussed later. Also government interest payment to abroad is treated as fixed because this payment is most likely depending on government commitments to the rest of the world. Government saving is endogenous and assumed to be a fixed share of total government revenue.

Prices

Factor and commodity prices are determined in the optimization conditions of the model. The relevant theory for these conditions is shown in Norton and Scandizzo (1981 and 1986) and is elaborated upon for Indoensia in the following section. In the present model, it is assumed that the exchange rate is fixed, at least in the short-run, and therefore, this model would not be valid under circumstances which imply very large changes in balance of payments.

The Model

The principal elements of any general equilibrium model are given in Hazell and Norton (1986) as: (1) a technology and producer behavior specification, including resource limitations; (2) commodity balances for market clearing; (3) a description of how income is formed and distributed; and (4) a representation of demand behavior. If the demand functions are not homogenous of degree zero, i.e., they are not necessarily derived from individual or household utility maximization, then the household budget constraints will not be satisfied automatically. Therefore, they must be added to the model explicitly. Included in the producer behavior specification is an equation setting price equal to marginal costs and thus maximum output under competitive markets.

The marginal-cost pricing defines output price from the supply side, and segmented demand variables do the same thing from the demand side. Equating these prices ensure that price equals marginal cost in the primal solution.

In this specification of the model, extensive use is made of demand segment variables, along with associated convex combination constraints. Following the procedure described by Norton and Scandizzo (1981 and 1986), the primal equations of the model used in this present study are written as follows:

Maximand (1)[2]

$$\text{Max } Z = \sum_{i}\sum_{h}\sum_{s} \rho_{ihs} W_{ihs} - \sum_{f}\sum_{h} \bar{b}_{fh} P_f + \sum_{i} P_i^X E_i \ldots \qquad (4.1)$$

---

[2]The symbol in brackets after the equation name gives the number of equations in each set. Variables, parameters, and indexes are identified in the following section.

$$\left[\begin{array}{c}\text{Gross revenue}\\ \text{from sales}\\ \text{to households}\end{array}\right] - \left[\begin{array}{c}\text{Factor}\\ \text{costs}\end{array}\right] + \left[\begin{array}{c}\text{Gross revenue}\\ \text{from export}\\ \text{sales}\end{array}\right]$$

Subject to:

<u>Commodity Balances (N).</u>

In general, (N - 1) of the commodity balance equations are written as:

$$\sum_{h}\sum_{s} \theta_{ihs} W_{ihs} + GCON_i + INV_i + E_i - \sum_{j}\sum_{t} a^{*}_{ijt}\, q_{jt} - MARG_i - INDTAX_i$$

$$- M_i \leq 0 \qquad (4.2)$$

In verbal, commodity balances can be expressed as:

$$\left[\begin{array}{c}\text{Quantity}\\ \text{sold to}\\ \text{households}\end{array}\right] + \left[\begin{array}{c}\text{Government}\\ \text{consumption}\end{array}\right] + \left[\begin{array}{c}\text{Investment}\end{array}\right] + \left[\begin{array}{c}\text{Exports}\end{array}\right]$$

$$= \left[\begin{array}{c}\text{Production net}\\ \text{of intermediate}\\ \text{sales}\end{array}\right] + \left[\begin{array}{c}\text{Trade and}\\ \text{transport}\\ \text{margin}\end{array}\right] + \left[\begin{array}{c}\text{Indirect}\\ \text{taxes}\end{array}\right] + \left[\begin{array}{c}\text{Imports}\end{array}\right]$$

For the trade and transport margin sector, the commodity balance equation is:

$$\sum_{h}\sum_{s} \theta_{mhs} W_{mhs} + GCON_m + INV_m + E_m + \sum_{i} MARG_i - \sum_{j}\sum_{t} a^{*}_{mjt}\, q_{jt} -$$

$$MARG_m - INDTAX_m - M_m \leq 0 \qquad (4.3)$$

Verbal interpretation of equation (4.3)

[Quantity sold to households] + [Government consumption] + [Investment] + [Exports] +

[Total trade and transport margin] = [Production net of intermediate sales] + [Trade and transport margin] +

[Indirect taxes] + [Imports]

<u>Resource Constraints (F)</u>

$$\sum_i \sum_t r_{fi,t}\, q_{it} \leq \bar{s}_f \tag{4.4}$$

[Requirement for resource f using technology t in production of sector i] ≤ [Available supply of resource f]

<u>Domestic Demand Functions (N x H)</u>

$$-\frac{1}{X_{i,h,o}} \sum_s \theta_{ihs} W_{ihs} + \sum_j \frac{\eta_{ijh}}{P_{j,o}} P_j + \frac{\varepsilon_{ih}}{Y^D_{h,0}} (1 - \bar{a}_h)\, Y_h = -1 \tag{4.5}$$

$$\begin{bmatrix} \text{Quantity demanded} \\ \text{relative to base} \\ \text{year quantity} \\ \text{demanded} \end{bmatrix} + \begin{bmatrix} \text{Elasticity adjusted} \\ \text{term in all} \\ \text{product} \\ \text{prices} \end{bmatrix} +$$

$$\begin{bmatrix} \text{Disposable income} \\ \text{relative to base year} \\ \text{income, adjusted to Engel} \\ \text{elasticity and saving propensity} \end{bmatrix} = -1$$

Household Budget Constraints (H)

$$- (1 - \bar{a}h)\, Y_h + \sum_i \sum_s \rho_{ihs} W_{ihs} \leq 0 \tag{4.6}$$

$$\begin{bmatrix} \text{Disposable} \\ \text{income of} \\ \text{households} \\ \text{in category h} \end{bmatrix} \geq \begin{bmatrix} \text{Value of consumption} \\ \text{expenditure by} \\ \text{households} \\ \text{in category h} \end{bmatrix}$$

Household Income Formation (H)

$$-\sum_k H_k TRH_h - COMTRH_h - GTRH_h - REMH_h - \sum_f \bar{b}_{fh} P_f + Y_h = 0 \tag{4.7}$$

$$\begin{bmatrix} \text{Household} \\ \text{transfer} \\ \text{payments} \end{bmatrix} + \begin{bmatrix} \text{Transfer payments} \\ \\ \text{from companies} \end{bmatrix} + \begin{bmatrix} \text{Transfer payments} \\ \\ \text{from government} \end{bmatrix}$$

$$+ \begin{bmatrix} \text{Income} \\ \text{from} \\ \text{abroad} \end{bmatrix} + \begin{bmatrix} \text{Value of return} \\ \text{to factor endowment} \\ \text{held by households} \end{bmatrix} = \begin{bmatrix} \text{Income of} \\ \text{households} \\ \text{in category h} \end{bmatrix}$$

Marginal Cost Pricing (N x T)

$$a^*_{i,i,t}\, P_i - \Sigma a^*_{j,i,t}\, P_j - \sum_f r_{fi,t}\, P_f \leq 0 \qquad (4.8)$$

[Unit value of output] ≤ [Intermediate goods costs per unit of output] + [Factor cost per unit of output]

Trade and the Balance of Payments Constraint (1)

$$\sum_i M_i + ICOM + IGOV + WCAP + WINV - \sum_i E_i - \sum_h REMH_h$$

$$- REMCOM - REMG \leq 0 \qquad (4.9)$$

[Imports] + [Company's interest payment abroad] + [Government interest payment abroad]

+ [Capital payment abroad] + [Investment abroad] = [Exports] + [Payments from abroad]

Import Functions (N)

$M_i - m_i q_i = 0$ (non-competitive imports are assumed a linear function of domestic production) (4.10)

Convexity Constraints (N x H)

$$\sum_s W_{ihs} - \left(\frac{\varepsilon_{ih}}{Y^D_{h,0}}\right)(1 - \overline{a}h)\; Y_h - \sum_{j \neq i} \left(\frac{\eta_{ijh}}{P_{j,0}}\right) P_j \leq 1 + \eta_{iih} \qquad (4.11)$$

$$\left[\begin{array}{c}\text{Sum of demand}\\ \text{segment variables,}\\ \text{good i, households h}\end{array}\right] \leq 1 + \left[\begin{array}{c}\text{Term in the}\\ \text{rate of change in}\\ \text{disposable income}\end{array}\right]$$

$$+ \left[\begin{array}{c}\text{Sum of terms in rate}\\ \text{of change of}\\ \text{prices of other goods}\end{array}\right]$$

Government Revenue (1)

Since, in the current SAM, the total fertilizer subsidy has been included, thus to reflect this total subsidy in the model, government revenue may be written as follows:

$$-GREV + \sum_h t_h Y_h + \sum_i INDTAX_i + (S^0 - S)\, q_i + t_c\, COMREV +$$

$$\bar{b}_{fg} P_f + GTRG + REMG = 0 \qquad (4.12)$$

$$\left[\begin{array}{c}\text{Government}\\ \\ \text{revenue}\end{array}\right] = \left[\begin{array}{c}\text{Direct}\\ \\ \text{taxes}\end{array}\right] + \left[\begin{array}{c}\text{Indirect}\\ \\ \text{taxes}\end{array}\right] + \left[\begin{array}{c}\text{Net Government}\\ \text{reduction in subsidy}\\ \text{to Bimas paddy}\end{array}\right]$$

$$+ \left[\begin{array}{c}\text{Tax from}\\ \text{company}\\ \text{revenue}\end{array}\right] + \left[\begin{array}{c}\text{Tax}\\ \text{on}\\ \text{capital}\end{array}\right] + \left[\begin{array}{c}\text{Government}\\ \text{transfer}\\ \text{payment}\end{array}\right] + \left[\begin{array}{c}\text{Payment}\\ \text{from}\\ \text{abroad}\end{array}\right]$$

where: S^0 = fertilizer subsidy per unit of Bimas paddy output in the base SAM.

S = the level of fertilizer subsidy in the model, thus S becomes a policy variable with the value $0 \leq S \leq S^0$.

Government Fertilizer Subsidy Cost for Bimas Program (1)

$$S\, q_i \leq GCOST \tag{4.13}$$

[Fertilizer subsidy to Bimas producers] ≤ [Available total subsidy to Bimas provided by government]

Government Expenditure (1)

$$-GEX + \sum_h GTRH_h + IGOV + GTRG + \sum_i GCON_i + GSAVE = 0 \tag{4.14}$$

[Government expenditure] = [Total transfer payment from government to households]

+ [Government interest payment abroad] + [Government transfer payment]

+ [Total government consumption] + [Government saving]

Company Revenue (1)

$$COMREV - COMTRCOM - \bar{b}_{fc}\, P_f - REMCOM = 0 \tag{4.15}$$

$$\begin{bmatrix} \text{Company} \\ \\ \text{revenue} \end{bmatrix} = \begin{bmatrix} \text{Transfer payment} \\ \text{from company} \\ \text{to company} \end{bmatrix}$$

$$+ \begin{bmatrix} \text{Value of return} \\ \text{to factor endowment} \\ \text{held by company} \end{bmatrix} + \begin{bmatrix} \text{Payment} \\ \text{from} \\ \text{abroad} \end{bmatrix}$$

Saving and Investment (1)

$$s_g \, GREV + s_c \, COMREV + \sum_h s_h Y_h - TINV = 0 \tag{4.16}$$

$$\begin{bmatrix} \text{Government} \\ \\ \text{saving} \end{bmatrix} + \begin{bmatrix} \text{Company} \\ \\ \text{saving} \end{bmatrix} + \begin{bmatrix} \text{Household} \\ \\ \text{saving} \end{bmatrix} = \begin{bmatrix} \text{Total} \\ \\ \text{investment} \end{bmatrix}$$

Definition of Variables

W_{ihs} = segment choice variables on domestic demand function

P_f = price of factor f

P_i, P_j = domestic commodity prices

P^X_i = export commodity prices

$q_{j,t}$ = production of commodity j under technology t

M_i = imports of commodity i

E_i = exports of commodity i

$X_{i,h,o}$ = total commodity demanded by households h in the base SAM

Y_h = household income

$Y^D_{h,o}$ = household disposable income in the base SAM

$GCON_i$ = government consumption of commodity i

GREV = government revenue

COMREV = company revenue

INV_i = investment of commodity i

TINV = total investment

H_kTRH_h = transfer payment from households k to households h

$COMTRH_h$ = transfer payment from company to households h

$GTRH_h$ = transfer payment from government to households h

$REMH_h$ = income from abroad to households h

GTRG = transfer payment from government to government

REMG = income from abroad to government

COMTRCOM = transfer payment from company to company

REMCOM = income from abroad to company

$INDTAX_i$ = indirect tax minus subsidy for commodity i

$MARG_i$ = transport and trade margin for commodity i

$P_{j,0}$ = domestic commodity price in base SAM

ICOM = company's interest payment abroad

IGOV = government interest payment abroad

WCAP = capital payment abroad

WINV = investment abroad

GEX = government expenditure

GSAVE = government saving

<u>Definition of Parameters</u>

ρ_{ihs} = gross revenue (price times quantity) from sales to households

$\bar{b}_{fh}$ = initial endowments of resources (factors) held by households

$\bar{b}_{fg}$ = initial endowment of resource (factor) f held by government

θ_{ihs} = quantity demanded in domestic price

a^{*}_{ijt} = element of a rectangular (I-A) Leontief matrix

r_{fi} = resource requirement per unit of production

η_{ijh} = direct and cross-price elasticities of demand

ε_{ih} = Engel elasticity

s_h = average propensity to save by households h

s_c = average propensity to save by private company

s_g = average propensity to save by government

$\bar{s}_f$ = available supply of resource f

$\bar{b}_{fc}$ = initial endowment of resource (factor) f held by private company

$\bar{a}h$ = average propensity to save plus average propensity to tax plus average payment from household to household

t_h = average propensity to tax paid by households h

t_c = average propensity to tax paid by company

<u>Definition of Indexes</u>

i, j	= 1, 2, ..., N	goods
h	= 1, 2, ..., H	households
s	= 1, 2, ..., S	demand function segments
t	= 1, 2, ..., T	production technologies per good
f	= 1, 2, ..., F	resources (factors)

CHAPTER V

ESTIMATING AGGREGATE DEMAND USING THE FRISCH METHOD

This chapter sets a framework for estimating the aggregate demand for the commodities included in this study. The method follows that formulated by Frisch (1959). The estimated income and own and cross price elasticities are used to develop the applied general equilibrium model for Indonesia. This chapter discusses: (1) the Frisch methodology, and (2) application of aggregate demand estimation to Indonesia.

The Frisch Methodology

The study of consumer behavior generally begins with the theory of utility maximizing individuals (Stigler, 1965), while other studies have attempted to make certain generalizations based on observed consumer behavior (Houthakker, 1961). The consumer is confronted with a set of goods from which to make a choice. Choice is governed by certain behavioral factors, the most important being that of maximizing satisfaction.

Suppose that a consumer with a given income, Y, makes a choice of quantities, $q_1, q_2, \ldots, q_n$, from a commodity space with n elements. Then the utility function can be specified as:

$$U = U(q_1, q_2, \ldots, q_n) \qquad (5.1)$$

If P_1, P_2, ..., P_n represent the unit prices of these commodities, $P_1q_1 + P_2q_2 + \ldots + P_nq_n$ will be the total expenditure and this should not exceed the income; or

$$P_1q_1 + P_2q_2 + \ldots, + P_nq_n \leq Y \tag{5.2}$$

The consumer's choice of q_1, q_2,..., q_n will correspond to the quantities consistent with maximization of

$$L\,(q_1, q_2, \ldots, q_n, \Lambda) = \mu(q_1, q_2, \ldots, q_n) + \Lambda\,(Y - P_1q_1 + P_2q_2 \ldots, - P_nq_n) \tag{5.3}$$

Differentiating equation (5.3) with respect to q_1, q_2,..., q_n and Λ, we get the following normal equations:

$$\mu_j\,(q_1, q_2, \ldots, q_n) - \Lambda\, P_j = 0$$

$$Y - P_1q_1 + P_2q_2 + \ldots, + P_nq_n = 0$$

$$j = 1, 2, \ldots, n \tag{5.4}$$

where:

$\mu_j = \dfrac{\partial U}{\partial q_j} =$ the marginal utility of commodity j

P_j = the price of commodity j

q_j = the quantity of commodity j

Y = total consumer income

Λ = the marginal utility of income

The demand functions can be represented as:

$$q_i = q_i\,(P_1, P_2, \ldots, P_n, Y) \tag{5.5}$$

The demand elasticities (η_{ij}) and income elasticities (ε_{iy}) are defined as:

$$\eta_{ij} = \frac{\partial q_i}{\partial P_j} \frac{P_j}{q_i}, \qquad \text{and}$$

$$\varepsilon_{iy} = \frac{\partial q_i}{\partial y} \frac{Y}{q_i} \tag{5.6}$$

where: (i, j = 1, 2, ..., n)

The proportion of expenditure on the ith commodity is denoted by:

$$w_i = \frac{P_i q_i}{Y} \tag{5.7}$$

The marginal utility of money, Λ, is defined as a common ratio:

$$\Lambda = \frac{\mu_j (q_1, q_2, \ldots, q_n)}{P_j} \tag{5.8}$$

Frisch considers the implications for estimation of a matrix of demand coefficients in which the utility of some or all commodities are independent of the quantity of others. The idea of want independence is explained by Frisch by referring to commodities were, for example, "... the marginal utility of using more electricity in the home can safely be regarded as independent of the quantity of Swiss cheese consumed". Similarly, he discussed the case where commodity groups may be want independent, but dependence is assumed among commodities within a group. The major argument is for the case of want-independent commodities and can be compared with the classical case in which the Slutsky relation is given as:

$$\eta_{ij} = \eta_{ji} \frac{w_j}{w_i} + w_j (\varepsilon_{jy} - \varepsilon_{iy}) \tag{5.9}$$

The Frisch statement of this relation expresses price elasticities (η_{ij}) as a function of want elasticities (σ_{ij}), budget proportions (w_i), income elasticities (ε_{iy}) and the flexibility of marginal utility of income with respect to income ($\overline{\Phi}$):

$$\eta_{ij} = \sigma_{ij} - w_j\,\varepsilon_{iy} - \frac{1}{\overline{\Phi}}\,w_j\,\varepsilon_{jy}\,\varepsilon_{iy} \tag{5.10}$$

where:

$$\sigma_{ij} = \frac{\partial q_i(U_1, U_2, \ldots, U_n)}{\partial U_j}\;\frac{U_j}{q_i} \quad \text{(want elasticity)}$$

and

$$\overline{\Phi} = \frac{\partial \Lambda}{\partial Y} \cdot \frac{Y}{\Lambda} \quad \text{(money flexibility).}$$

For income elasticities, the conventional row restraint, as the Slultsky-Schultz condition, is that the elasticities for prices and income sum to zero, or:

$$-\varepsilon_{iy} = +\sum_j \eta_{ij} \tag{5.11}$$

$(i, j = 1, 2, \ldots, n)$

The Frisch statement in terms of want elasticities and the money flexibility coefficient is:

$$\varepsilon_{iy} = \overline{\Phi} \sum_j \sigma_{ij} \tag{5.12}$$

Consider the case where a good is want independent of all other goods. This implies that $\sigma_{ij} = 0$ for $i \neq j$. The cross-price and income elasticities may then be expressed as:

$$\eta_{ij} = -w_j\,\varepsilon_{iy} - \frac{1}{\overline{\Phi}}\,w_j\,\varepsilon_{jy}\,\varepsilon_{iy}, \tag{5.13}$$

or

$$\eta_{ij} = \varepsilon_{iy}\,w_j\,(1 + \frac{\varepsilon_{jy}}{\overline{\Phi}}) \quad \text{(cross-elasticities), and}$$

$$\varepsilon_{jy} = \bar{\Phi}\sigma_{ii} \quad \text{(income elasticities)} \tag{5.14}$$

To obtain the direct price elasticity under want independence, solve for σ_{ii} in equation (5.11), substitute the term in equation (5.10), and obtain

$$\eta_{ii} = \frac{\varepsilon_{iy}}{\bar{\Phi}} - w_i \varepsilon_{iy} - \frac{1}{\bar{\Phi}} w_i \varepsilon_{iy} \varepsilon_{iy} \tag{5.15}$$

or $$\eta_{ii} = - \varepsilon_{iy} w_i - \left[\frac{1 - w_i \varepsilon_{iy}}{\bar{\Phi}} \right] \quad \text{(own price elasticity)}$$

Under want independence, Frisch defined:

$$\bar{\Phi} = \frac{\varepsilon_{iy} (1 - w_i \varepsilon_{iy})}{\eta_{ii} + w_i \varepsilon_{iy}} \quad \text{(money flexibility)} \tag{5.16}$$

Further, with regard to money flexibility ($\bar{\Phi}$), Frisch defined the following criteria:

If $\bar{\Phi}$ = -10, for an extremely poor and apothic part of the population

$\bar{\Phi}$ = -4, for slightly better off but still poor part of the population

$\bar{\Phi}$ = -2, for middle income bracket "the median part" of population

$\bar{\Phi}$ = -.7, for better off of the population, and

$\bar{\Phi}$ = -.1, for the rich part of population with ambition toward "conspicuous consumption".

According to Frisch, if a value of $\bar{\Phi}$ is known, equation (5.12) may be used to obtain estimates of cross elasticities under want independence ($\sigma_{ij} = 0$). Money flexibility may be estimated from equation (5.15) for any commodity where the direct-price and income elasticity are known. Further, estimates for various commodities or commodity groups should give similar values of $\bar{\Phi}$ if the assumption of want independence is satisfied. Therefore, if all income elasticities, expenditure weights, and a direct-price elasticity for a single good are known, the remaining parameters can be estimated.

The assumption of want independence for all commodities implies complete additivity of the direct utility function, or:

$$U(q_1, q_2, \ldots, q_n) = U_1(q_1) + U_2(q_2) + \ldots + U_n(q_n) \qquad (5.14)$$

Houthakker (1961) refers to this case of independent utilities as "direct additivity" and shows that the cross derivatives of demand are proportional to the derivatives with respect to income. Therefore, under independent utilities, the commodities are still related through the budget restraint but with demand interrelationships of a much less complex form than with conventional theory when complete dependence is permitted.

Application of Aggregate Demand Estimation to Indonesia

The most important conclusion to be drawn from the preceding discussion of the Frisch method is clear. To obtain a reliable estimate of $\overline{\Phi}$ (Frisch parameter), we need only direct price elasticity of a single good and income elasticities of all goods. Thus, knowing all income elasticities, expenditure weights, and the direct price elasticity of a single good, all remaining parameters can be estimated.

Representative income elasticities in Table XVI and the direct price elasticity for rice were obtained from Gupta (1977) and Johnson et al. (1986). These were combined with budget shares (w_i) from the 1980 SAM to calculate all parameters needed for developing a demand system.

The estimates of aggregate demand parameters, ordinary and compensated demand, are presented in Table XVII and Table XVIII for the agricultural laborer household class. Similar data are presented for all other household classes in Appendix A. All estimated direct price elasticities are negative, indicating an inverse relationship between consumption and price. Further, all estimated income elasticities are positive. This implies that all commodities may be classified as normal goods. An increase in household income will increase quantity of commodity demanded, and vice versa.

The estimated income flexibility or Frisch parameters ($\overline{\Phi}$) vary across the household classes as follows: -4.28383 for agricultural laborers, -3.31512 agricultural operators, -2.99857 for non-agricultural rural-low, -2.6423 for non-agricultural rural high, -0.88968 for urban-low, and -0.47272 for urban-high. These results are very consistent with the Frisch criteria.

Comparing all compensated cross-price elasticities (η_{ij}^{s}) across all household classes, it is interesting to note that all η_{ij}^{s} are positive, indicating substitute relationships among all goods. In other words, when price of non-paddy increases (decreases) all households will respond to increases (decreases) in the quantity of paddy demanded. These results are consistent with economic theory. Thus, based on the estimated compensated price elasticities (η_{ij}^{s}), it is concluded that all households have the same type of consumption behavior. However, because of the income effects ($\omega_j \varepsilon_{iy}$), the sign of ordinary cross-price elasticities (η_{ij}) for lower income groups (agricultural laborers, agricultural operators, rural-low, and rural-high) are negative, indicating gross complementary relationships among all goods. Ordinary cross-

TABLE XVI

REPRESENTATIVE EXPENDITURE ELASTICITIES BY HOUSEHOLD GROUP USED IN THE PRESENT STUDY, INDONESIA

Commodity/ Household Group	Per Capita Income, 1980 (Thousand Rp./Year)	Expenditure Elasticities	Sources
Paddy:			
1. Agricultural Laborers	119.73	0.67000	Johnson et al.
2. Agricultural Operators	149.67	0.67000	Johnson et al.
3. Rural-Low	180.44	0.67000	Johnson et al.
4. Rural-High	259.83	0.58080	Johnson et al.
5. Urban-Low	335.95	0.55240	Johnson et al.
6. Urban-High	465.86	0.23550	Johnson et al.
Food Non-paddy:			
1. Agricultural Laborers	119.73	1.14768	Johnson et al.
2. Agricultural Operators	149.67	1.14768	Johnson et al.
3. Rural-Low	180.44	1.14768	Johnson et al.
4. Rural-High	259.83	1.14768	Johnson et al.
5. Urban-Low	335.95	1.12746	Johnson et al.
6. Urban-High	465.86	1.12746	Johnson et al.
Agriculture Non-Food			
1. Agricultural Laborers	119.73	1.43360	Gupta
2. Agricultural Operators	149.67	1.43360	Gupta
3. Rural-Low	180.44	1.43360	Gupta
4. Rural-High	259.83	1.43360	Gupta
5. Urban-Low	335.95	1.43360	Gupta
6. Urban-High	465.86	1.43360	Gupta
Mining, Industry, etc.			
1. Agricultural Laborers	119.73	1.27493	Gupta
2. Agricultural Operators	149.67	1.27493	Gupta
3. Rural-Low	180.44	1.27493	Gupta
4. Rural-High	259.83	1.27493	Gupta
5. Urban-Low	335.95	1.27493	Gupta
6. Urban-High	465.86	1.27493	Gupta
Chemical			
1. Agricultural Laborers	119.73	1.0220	Gupta
2. Agricultural Operators	149.67	1.0220	Gupta
3. Rural-Low	180.44	1.0220	Gupta
4. Rural-High	259.83	1.0220	Gupta
5. Urban-Low	335.95	1.0220	Gupta
6. Urban-High	465.86	1.0220	Gupta

TABLE XVII

BUDGET SHARE, INCOME ELASTICITIES, ORDINARY OWN- AND CROSS-PRICE ELASTICITIES FOR AGRICULTURAL LABORER HOUSEHOLDS, INDONESIA

Commodities	Budget Share	Income Elasticity	Share*Income Elasticity	Elasticities							Total Elasticities
	w	ε	w*ε	Paddy	Nonpaddy	Nonfood	Mindustel	Chemical	Transcomm	Service	
Paddy	0.25725	0.67000[a]	0.17235	-0.30180	-0.25766	-0.04331	-0.01978	-0.00440	-0.01170	-0.03134	-0.67000
Nonpaddy	0.52529	1.14768[a]	0.60287	-0.24906	-0.70926	-0.07419	-0.03389	-0.00754	-0.02005	-0.05369	-1.14768
Nonfood	0.09716	1.43360[b]	0.13929	-0.31111	-0.55131	-0.42733	-0.04233	-0.00942	-0.02504	-0.06707	-1.43360
Mindustel	0.04204	1.27493[b]	0.05359	-0.27668	-0.49029	-0.08242	-0.33526	-0.00837	-0.02227	-0.05964	-1.27493
Chemical	0.00884	1.10220[b]	0.00975	-0.23919	-0.42386	-0.07125	-0.03254	-0.26453	-0.01925	-0.05156	-1.10220
Transcomm	0.01887	0.31899[c]	0.00602	-0.06922	-0.12267	-0.02062	-0.00942	-0.00210	-0.08004	-0.01492	-0.31899
Service	0.05054	0.31899[c]	0.01612	-0.06922	-0.12267	-0.02062	-0.00942	-0.00210	-0.00557	-0.08939	-0.31899
Total	1.00000		1.00000								

Frisch Parameter (Φ) = -4.28383

[a] Obtained from Johnson et al. (1986)
[b] Obtained from Gupta (1977)
[c] Recalculated using Engel Aggregation

TABLE XVIII

COMPENSATED OWN- AND CROSS-PRICE ELASTICITIES FOR AGRICULTURAL LABORER HOUSEHOLDS, INDONESIA

Commodities	Compensated Own- and Cross-Price Elasticities							Total Elasticities
	Paddy	Nonpaddy	Nonfood	Mindustel	Chemical	Transcomm	Service	
Paddy	-0.12945	0.09429	0.02179	0.00838	0.00152	0.00094	0.00252	0.00000
Nonpaddy	0.04618	-0.10640	0.03732	0.01436	0.00261	0.00161	0.00432	0.00000
Nonfood	0.05768	0.20175	-0.28804	0.01794	0.00326	0.00201	0.00540	0.00000
Mindustel	0.05130	0.17942	0.04146	-0.28166	0.00290	0.00179	0.00480	0.00000
Chemical	0.04435	0.15511	0.03584	0.01379	-0.25478	0.00155	0.00415	0.00000
Transcom	0.01283	0.04489	0.01037	0.00399	0.00073	-0.07401	0.00120	0.00000
Service	0.01283	0.04489	0.01037	0.00399	0.00073	0.00045	-0.07326	0.00000

price elasticities for high income groups (urban-low and urban-high) are positive, indicating gross substitution relationships among those goods[1]. This result infers that the total effect of any changes in non-paddy price are different across all households. For lower income groups such as agricultural laborers, production workers, rural-low, and rural-high, for example, an increase in non-paddy price will lead to a decrease in quantity of paddy consumed, while higher income groups (urban-low and urban-high) tend to increase quantity of paddy demanded.

Compared with the study by Johnson and Meyer (1986), these results are consistent. For example, for rural households, Johnson and Meyer found, in general, negative ordinary cross-price elasticities among all goods, indicating gross-complementary relationships among those food commodities (Table XIX).

Even though empirical results show different patterns of ordinary cross-price elasticities (η_{ij}), these patterns may not reduce the usefulness of the results for developing applied general equilibrium models such as used in the present study. The demand parameters satisfy the following conditions: (1) homogeneity; (2) Cournot aggregation; (3) Engel aggregation; and (4) Symmetry. These conditions are critical for developing the Indonesia general equilibrium model.

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[1]Slutsky defines the following relationship:

$$\eta_{ij} = \eta_{ij}^{s} - \omega_j \varepsilon_{iy}$$

where: η_{ij} = ordinary price elasticities (total effect)

η_{ij}^{s} = compensated price elasticities

ε_i = income elasticities

ω_j = budget share

TABLE XIX

A MATRIX OF FOOD DEMAND ELASTICITIES FOR RURAL HOUSEHOLDS, INDONESIA

Commodities	Own- and Cross-Price Elasticities						
	Rice	Palawija	Beans	Fruit and Vegetables	Fish	Meat and Dairy Products	Others
Rice	-.2408	–	-.823	-.0525	–	-.0080	-.1030
Palawija	–	-1.0867	–	–	-.1028	.0840	.2988
Beans	-1.1810	–	-.7575	-.4009	.1807	.0213	–
Fruit and Vegetables	-.3554	–	-.0966	-.8107	.0955	.0016	.0129
Fish	–	-.0.0739	.0660	.1214	-.7482	–	.1623
Meats, Poultry and Dairy Products	-.5643	-0.0125	-.0155	-.1071	–	-.9897	.0875

Source: Adapted from Johnson et al. (1986). Evaluating Food Policy in Indonesia Using Full Demand Systems, Agriculture and Rural Development, Iowa State University.

CHAPTER VI

CONSTRUCTION AND VALIDATION OF THE APPLIED GENERAL EQUILIBRIUM MODEL

The main components of any general equilibrium model are given in Hazell and Norton (1986) as: (1) a technology and producer behavior specification, including resource limitations; (2) commodity balances for market clearing; (3) a description of how income is formed and distributed; and (4) a representation of consumer demand behavior. *

The central purpose of this chapter is, therefore, to present and discuss these four model components and data sources for construction of the applied general equilibrium model (GEM) for Indonesia as outlined in Chapter IV. This chapter also presents a validation of the model. A discussion of alternative policy formulations of the Bimas program for purposes of improving social and rural welfare is presented in Chapter VII.

Model Components and Data Sources

Technology and Producer Behavior Specification

For Indonesia, structure of the applied GEM is determined by data available in the form of a SAM. Fortunately, all categories of production in the SAM are appropriate for this type of study. Activity analysis specification of paddy Bimas production has been used, i.e. input-output production vectors with variations by technology, which in this case are based on the level of capital and labor used for a given fertilizer use under subsidy (Table XX). For example, base technology is defined as a combination of 805.75 billion rupiahs capital and 1512.61 billion rupiahs of labor used in paddy Bimas for a 37.5 percent subsidy of fertilizer, fertilizer use of 187.87 billion rupiahs, and output of 2,604.00 billion rupiahs. Other technologies defined are shown in Table XX.

The model, therefore, specifies factor input to paddy Bimas production on the basis of these vectors, and then factor prices combined with the level of resource endowment ($\overline{b}_{fh}$) give values for factor incomes. Estimates of production parameters and a grid linearization for setting capital (K) and labor (L) inputs are presented in Appendix D. Production functions for all other sectors are assumed to be determined by a Leontief production function which permits zero substitution among inputs. The Leontief production functions are taken directly from the Indonesian SAM.

<u>Commodity Balances for Market Clearing</u>

As shown in the SAM, there are seven commodity balances in the model, i.e. three for agriculture (rice, food non-rice, and agriculture non-food) and four for the non-agricultural sectors (mining and industry, chemical and fertilizer, transport and communication, and services). Each commodity balance provides for market clearing, abstracting from short-run inventory fluctuation. As shown in equation (4.2), six of the commodity balances can be expressed as total domestic production, plus trade and transport margin, plus indirect taxes, and plus imports. This supply of total commodity must be equal to the total source of demand: intermediate input-output demand, household consumption, government consumption, capital formation, and exports. For the trade and transport margin sector, the commodity balance equation is expressed as total

TABLE XX

CAPITAL AND LABOR USED IN BASE SAM PADDY BIMAS PRODUCTION AND 37.5 PERCENT FERTILIZER SUBSIDY, INDONESIA, 1980

Notation	Capital (Billion Rp.)	Labor (Billion Rp.)	Explanation
XRICETO	805.75	1512.61	Base Technology
XRICET1	646.45	1700.00	Technology 1
XRICET2	524.63	1900.00	Technology 2
XRICET3	423.77	2100.00	Technology 3

Note: Base technology is the current technology used in the base 1980 SAM. The alternative technologies are based on different combinations of capital and labor use. See Appendix D for additional activities.

domestic production, plus trade and transport margin, plus indirect taxes, and plus imports. This supply must be exactly equal to total demand: intermediate input-output demand, household consumption, government consumption, investment (capital goods), and total trade and transport margin. Each equation in (4.2) and (4.3) is expressed in constant price terms and is an equality which in principle allows free disposal of excess supply.

The quantity parameters, θ_{ihs}, of the segmented demand functions are estimated directly using the base SAM quantity and the direct price elasticity. These values are computed below as part of the objective function. The a^{*}_{ijt} coefficients of the Leontief (I - A) matrix are obtained from the input-output transaction table in the base SAM. These coefficients are presented in Table XXI.

Household Income Formation

As shown in the base SAM, household income is formed on the basis of domestic factor income shares, income from abroad, household transfer payments, company transfer payments, and government transfer payments. To simplify the model it has been assumed that all transfer payments are treated as exogenous (fixed or policy) variables. Therefore, in the short-run income formation for any household class is not affected by income changes in any other household class.

The parameters $\overline{b}_{fh}$ (initial endowment of factor f held by households h) are obtained directly from the base SAM, i.e. intersection between columns of factors of production and rows of institutions.

TABLE XXI

THE LEONTIEF (I-A) COEFFICIENTS, 1980, INDONESIA

Commodity	Paddy (Bimas)	Production Sectors						
		Paddy (Non-Bimas)	Food Non-Paddy	Agriculture Non-Food	Mindustel	Chemfert	Transcomm	Service
	14	15	16	17	18	19	20	21
23. Rice	0.97866	0.97990	-0.01413	0.00000	-0.00070	0.00000	0.00000	0.00000
24. Food Non-Rice	-0.00192	-0.00180	0.64017	-0.00137	-0.00221	-0.00519	-0.06432	-0.01294
25. Agriculture Non-Food	-0.00008	-0.00008	-0.08268	0.84860	-0.03736	-0.01279	-0.00581	-0.00021
26. Mining, Industry, Gas, etc.	-0.00411	-0.00390	-0.02893	-0.02893	0.81014	-0.40055	-0.04627	-0.03243
27. Chemical and Fertilizer	-0.07215	-0.05658	-0.01634	-0.03450	-0.12506	0.79020	-0.07756	-0.05282
28. Trade, Transport & Commun.	-0.00037	-0.00034	-0.00254	-0.01986	-0.01056	-0.01159	0.92575	-0.01797
29. Services	-0.00973	-0.00915	-0.00834	-0.01371	-0.02065	-0.01515	-0.03353	0.97007

Representation of Demand Behavior

The applied general equilibrium model discussed here utilizes a demand system which satisfies the Cournot and Engel aggregation, symmetry, and homogeneity conditions. The later condition states that demand functions must be homogeneous of degree zero in prices and income. Therefore, for this purpose, these demand parameters have been estimated using the Frisch method. The results of these estimates were presented in Chapter V.

Identification of Policy Variables

In developing an applied GEM for this study, the general objective was to be able to analyze the economic impact of policy changes for different socio-economic groups in Indonesia. Among the policies, reduced fertilizer subsidy to paddy Bimas producers was a major concern. The reason is that in 1980, the government spent about 83.60 billion rupiahs on fertilizer subsidy to paddy Bimas producers (Sastrohoetomo, 1984). Therefore, the agricultural sectors are treated in more detail than the non-agricultural sectors. Other policy variables analyzed are: (1) an increase in government transfer payments to households, (2) an increase in agricultural employment, and (3) an increase in agricultural non-food exports . These policy variables are discussed further in Chapter VII.

Setting the Objective Function

The objective function of the programming model is the algebraic sum of the value of final consumption plus value of export sales minus factor costs. This is referred to as the "net social surplus". The objective function maximizes the area under the marginal revenue function when marginal revenue is defined as price. Market clearing is assured under competitive conditions rather than monopolistic conditions because of marginal cost pricing.

It is apparent that the objective function of the maximization model is non-linear. Grid linearization is thus used in model solution following Norton and Scandizzo (1981; 1986). Grid linearization requires prior specification of the relevant range of values for the demand and revenue functions. It also requires use of variables that represent interpolation weights among predetermined grid points. The interpolation grid becomes the variables in the model and their values are jointly constrained by a set of convex combination constraints.

For the linearized demand function, the steps required for calculating the values in the tableau can be described briefly. Excluding the cross-price effects, the starting parameter values needed for each demand function are three: (1) the own-price elasticity (η_j), (2) the initial price (P_{jo}), and (3) the initial quantity (Q_{jo}).

The first step is to calculate the parameter α_j (intercept) and β_j (slope) of the linearized inverse demand function as follows:

$$\beta_j = -\frac{dP_j}{dQ_j} = -\frac{P_{j0}}{\eta_j Q_{j0}} > 0 \tag{6.1}$$

and

$$\alpha_j = P_{j0} + \beta_j Q_{j0} > 0 \tag{6.2}$$

The second step is to determine the relevant range of the demand function. Hazell and Norton (1986) suggest that a range of $(P_j^l, P_j^u) = (.5P_{j0}, 2 P_{j0})$ is adequate. Following their procedures, the range is then translated to the quantity axis:

$$Q_j^l = \frac{\alpha_j - P_j^u}{\beta_j} \tag{6.3}$$

$$Q_j^u = \frac{\alpha_j - P_j^l}{\beta_j} \tag{6.4}$$

The third step is to establish the length of segments between points on the demand function; that length depends upon Q_j^l, Q_j^u, and the number of segments. In this study, the number of segments is set equal to 10. The segment length is then calculated using the following formula:

$$k_j = \frac{Q_j^u - Q_j^l}{n-1} \tag{6.5}$$

where n is the number of segments. The quantities at each point on the demand function are:

$$\theta_{jo} = Q_j^l.$$

$$\theta_{j1} = Q_j^l + k_j$$

$$\theta_{j2} = Q_j^l + 2k_j$$

.
.
.

$$\theta_{j9} = Q_j^l + 9k_j = Q_j^u \tag{6.6}$$

Finally, the value of revenue (ρ) is calculated on the basis of the following information:

$$\rho_{js} = \alpha_j \theta_{js} - \beta_j \theta_{js}^2 \tag{6.7}$$

The results of the calculation of these segments for all household classes in terms of quantity and revenue for rice are presented in Table XXII. Similar results for other commodities are given in Appendix B.

For purpose of illustration, a portion of the initial tableau of the applied GEM is presented in Appendix B. A portion of the initial coefficients of the applied GEM associated with SAM are presented in Table XLIII (Appendix B).

Validation of the Applied GEM for Indonesia

Once the model is constructed, the first step is to test it against the base SAM data set. If the model is correctly specified it should reproduce the base SAM data exactly. This test does not constitute a statistical "validation" but rather simply confirms that the model was correctly specified and any unintentional errors have been removed. Otherwise the solution will tend to depart significantly from the base SAM data set.

After validation of the model has been done, experiments can be conducted in a comparative static mode. The experiments may refer to an exogenous change -- such as a new level of fertilizer subsidy, agricultural non-food exports, or expansion of agricultural employment. In each experiment, a model parameter or exogenous variable is altered and the model is solved again. The new solution refers to a new equilibrium toward which the economy would tend, but, as in all comparative static analyses, there is no assurance that the economy actually would arrive at the new equilibrium because other changes may intervene in the meantime. Nevertheless, from the view point of policy analysis, it is useful to compare alternative new equilibria toward which the economy might be pushed by different policy alternatives.

TABLE XXII

QUANTITY AND REVENUE OF SEGMENTED DEMAND FOR RICE BY TYPE OF HOUSEHOLD

		Type of Household					
Segment	Quantity (Q) Revenue (ρ)	Agricultural Laborers	Agricultural Operators	Rural Low	Rural High	Urban Low	Urban High
1	Q (Billion Rp.)	154.73878	711.98875	281.03904	67.77584	159.70473	59.78472
	ρ (Billion Rp.)	464.21635	2135.96624	843.11711	203.32751	319.40947	119.56944
2	Q	187.46398	862.56491	340.47506	82.10953	206.63648	69.84093
	ρ	510.31861	2348.09336	926.84878	223.52028	378.83354	128.04171
3	Q	220.18918	1013.14107	339.91108	96.44322	253.56822	79.89715
	ρ	538.24021	2476.56705	977.56042	235.75008	422.61370	133.16191
4	Q	252.91437	1163.71723	459.34711	110.77691	300.49997	89.95336
	ρ	547.98114	2521.38733	995.25206	240.01663	450.74995	134.93004
5	Q	285.63957	1314.29339	518.78313	125.11059	347.43171	100.00957
	ρ	539.54141	2482.55418	979.92369	236.32001	463.24228	133.34610
6	Q	318.36477	1464.86955	578.21915	139.44428	394.36346	110.06579
	ρ	512.92101	2360.06760	931.57530	24.66023	460.09070	128.41008
7	Q	351.08996	1615.44571	637.65517	153.77797	441.29520	120.12200
	ρ	468.11995	2153.92761	850.20690	205.03730	441.29520	120.12200
8	Q	383.81516	1766.02187	697.09120	168.11166	448.22694	130.17821
	ρ	405.13823	1864.13419	735.81848	177.45120	406.85579	108.48184
9	Q	416.54036	1916.59803	756.52722	182.44535	535.15869	140.23443
	ρ	323.97583	1490.68736	588.41006	141.90194	356.77246	93.48962
10	Q	449.26555	2067.17419	815.96324	196.77904	582.09043	150.29064
	ρ	224.63278	1033.58709	407.98162	98.38952	291.04522	75.14532

Results from validation of the Indonesia applied general equilibrium model are presented in Table XXIII. It is interesting to note that household income and public real income in this solution are almost identical to their corresponding values in the SAM. All commodity prices and factor prices are unity. All production levels show only minor discrepancies from their corresponding values in the base SAM 1980. These discrepancies arise because of rounding errors in some of the model's coefficients. However, in general, the solution of the GEM is almost identical to the base SAM. This implies that the applied GEM has been correctly specified and all errors removed. Thus the model is ready for comparative static experiments which are discussed in Chapter VII.

TABLE XXIII

VALIDATION RESULTS OF THE GENERAL EQUILIBRIUM MODEL FOR INDONESIA (COMPARISON BETWEEN GEM SOLUTION AND BASE SAM 1980)

Items	Base SAM 1980	GEM Solution
Input Prices (Indices)		
1. Agricultural Laborers	1.00000	1.00000
2. Production Workers	1.00000	1.00000
3. Sales and Services	1.00000	1.00000
4. Professional and Management	1.00000	1.00000
5. Capital	1.00000	1.00000
Household Real Income (Billion Rupiahs)		
6. Agricultural Laborers	1622.88231	1622.88000
7. Agricultural Operators	11277.30000	11277.30000
8. Non-agricultural Rural-low	5370.48000	5370.48000
9. Non-agricultural Rural-high	1970.91000	1970.91000
10. Urban-low	6337.41000	6337.41000
11. Urban-high	4593.30000	4593.30000
Total household Income	31172.28231	31172.28000
Institutional Real Income		
12. Private Companies	17890.28000	17890.23000
13. Government Revenue	10240.23000	10240.01000
Production (Billion Rupiahs)		
14. Paddy (Bimas)	2604.00058	2604.00000
15. Paddy (Non-Bimas)	377.19298	377.24000
16. Food Non-paddy	14022.64084	14021.89000
17. Agricultural Non-food Crops	5035.34000	5032.26000
18. Mining, Industry, Gas, etc.	27823.95000	27829.36000
19. Chemical and Fertilizer	4899.75000	4892.25000
20. Trade, Transposrt and Communication	14567.67000	14555.79000
21. Services	7314.70000	7312.44000
Commodity Prices (Indices)		
23. Rice	1.00000	1.00000
24. Food Non-rice	1.00000	1.00000
25. Agricultural Non-food	1.00000	1.00000
26. Mining, Industry, Gas, etc.	1.00000	1.00000
27. Chemical and Fertilizer	1.00000	1.00000
28. Trade, Transport and Communication	1.00000	1.00000
29. Services	1.00000	1.00000
Aggregate Price Index	1.00000	1.00000
Government Account (Billion Rupiahs)		
31.1. Government Expenditure	10240.23000	10240.01000
31.2. Indirect Tax minus Subsidy	402.24000	402.13497
31.3. Fertilizer Subsidy	83.68000	83.68000
Rest of the World (Billion Rupiahs)		
32.1. Commodity Imports	9903.91935	9903.40000
32.2. Commodity Exports	16162.16000	16162.16000
32.3. ROW Transactions	16426.11000	16426.11000
Rice Consumption (Billion Rupiahs)		
33.1. Agricultural Laborers	390.36020	390.35140
33.2. Agricultural Operators	1796.13710	1796.11940
33.3. Non-agricultural Rural-low	708.78400	708.77840
33.4. Non-agricultural Rural-high	170.97840	170.97839
33.5. Urban-low	441.29520	441.29519
33.6. Urban-high	120.12200	120.12200
Per Capita Household Income (Thousand Rupiahs)		
34.1. Agricultural Laborers	119.73000	119.72900
34.2. Agricultural Operators	149.67000	149.67000
34.3. Non-agricultural Rural-low	180.44000	180.44000
34.4. Non-agricultural Rural-high	259.83000	259.83000
34.5. Urban-low	355.95000	355.95000
34.6. Urban-high	816.13000	816.13000

CHAPTER VII

POLICY SIMULATIONS USING THE APPLIED GENERAL EQUILIBRIUM MODEL

Construction and validation of the Applied General Equilibrium Model were presented and discussed in the preceding chapter. This chapter presents alternative policy simulation experiments and analyzes the impacts on factor prices, commodity prices, sector production, household and institutional income, trade, government accounts, and basic nutrition. It further evaluates the impact of policy on the Bimas program. For purposes of policy formulation, the following six policy simulations are presented and discussed:

Policy Simulation I: reduced fertilizer subsidy for Bimas and all commodity exports held at base SAM levels.

Policy Simulation II: same as Policy Simulation I but with increased government transfers to households equal to reduced cost of fertilizer subsidy.

Policy Simulation III: same as Policy Simulation I but with commodity exports determined endogenously.

Policy Simulation IV: same as Policy Simulation III but with increased government transfers to households equal to reduced cost of fertilizer subsidy.

Policy Simulation V: same as Policy Simulation III but with the assumption of disequilibrium in the base SAM for the agricultural labor market.

Policy Simulation VI: reduced fertilizer subsidy for Bimas, food non-rice exports held constant at the base SAM level, and agricultural non-food exports increased at constant international prices.

Policy Simulations

Policy Simulation I: Reducing Fertilizer Subsidy and Holding Commodity Exports Constant

This policy simulation reduces the level of fertilizer subsidy to Bimas producers and treats all commodity exports fixed at the base SAM level. The objective of this policy simulation is to analyze the impact of reducing fertilizer subsidy to paddy (Bimas) producers on overall rice production, sector output, factor and commodity prices, household and institutional income, government revenue and expenditure, trade, and basic nutrition.

Results of this simulation are presented in Table XXIV. The first solution is the model's replication of the base SAM. The other solutions simulate the progressive effects of a reduction in the level of fertilizer subsidy to Bimas paddy producers. The initial effect of a decrease in fertilizer subsidy is an increase in private cost of paddy production by Bimas producers. Since fertilizer costs are about 7 percent of total costs of paddy production, total elimination of fertilizer subsidy increases cost of paddy by about 9 percent.

The reduction in fertilizer subsidy causes all factor prices to increase. In general, input prices are expected to increase with fixed resources and a

TABLE XXIV

GENERAL EQUILIBRIUM RESULTS (INDICES)FOR INDONESIA, POLICY SIMULATION I: REDUCED FERTILIZER SUBSIDY AND CONSTANT COMMODITY EXPORTS

Items	Fertilizer Subsidy (Percent)			
	37.5	25	15	0
Input Prices				
1. Agricultural Laborers	1.00000	1.00799	1.01675	1.02532
2. Production Workers	1.00000	1.01574	1.01823	1.02698
3. Sales and Services	1.00000	1.00339	1.01225	1.01992
4. Professional and Management	1.00000	1.01583	1.01824	1.02785
5. Capital	1.00000	1.05740	1.08295	1.15340
Household Real Income[a]				
6. Agricultural Laborers	1.00000	0.95412	0.94883	0.92462
7. Agricultural Operators	1.00000	0.97551	0.97405	0.97382
8. Non-agricultural Rural-low	1.00000	0.97108	0.96634	0.96379
9. Non-agricultural Rural-high	1.00000	0.96757	0.95031	0.93820
10. Urban-low	1.00000	0.97643	0.96223	0.95426
11. Urban-high	1.00000	0.97592	0.95708	0.94218
Total Household Income	1.00000	0.97338	0.96501	0.95864
Institutional Real Income[a]				
12. Private Companies	1.00000	1.00050	1.00481	1.02826
13. Government	1.00000	1.00089	1.00160	1.01455
Production				
14. Paddy (Bimas)	1.00000	0.98563	0.97609	0.96386
15. Paddy (Non-Bimas)	1.00000	1.00697	1.01180	1.04170
16. Food Non-paddy	1.00000	0.94093	0.93976	0.88303
17. Agricultural Non-food Crops	1.00000	0.98791	0.98412	0.96868
18. Mining, Industry, Gas, etc.	1.00000	1.01735	1.02138	1.03857
19. Chemical and Fertilizer	1.00000	1.00222	1.00747	1.01105
20. Trade, Transport and Communication	1.00000	0.98889	0.98267	0.97882
21. Services	1.00000	0.99567	0.99360	0.99147
Total Gross Output	1.00000	0.99186	0.99152	0.98539
Commodity Prices				
23. Rice	1.00000	1.02562	1.04016	1.07062
24. Food Non-rice	1.00000	1.10081	1.11452	1.15830
25. Agricultural Non-food	1.00000	1.04379	1.06433	1.11742
26. Mining, Industry, Gas, etc.	1.00000	1.04942	1.07085	1.12993
27. Chemical and Fertilizer	1.00000	1.04877	1.06975	1.12783
28. Trade, Transport and Communication	1.00000	1.03722	1.05326	1.09696
29. Services	1.00000	1.03114	1.04460	1.07982
Aggregate Price Index[b]	1.00000	1.06179	1.07742	1.12106
Capital Account				
30. Savings (Nominal)	1.00000	1.00900	1.01260	1.03570
Government				
31.1. Subsidy Cost	1.00000	0.65710	0.33517	0.00000
31.2. Total Expenditures (Nominal)	1.00000	1.01804	1.02575	1.05042
Rest of World				
32.1. Total Commodity Imports	1.00000	0.99186	0.99152	0.98539
32.2. Total Commodity Exports	1.00000	1.00000	1.00000	1.00000
Rice Consumption				
33.1. Agricultural Laborers	1.00000	0.98249	0.95494	0.93992
33.2. Agricultural Operators	1.00000	0.99293	0.98921	0.97809
33.3. Non-agricultural Rural -low	1.00000	0.98776	0.97792	0.97302
33.4. Non-agricultural Rural-high	1.00000	0.98509	0.97209	0.95449
33.5. Urban-low	1.00000	0.99403	0.98599	0.96792
33.6. Urban-high	1.00000	0.97518	0.95601	0.92766

[a]Household and institutional income are deflated by the aggregate price index.

[b]Computed as the sum of nominal price indices weighted by the base year average budget share of the commodity in national consumption.

reduction in fertilizer subsidy. The price of capital, for example, increases from 1.00 in the base solution to 1.1534 (a 15.3 percent increase) when fertilizer subsidy is reduced to zero. Factor prices for labor increase from 2.0 percent to 2.8 percent, depending on the type of labor, with a complete reduction in fertilizer subsidy. The significant impact on capital is due in part to land rents which are classified as returns to capital. As a result of the reduction in fertilizer subsidy, the demand for capital (including land) and labor shift to the right, thus increasing all factor prices

Economic theory suggests that increases in all factor prices means a shift to the left in the supply functions. Thus, given constant commodity demand functions, reducing the fertilizer subsidy increases the total private costs of producing all commodities, shifting the supply functions to the left, and causes all commodity prices to increase. As shown in Table XXIV, removing all fertilizer subsidy (zero subsidy) causes the commodity prices of rice, food non-rice, agriculture non-food, mining and industry, chemical and fertilizer, transport and communication, and services to increase by 7.1 percent, 15.8 percent, 11.7 percent, 12.9 percent, 12.8 percent, 9.7 percent, and 8.0 percent, respectively, The aggregate price index increases by 12.1 percent.

Interestingly, the price of rice increased less than the aggregate price index, while the price of food non-rice and agriculture non-food increased more than the price of rice and the price of food non-rice increased more than the aggregate price index. There are several reasons why the price of rice increases less than the price of other commodities even though the initial effect of a reduction in fertilizer subsidy is an increase in cost of paddy production by Bimas producers:

1. Factor income proportions in rice production (both Bimas and non-Bimas) are greater for labor than for capital (see Table XV) and factor prices increase much less for labor than for capital.

2. Capital-labor substitutions are allowed with paddy Bimas production but not for the other commodities. This is a limitation of the current model but should not be an overwhelming factor in contributing to commodity price increases.

3. Income decreases are greatest for agricultural laborers and it is this group that has the highest budget share for rice (.25) and the highest income elasticity of demand for rice (.67) (see Table XVII). Thus, with a greater than average decrease in income for this group there is a corresponding greater than average decrease in the demand for rice. In fact, rice consumption decreases by 6 percent for this group which is the highest percentage decrease except for the urban high-income group where the budget share is small but the price elasticity is relatively high.

4. Paddy production can be shifted to non-Bimas producers where the labor-capital ratio is higher than for the Bimas producers. In fact, paddy production by Bimas producers decreases by 4 percent and increases for non-Bimas producers by the same percentage. Total paddy production, however, decreases by about 2.6 percent.

In the case of food non-rice and agriculture non-food, which are classified as tradeable goods, the dramatic increase in price is explained by the market assumptions for these commodities. Assume two separate markets for these commodities, a domestic market and an export market (see Figure 2).

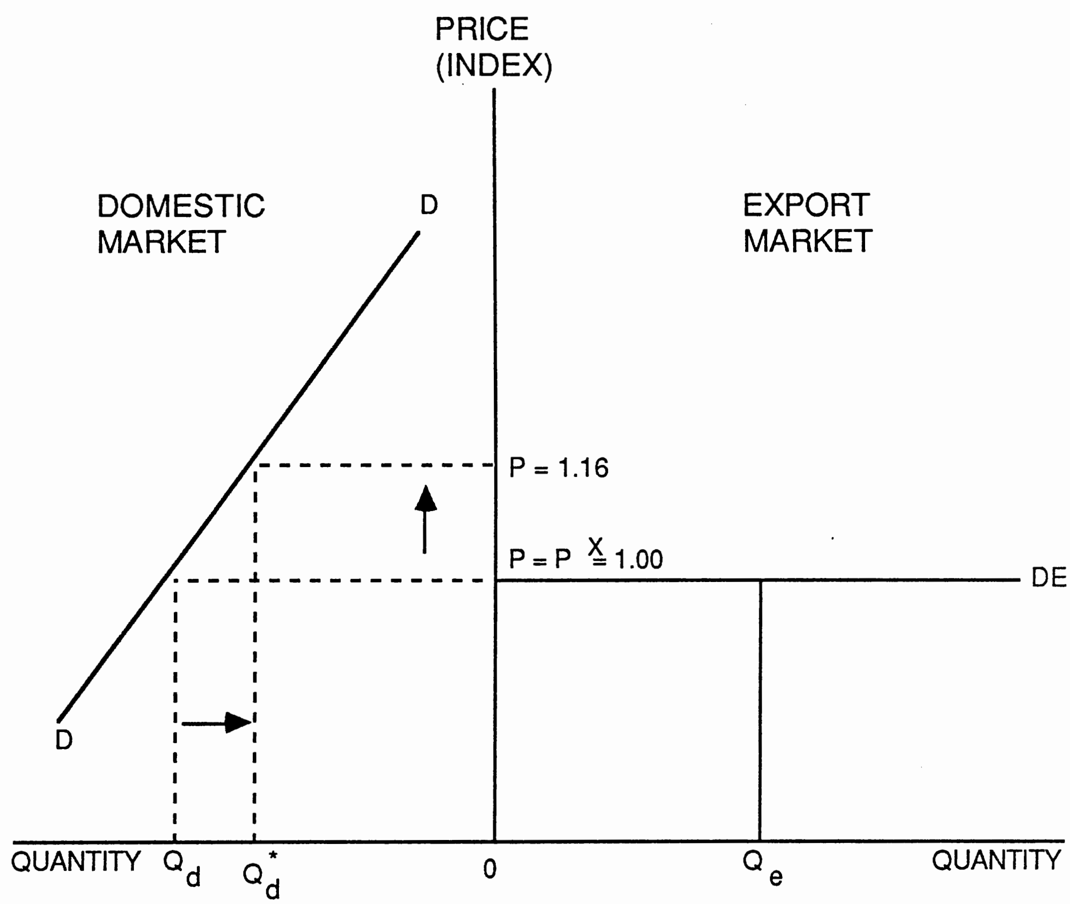

Figure 2. Commodity Prices in the Domestic and Export Markets

The demand curve for the domestic market is represented by DD, while the demand curve for the export market is DE, which is assumed to be perfectly elastic. This assumption is valid for small countries like Indonesia where expansion and contraction of commodity exports do not influence world markets significantly. As discussed earlier, for the base solution, domestic prices and world prices are the same, i.e. equal to 1.00. Quantities sold in the domestic and world markets are equal to the values in the base SAM. Thus, $Q_d + Q_e$ is the total quantity sold in both markets and is assumed equal to domestic production plus non-competitive imports (no excess supply).

As shown in Table XXIV, a reduction in the total level of fertilizer subsidy to Bimas paddy producers causes output of food non-rice to decrease by 12 percent and the output of agriculture non-food to decrease by 3 percent. This implies a reduction in total supply for both commodities. Holding the total commodity exports constant at the base SAM level and reducing total supply causes a significant reduction in quantity sold in the domestic market. This is represented by a movement from Q_d to Q_d^* in the domestic market (Figure 2). Consequently, with world price remaining at 1.00, domestic price increases. This price increase is 15.8 percent for food non-rice and 11.7 percent for agriculture non-food. Adoption of this policy hurts domestic consumers since they must pay higher prices for those commodities. Policy Simulation III, to be discussed later, removes this constraint and allows commodity exports to be determined endogenously.

The impact of a reduction in the level of fertilizer subsidy to Bimas paddy producers on household real income is found to vary across the household classes. All household classes experienced a reduction in income. Impact on incomes can largely be explained by the relative factor income shares.

Aggregate labor and capital income shares for the household classes are shown in Table XXV. Agricultural laborers had the largest income reduction at about 8 percent and it is the group with the highest aggregate labor income share. Agricultural operators had the lowest income reduction at 3 percent and it had the lowest aggregate labor income share and the highest capital income share. This also would be the group with the highest land rent share. Non-agricultural rural-high and urban-high income groups had lower capital income shares than non-agricultural rural-low income and urban-low income groups and hence, the former two groups had higher income reductions.

To state the reverse of this -- the Bimas fertilizer subsidy program has benefitted agricultural laborers and consumers the most. It has benefitted agricultural laborers since it has reduced factor prices less for labor, which they have in abundance, relative to capital, which they have very little. It has benefitted consumers by holding down the relative price for rice, freeing up resources for the production of food non-rice (an increase in production of 12 percent), and reducing the aggregate price index by about 12 percent. The urban and non-agricultural rural groups have particularly benefitted from the reduced aggregate price index.

Agricultural producers (operators), on the other hand, have not benefitted as much from the Bimas fertilizer subsidy program. Their incomes have increased by only 3 percent versus an overall income increase of 4 percent. Fertilizer is a direct substitute for land and since their capital income share is 53 percent versus an aggregate labor income share of 43 percent, they have benefitted less from the relative changes in factor prices and the reduced aggregate price level.

TABLE XXV

AGGREGATE LABOR AND CAPITAL INCOME SHARES BY HOUSEHOLD CLASS

Household Class	Aggregate Labor Income Share (Percent)	Capital Income Share (Percent)
Agricultural Laborers	84	10
Agricultural Operators	43	53
Non-agricultural Rural-Low	70	24
Non-agricultural Rural-High	71	14
Urban-Low	66	24
Urban-High	60	15

Removing the fertilizer subsidy reduces government subsidy cost and increases government revenue since a source of government revenue is indirect tax minus subsidy. Government revenue also increases from a net increase in government payments (taxes) from households and private companies. Tax revenues from private companies increases because of an increase in the price of capital and this offsets a decrease in tax revenue from a decrease in household real income. The net effect on government revenue from removing all fertilizer subsidy cost is a 1.5 percent increase. Total government expenditure is accounted for apart from government revenue and includes transfers to institutions (including households), government consumption, government savings, and government payments abroad. All of these expenditures are held at the base SAM level except government savings which is assumed proportional to government revenue and government commodity consumption which is assumed to be fixed at the physical level of base SAM but valued at new solution of commodity prices. The government expenditure indice increases by 5.0 percent at the zero fertilizer subsidy rate which when deflated by the aggregate price index means government expenditure has decreased by 6.3 percent. Because of the increase in the aggregate price index, the real value of government transfers to institutions has decreased. In fact, combining the 6.3 percent decrease in real expenditures with the 1.5 percent increase in government real income means a 7.8 percent change in government budget available for whatever purpose deemed appropriate including increased saving and investment by government, increased transfers to households, or decreased taxation.

This policy scenario has the effect of reducing resources available to the economy equal to the cost of the fertilizer subsidy program. Those resources are taken out of the economy and not put back by means of a tax reduction or a government transfer to households. The overall effect is a reduction in real incomes to households by 4 percent. This is offset in part by a 2.8 percent increase in real income to private companies. Policy Simulation II, to be discussed next, returns these resources to the economy by means of government transfers to households equal to the reduction in the cost of the fertilizer subsidy program.

Reducing the fertilizer subsidy has a smaller than expected change on rice production. The reason, in part, is that even though Bimas farmers decrease their rice production in response to a reduction in fertilizer subsidy, non-Bimas farmers increase their production in response to an increase in the price of rice. In total, reducing the fertilizer subsidy from 37.5 percent to 25 percent reduces rice production by 1.2 percent. The next 10 percent reduction in subsidy reduces rice production by 0.8 percent and the last 15 percent reduction in subsidy reduces rice production by 0.7 percent. The effect of a total reduction in fertilizer subsidy to Bimas producers is a reduction in total rice production of 2.6 percent. Therefore, adoption of this policy might not harm "food self-sufficiency" or "basic nutrition" to the extent previously thought.

Even though the production indices are measured in rupiahs, they can be interpreted as physical output indices since prices have been normalized to the base SAM values. The production indices show the dramatic effect fertilizer subsidy to paddy (Bimas) producers has on the food non-rice and agriculture non-food sectors. Completely eliminating the fertilizer subsidy reduces output of the food non-rice sector by about 12 percent and the agriculture non-food sector by about 3 percent. Or stated in the reverse, the fertilizer subsidy program of Bimas has freed up sufficient resources to expand the food non-rice sector by 12 percent and the agriculture non-food sector by 3 percent. With a strong export market for commodities of the agriculture non-food sector, the effects of the Bimas fertilizer subsidy program may become more important and these effects are analyzed in succeeding policy simulations.

Reducing the subsidy program has differential effects on the four non-agricultural sectors. Production increases for two sectors (18 and 19) and decreases for two sectors (20 and 21). These differences are the results of linkages to paddy production and to relative changes on the demand side.

Nominal savings increase by 3.6 percent with a complete reduction in fertilizer subsidy but with a 12.1 percent increase in the aggregate price index, the real savings decreases. The current GEM does not include a monetary sector and hence, does not determine an equilibrium interest rate. The result of this limitation is shown by a nominal return to capital of 15.3 percent, which is greater than the aggregate price index, but a nominal increase in aggregate savings is less than the increase in the aggregate price index. This would indicate that less is available for investment during the next period when valued in real purchasing power.

Total commodity imports decrease marginally with reductions in fertilizer subsidy. This is because sector production decreases and imports are a function of level of production. Foreign exchange requirements for imports are thus marginally reduced since the price of imports are assumed to remain at the base SAM level. Total commodity exports remain constant as assumed for this policy simulation. Export prices also remain at the base SAM level and hence, this policy simulation would show a marginal foreign exchange savings. The domestic value of exports decreases significantly, however, because of the 12.1 percent increase in the aggregate price index. Later policy simulations allow an endogenous determination of agricultural exports. The current formulation of the GEM does not allow an endogenous determination of the foreign exchange rate.

As discussed above, a reduction in fertilizer subsidy to Bimas paddy producers causes household incomes to decrease. This implies that household purchasing power also decreases. A basic concern is the effect of this decrease on basic nutrition. Rice is the basic food commodity in the Indonesian diet. It constitutes a 25 percent budget share in low income groups (see Chapter V). Results in Table XXIV show that completely eliminating the fertilizer subsidy decreases rice consumption by 6.0 percent for agricultural laborers, 2.2 percent by agricultural operators, and 2.7 percent by non-agricultural rural low-income households. Since these are the three lowest income groups, the Indonesian government may wish to consider income transfers to these groups equal to the reduction caused by removing the fertilizer subsidy. This is the next policy simulation considered.

Policy Simulation II: Reducing Fertilizer Subsidy, Holding Commodity Exports Constant, and Increasing Government Transfer Payments to Households

The reduction in fertilizer subsidy decreases all household real incomes. This is expected because government is taking resources out of the system equal to the reduced subsidy. The objective of Policy Simulation II is to analyze the effect of giving the resources back to the system by means of government transfers to households. An alternative means of giving the resources back to the system would be to reduce government taxes. However, uniformly reducing taxation rates will undoubtedly increase income inequalities among household classes. Thus, results of Policy Simulation I were used to weight government transfer payments to households. Households experiencing a greater reduction in real income received higher weights in income transfers, and vice versa. The objective of this policy is to restore household real incomes as close as possible to the base SAM. By so doing, household purchasing power remains close to the same level as before the fertilizer subsidy is reduced.

The government income transfer weights are based on the per capita income loss in Policy Simulation I from removing fertilizer subsidy and the aggregate number of households in each household group. The computations for these income weights are given in Table XXVI. For each monetary unit of government revenue saved by a reduction in fertilizer subsidy, a unit of government revenue was transferred back to households and in proportion to the income transfer weights given in Table XXVI. Hence, government costs from fertilizer subsidy in Policy Simulation I are exactly offset by government transfers to households in Policy Simulation II.

Results of this policy simulation are presented in Table XXVII. Government transfers to households were not able to restore incomes completely to the base SAM levels but came within 2 percentage points in most cases. Slightly lower household incomes are offset by slightly higher private company and government incomes.

Reducing fertilizer subsidy causes all factor input prices to increase just as in Policy Simulation I but at a slightly reduced rate. The reasons for higher factor prices are as before -- with fertilizer subsidy reduced, farmers tend to use more land (capital) and labor in paddy production, less is available for production in other sectors, and this results in a rise in all input prices. Production changes are most significant in paddy (non-Bimas), food non-paddy, and agricultural non-food crops. In comparing total subsidy reduction in Policy Simulation II with Policy Simulation I, production of paddy (non-Bimas) increases from an index of 1.042 to 1.209, food non-paddy increases from

TABLE XXVI

CALCULATED GOVERNMENT INCOME TRANSFER WEIGHTS BY HOUSEHOLD CLASS, INDONESIA

Household Class	Population (1,000)	Percent of Population	Per Capita Income, Base SAM (Thousand Rp.)	Per Capita Income Loss Policy Sim. I (Thousand Rp.)	Per Capita Percent Income Loss	Per Capita Percent Income Loss Weighted by Percent Population	Income Transfer Weight
Agricultural Laborers	13,554	8.75	119.730	9.025	7.5	65.625	17.07
Agricultural Operators	75,348	48.62	149.670	3.918	2.6	126.412	32.89
Non-agricultural Rural-Low	29,763	19.21	180.440	6.534	3.6	69.156	17.99
Non-agricultural Rural-High	7,585	4.89	259.830	16.058	6.2	30.318	7.89
Urban-Low	18,864	12.17	335.950	15.366	4.6	55.982	14.56
Urban-High	9,860	6.36	465.860	26.935	5.8	36.888	9.60
Total	154,974	100.00	201.150	8.319	4.1	384.381	100.00

TABLE XXVII

GENERAL EQUILIBRIUM RESULTS (INDICES) FOR INDONESIA, POLICY SIMULATION II: REDUCED FERTILIZER SUBSIDY, CONSTANT COMMODITY EXPORTS, AND INCREASED GOVERNMENT TRANSFERS TO HOUSEHOLDS

Items	Fertilizer Subsidy (Percent)			
	37.5	25	15	0
Input Prices				
1. Agricultural Laborers	1.00000	1.00719	1.01607	1.02383
2. Production Workers	1.00000	1.01443	1.01621	1.02487
3. Sales and Services	1.00000	1.00331	1.01214	1.01894
4. Professional and Management	1.00000	1.01545	1.01733	1.02001
5. Capital	1.00000	1.05308	1.08183	1.14518
Household Real Income[a]				
6. Agricultural Laborers	1.00000	0.95604	0.95944	0.96637
7. Agricultural Operators	1.00000	0.98064	0.98260	0.99166
8. Non-agricultural Rural-low	1.00000	0.97310	0.97631	0.97780
9. Non-agricultural Rural-high	1.00000	0.97064	0.97253	0.97419
10. Urban-low	1.00000	0.96905	0.97291	0.97539
11. Urban-high	1.00000	0.97355	0.97508	0.97754
Total Household Income	1.00000	0.97491	0.97762	0.97862
Institutional Real Income[a]				
12. Private Companies	1.00000	0.99919	1.00252	1.01324
13. Government	1.00000	1.00049	1.00187	1.00831
Production				
14. Paddy (Bimas)	1.00000	0.98565	0.97609	0.96386
15. Paddy (Non-Bimas)	1.00000	1.00710	1.15425	1.20865
16. Food Non-paddy	1.00000	0.97157	0.96983	0.92679
17. Agricultural Non-food Crops	1.00000	1.00048	1.00769	1.00993
18. Mining, Industry, Gas, etc.	1.00000	1.01280	1.01428	1.03940
19. Chemical and Fertilizer	1.00000	1.00360	1.00460	1.01238
20. Trade, Transport and Communication	1.00000	0.99221	0.99188	0.95015
21. Services	1.00000	0.99801	0.99730	0.99662
Total Gross Output	1.00000	0.99889	0.99861	0.98844
Commodity Prices				
23. Rice	1.00000	1.02725	1.03888	1.06586
24. Food Non-rice	1.00000	1.09790	1.10900	1.13220
25. Agricultural Non-food	1.00000	1.05660	1.07850	1.11210
26. Mining, Industry, Gas, etc.	1.00000	1.04338	1.06613	1.11580
27. Chemical and Fertilizer	1.00000	1.04270	1.06505	1.11355
28. Trade, Transport and Communication	1.00000	1.03809	1.04435	1.04385
29. Services	1.00000	1.05763	1.04190	1.06972
Aggregate Price Index[b]	1.00000	1.06167	1.07020	1.09853
Capital Account				
30. Savings (Nominal)	1.00000	1.00670	1.01450	1.03650
Government				
31.1. Subsidy Cost	1.00000	0.65710	0.33517	0.00000
31.2. Total Expenditures (Nominal)	1.00000	1.02102	1.03454	1.04074
Rest of World				
32.1. Total Commodity Imports	1.00000	0.99960	0.99854	0.98837
32.2. Total Commodity Exports	1.00000	1.00000	1.00000	1.00000
Rice Consumption				
33.1. Agricultural Laborers	1.00000	0.97823	0.98096	0.98695
33.2. Agricultural Operators	1.00000	0.99457	0.99568	1.00000
33.3. Non-agricultural Rural -low	1.00000	0.99221	0.99312	0.99374
33.4. Non-agricultural Rural-high	1.00000	0.98086	0.99074	0.99320
33.5. Urban-low	1.00000	0.99799	0.99830	0.99945
33.6. Urban-high	1.00000	0.99880	0.99885	0.99923

[a]Household and institutional income are deflated by the aggregate price index.

[b]Computed as the sum of nominal price indices weighted by the base year average budget share of the commodity in national consumption.

0.883 to 0.927, and agricultural non-food crops increases from 0.969 to 1.010. The aggregate price index is slightly lower for Policy Simulation II compared to Policy Simulation I. Restoring income levels restores purchasing power and brings rice consumption levels back closer to the base SAM for all household classes. Agricultural laborers is the household group that has the highest reduction in rice consumption and it is only 1.3 percent less than the base SAM level.

It is clear that Policy Simulation II results in negligible differences in income levels and rice consumption. However, in practical terms, it might be difficult to implement Policy Simulation II because of the need for a sophisticated administration system to track personal income losses and to devise a system for government transfer payments to households. One possible solution is to determine if modification of the general income tax rates can be used to bring about the needed income transfers including that of a negative income tax. Another possible solution to increase incomes of lower income groups or to maintain purchasing power of lower income groups is to introduce "labor intensive programs" in the agricultural sector which is discussed under Policy Simulation V.

Policy Simulation III: Reducing Fertilizer Subsidy but with Agricultural Exports Determined Endogenously

In this policy simulation, agricultural commodity exports are allowed to be determined endogenously. Since export prices are determined in the international market, the assumption is that export prices remain at the normalized price of 1.0. Therefore, domestic prices will not differ much from the export price until exports are pushed to zero. The effects of Policy Simulation III are compared with the results of Policy Simulation I.

Results of this experiment are presented in Table XXVIII. Commodity prices for food non-rice and agriculture non-food differ little from the normalized export price. Only when fertilizer subsidy to paddy (Bimas) producers is completely eliminated does the price of food non-rice increase by 1 percent. At this level, exports of food non-rice have been reduced to zero and domestic price begins to increase. Total commodity exports are reduced significantly, especially for the case of zero fertilizer subsidy. In that case, total commodity exports are reduced by about 9 percent. As in the previous simulations, a reduction in fertilizer subsidy to Bimas farmers leads to increases in all factor prices. However, all factor price increases are less than under Policy Simulation I. Commodity prices are substantially lower than under Policy Simulation I. The aggregate price index increases by 5.2 percent under zero fertilizer subsidy compared to 12.1 percent for Policy Simulation I. With zero fertilizer subsidy the price of rice increases by 6.5 percent versus 7.1 percent in Policy Simulation I. But in this policy experiment the price of rice increases more than the aggregate price index.

At the lower commodity prices for food non-rice and agriculture non-food, paddy production by non-Bimas producers increases by 23.0 percent with zero fertilizer subsidy to Bimas producers over the amount produced with a 37.5 percent fertilizer subsidy to Bimas producers. Total rice production decreases by only 0.25 percent with the complete elimination of the fertilizer subsidy. Removing the fertilizer subsidy to Bimas producers of paddy requires a reduction in production of agriculture non-food by only 3.6 percent and a reduction in food non-rice by only 0.7 percent.

Agricultural operators are the major benefactors of reducing fertilizer subsidies. Real household income of agricultural operators increases by 3.3 percent under zero fertilizer subsidy and this is sufficient to marginally increase

TABLE XXVIII

GENERAL EQUILIBRIUM RESULTS (INDICES) FOR INDONESIA, POLICY SIMULATION III: REDUCED FERTILIZER SUBSIDY AND ENDOGENOUSLY DETERMINED EXPORTS

Items	Fertilizer Subsidy (Percent)			
	37.5	25	15	0
Input Prices				
1. Agricultural Laborers	1.00000	1.07020	1.01576	1.02327
2. Production Workers	1.00000	1.01420	1.01617	1.02479
3. Sales and Services	1.00000	1.00310	1.01172	1.01861
4. Professional and Management	1.00000	1.01505	1.01670	1.01995
5. Capital	1.00000	1.05107	1.08095	1.14439
Household Real Income[a]				
6. Agricultural Laborers	1.00000	0.99210	0.99024	0.98277
7. Agricultural Operators	1.00000	1.00975	1.01773	1.03265
8. Non-agricultural Rural-low	1.00000	0.99821	0.99800	0.99682
9. Non-agricultural Rural-high	1.00000	0.99414	0.99169	0.98423
10. Urban-low	1.00000	0.99860	0.99746	0.99695
11. Urban-high	1.00000	0.99219	0.98993	0.98275
Total Household Income	1.00000	1.00100	1.00304	1.00621
Institutional Real Income[a]				
12. Private Companies	1.00000	1.03072	1.04787	1.08730
13. Government	1.00000	1.03071	1.04527	1.11311
Production				
14. Paddy (Bimas)	1.00000	0.98570	0.97609	0.96386
15. Paddy (Non-Bimas)	1.00000	1.11038	1.18908	1.23017
16. Food Non-paddy	1.00000	0.98821	0.99281	0.99346
17. Agricultural Non-food Crops	1.00000	0.97191	0.97040	0.96428
18. Mining, Industry, Gas, etc.	1.00000	1.00770	1.00923	1.03939
19. Chemical and Fertilizer	1.00000	1.00063	1.00562	1.01157
20. Transport and Communication	1.00000	0.98115	0.97988	0.94096
21. Services	1.00000	0.99667	0.99675	0.99577
Total Gross Output	1.00000	0.99499	0.99644	0.99979
Commodity Prices				
23. Rice	1.00000	1.02324	1.03837	1.06528
24. Food Non-rice	1.00000	1.00878	1.00987	1.01003
25. Agricultural Non-food	1.00000	1.00616	1.00709	1.00893
26. Mining, Industry, Gas, etc.	1.00000	1.04339	1.06537	1.11568
27. Chemical and Fertilizer	1.00000	1.04270	1.06430	1.11369
28. Trade, Transport and Communication	1.00000	1.02802	1.04372	1.08093
29. Services	1.00000	1.02761	1.04124	1.06932
Aggregate Price Index[b]	1.00000	1.02124	1.03123	1.05195
Capital Account				
30. Savings (Nominal)	1.00000	1.02840	1.04370	1.08490
Government				
31.1. Subsidy Cost	1.00000	0.65710	0.33517	0.00000
31.2. Total Expenditures (Nominal)	1.00000	1.02167	1.03296	1.05994
Rest of World				
32.1. Total Commodity Imports	1.00000	0.99499	0.99644	0.99979
32.2. Total Commodity Exports	1.00000	0.98315	0.92425	0.90985
Rice Consumption				
33.1. Agricultural Laborers	1.00000	0.98275	0.97526	0.96243
33.2. Agricultural Operators	1.00000	1.00105	1.00353	1.01063
33.3. Non-agricultural Rural -low	1.00000	0.99158	0.98869	0.98732
33.4. Non-agricultural Rural-high	1.00000	0.99493	0.98379	0.97203
33.5. Urban-low	1.00000	0.99817	0.99538	0.99154
33.6. Urban-high	1.00000	0.99686	0.98918	0.98492

[a]Household and institutional income are deflated by the aggregate price index.

[b]Computed as the sum of nominal price indices weighted by the base year average budget share of the commodity in national consumption.

total household income. All other household classes have reduced income with agricultural laborers and urban-high income classes showing the largest decreases.

Household rice consumption decreases for all household classes except agricultural operators. This result again shows that consumers, and especially low-income consumers have benefitted most from the government's policy of subsidizing fertilizer to paddy (Bimas) producers. It further shows that revenues to private companies and government tend to decrease as subsidy to Bimas producers increases.

In this policy simulation nominal savings increases more than the aggregate price index. This is due to the significant increases in real income of private companies and government. Real savings from households will be almost constant since real household incomes are almost constant.

Government real income increases significantly as fertilizer subsidy decreases. At zero fertilizer subsidy government real income increases by 11.3 percent. Total government expenditure in nominal prices increases by 6.0 percent but when adjusted for overall price increases the increase is only 0.7 percent. However, with the increase in real income of 11.3 percent, government has available about 12.0 percent additional revenue.

Policy Simulation IV: Reducing Fertilizer Subsidy, Agricultural Exports Determined Endogenously, and Increasing Government Transfer Payments to Households

This policy alternative is basically the same as Policy Simulation III but with government income transfers to households equal to the cost of fertilizer subsidy. The same household group income transfer weights are used as were used for Policy Simulation II. Results of this simulation are presented in Table XXIX. As in previous simulations, a reduction in fertilizer subsidy leads to an increase in all factor prices. An increase in factor prices forces up commodity prices. Putting resources back into the system by means of income transfers further increases domestic demand thus, causing commodity prices to increase more. As shown in Table XXIX, all commodity prices are slightly higher than for Policy Simulation III.

The results of Policy Simulation IV on household income and rice consumption are significantly different from the first three policy simulations. In this case, all households experience an increase in real income. For example, agricultural laborers' real income increases by 0.003 percent when fertilizer subsidy to Bimas farmers is removed. Agricultural operators experience the largest increase in real income, i.e. 3.06 percent. Rice consumption increases for all household classes with a commensurate increase in income. Private company revenue and government revenue are also better off. It is significant that government increases income even though the reduced cost of fertilizer subsidy is transferred to households.

The results of this policy alternative on sector output are only marginally different than for Policy Simulation III. The major difference is a significant reduction in agriculture non-food output and a slight decrease in food non-rice output. This reduced output in agriculture non-food crops is reflected by a marginal decrease in total commodity exports. The somewhat higher increase in household real income increases domestic demand, forces up commodity prices, and causes a shift in resources from export crop production to food crop production.

The interesting comparison is zero fertilizer subsidy of Policy Simulation IV (Table XXIX) with the base solution (37.5 percent fertilizer subsidy) of Policy

TABLE XXIX

GENERAL EQUILIBRIUM RESULTS (INDICES) FOR INDONESIA, POLICY SIMULATION IV: REDUCED FERTILIZER SUBSIDY, ENDOGENOUSLY DETERMINED EXPORTS, AND INCREASED TRANSFER PAYMENTS TO HOUSEHOLDS

Items	Fertilizer Subsidy (Percent)			
	37.5	25	15	0
Input Prices				
1. Agricultural Laborers	1.00000	1.07019	1.01605	1.02382
2. Production Workers	1.00000	1.01440	1.01617	1.02480
3. Sales and Services	1.00000	1.00330	1.01178	1.01890
4. Professional and Management	1.00000	1.01545	1.01770	1.01998
5. Capital	1.00000	1.05308	1.08190	1.14492
Household Real Income[a]				
6. Agricultural Laborers	1.00000	0.98892	0.99262	1.00003
7. Agricultural Operators	1.00000	1.00987	1.01778	1.03065
8. Non-agricultural Rural-low	1.00000	0.99862	0.99984	1.00045
9. Non-agricultural Rural-high	1.00000	0.98694	0.99017	1.00150
10. Urban-low	1.00000	0.96860	0.98746	1.00000
11. Urban-high	1.00000	0.98792	0.98957	1.00016
Total Household Income	1.00000	1.00136	1.00305	1.02020
Institutional Real Income[a]				
12. Private Companies	1.00000	1.02831	1.04493	1.08210
13. Government	1.00000	1.02607	1.03653	1.06109
Production				
14. Paddy (Bimas)	1.00000	0.98570	0.97609	0.96386
15. Paddy (Non-Bimas)	1.00000	1.05711	1.12908	1.23602
16. Food Non-paddy	1.00000	0.98982	0.98711	0.98693
17. Agricultural Non-food Crops	1.00000	0.95272	0.93704	0.93643
18. Mining, Industry, Gas, etc.	1.00000	1.01208	1.01709	1.02939
19. Chemical and Fertilizer	1.00000	1.00025	1.00566	1.01219
20. Trade, Transport and Communication	1.00000	0.98208	0.97987	0.95410
21. Services	1.00000	0.99667	0.99753	0.99658
Total Gross Output	1.00000	0.99550	0.99547	0.99130
Commodity Prices				
23. Rice	1.00000	1.02324	1.03870	1.06520
24. Food Non-rice	1.00000	1.00728	1.00979	1.01108
25. Agricultural Non-food	1.00000	1.00760	1.00876	1.01083
26. Mining, Industry, Gas, etc.	1.00000	1.04340	1.06854	1.11560
27. Chemical and Fertilizer	1.00000	1.04274	1.06435	1.12126
28. Trade, Transport and Communication	1.00000	1.02872	1.05437	1.07809
29. Services	1.00000	1.02756	1.04712	1.07750
Aggregate Price Index[b]	1.00000	1.02162	1.03234	1.05649
Capital Account				
30. Savings (Nominal)	1.00000	1.04060	1.05324	1.08290
Government				
31.1. Subsidy Cost	1.00000	0.65710	0.33517	0.00000
31.2. Total Expenditures (Nominal)	1.00000	1.02339	1.03801	1.05126
Rest of World				
32.1. Total Commodity Imports	1.00000	0.99550	0.99437	0.98819
32.2. Total Commodity Exports	1.00000	0.92014	0.91135	0.90954
Rice Consumption				
33.1. Agricultural Laborers	1.00000	0.99275	0.99753	1.00000
33.2. Agricultural Operators	1.00000	1.00810	1.01353	1.02368
33.3. Non-agricultural Rural -low	1.00000	0.99882	0.99989	1.00023
33.4. Non-agricultural Rural-high	1.00000	0.98493	0.98738	1.00009
33.5. Urban-low	1.00000	0.99170	0.99532	1.00000
33.6. Urban-high	1.00000	0.99679	0.99413	1.00006

[a]Household and institutional income are deflated by the aggregate price index.

[b]Computed as the sum of nominal price indices weighted by the base year average budget share of the commodity in national consumption.

Simulation III (Table XXVIII). These two solutions are at the same government cost since with Policy Simulation IV the government savings from reduced fertilizer subsidy are transferred back to households. The obvious result is that total household real income has increased in Policy Simulation IV by 2.0 percent. In fact, real income has increased for all household classes. Agricultural operators have the highest increase and non-agricultural rural high has the second highest increase. Non-agricultural rural-low, urban-high, and agricultural laborers all have marginal increases, whereas urban-low remains the same. But these relative changes can be influenced by policy makers decisions on the weights given to government transfers.

Further comparisons show that the aggregate price index increases 5.6 percent for Policy Simulation IV over Policy Simulation III and that factor prices also increase. But the net effect shows an increase in real incomes. Basic nutrition as measured by increases in rice consumption favor Policy Simulation IV over Policy Simulation III. Private company revenue and government revenue are both greater for Policy Simulation IV over Policy Simulation III. The one negative result is a decrease in commodity exports which is offset slightly by lower commodity imports.

The results of Policy Simulation IV indicate that reducing fertilizer subsidy to Bimas producers need not have a deleterious effect on household incomes and basic nutrition if government has a means of increasing incomes of households, particularly low income households, equal to the cost of the subsidy program. The next policy experiment considers the effects of increasing incomes of low income households through some kind of employment generation program.

Policy Simulation V: Reducing Fertilizer Subsidy, Endogenously Determining Agricultural Exports, and Increasing Agricultural Laborer Employment

Policy Simulation V is designed to capture interaction effects of increasing the agricultural laborer employment and reducing the fertilizer subsidy to Bimas producers of paddy. Agricultural exports in this policy alternative are treated as endogenous variables. Agricultural labor is abundant in Indonesia and this policy alternative recognizes that agricultural labor may be in disequilibrium for the initial base SAM. That is, the assumption is excess supply of agricultural laborers in 1980. If this is the case, expanding the agricultural laborer constraint increases supply and forces the economy to move to more efficient market equilibrium conditions characterized by equalization of labor supply and labor demand. The policy experiments with agricultural laborer supply increases of 5, 15, and 25 percent. All other resources are held constant at the base SAM.

This policy experiment is compared with Policy Simulations III and IV. Compared to Policy Simulation III, Policy Simulation V should show significantly lower input prices, lower commodity prices, and higher incomes, particularly for agricultural laborer households. Policy Simulation V can be considered an alternative government strategy for increasing household incomes when compared to Policy Simulation IV. Policy Simulation IV is a direct government transfer to households equal to the reduction in fertilizer subsidy cost. Policy Simulation V does not transfer income back to households, but rather, it considers a government strategy of employment generation and thus, an indirect means of increasing household incomes. The cost of this strategy is unknown.

Results of these model simulations are presented in Appendix C. A summary of results are shown in Table XXX. Entries going across the columns simulate the effect of expanding the agricultural laborer supply, other things ceteris paribus. Whereas, the entries going down the columns simulate the effect of a reduction in fertilizer subsidy, holding constant the agricultural laborer supply. Results of the base simulation in Table XXX are identical with results of Policy Simulation III in Table XXVIII.

The market for agricultural laborers is graphically shown in Figure 3. The base SAM assumes a supply of agricultural laborers equal to $\bar{s}_{10}$ and the equilibrium wage rate is shown by the wage rate index of 1.0. However, if unemployment of agricultural laborers exist at the wage rate index of 1.0 then the supply curves of $\bar{s}_{11}$, $\bar{s}_{12}$, and $\bar{s}_{13}$ can be drawn for assumed unemployment rates of 5, 15, and 25 percent, respectively. The equilibrium wage rates for base SAM at 37.5 percent fertilizer subsidy are given in Table XXX and show wage rate indexes of 0.979, 0.902, and 0.876 for agricultural laborer supplies of $\bar{s}_{11}$, $\bar{s}_{12}$, and $\bar{s}_{13}$, respectively. With the resource constraint for $\bar{s}_{10}$ of 5,356.08 for agricultural laborers (see Table XV) then $\bar{s}_{11}$ equals $\bar{s}_{10}$ (1 + 0.05), $\bar{s}_{12}$ equals $\bar{s}_{10}$ (1 + 0.15), and $\bar{s}_{13}$ equals $\bar{s}_{10}$ (1 + 0.25).

Expanding the agricultural laborer supply, as anticipated, reduces all factor input prices except capital. As expected, the wage rate for agricultural laborers decreases more than for the other labor categories. Wage rates in other labor categories decrease and generally the decrease by category in descending order is the following: production workers, professional and management, and sales and services. The price of capital increases in all cases. There are two reasons for this increase. First, except for Bimas paddy production the assumed relationship between capital and labor is a Leontief production function. Hence, capital and labor must enter the production

TABLE XXX

GENERAL EQUILIBRIUM RESULTS (INDICES) FOR INDONESIA, POLICY SIMULATION V: REDUCED FERTILIZER SUBSIDY, ENDOGENOUSLY DETERMINED AGRICULTURAL EXPORTS, AND INCREASED AGRICULTURAL LABORER SUPPLY

Items	Increasing Agricultural Laborer Supply by			
	0 Percent Base	5 Percent	15 Percent	25 Percent
	Fertilizer Subsidy 37.5 Percent			
Input Prices				
1. Agricultural Laborers	1.00000	0.97938	0.90250	0.87650
2. Production Workers	1.00000	1.00000	0.98800	0.98560
3. Sales and Services	1.00000	1.00000	0.99815	0.98855
4. Professional & Management	1.00000	1.00000	0.99566	0.98575
5. Capital	1.00000	1.00000	1.00005	1.00065
	Fertilizer Subsidy 25 Percent			
Input Prices				
1. Agricultural Laborers	1.00702	1.00520	1.00010	1.00000
2. Production Workers	1.01420	1.01300	1.00767	1.00066
3. Sales and Services	1.00310	1.00183	1.00150	1.00085
4. Professional & Management	1.01505	1.00150	1.01300	1.00096
5. Capital	1.05107	1.05313	1.05318	1.05322
	Fertilizer Subsidy 15 Percent			
Input Prices				
1. Agricultural Laborers	1.01576	1.01070	1.00765	1.00015
2. Production Workers	1.01617	1.01600	1.01520	1.01080
3. Sales and Services	1.01172	1.01165	1.01000	1.00670
4. Professional & Management	1.01670	1.01660	1.01275	1.00785
5. Capital	1.08095	1.08136	1.08172	1.08176
	Fertilizer Subsidy 0 Percent			
Input Prices				
1. Agricultural Laborers	1.02327	1.01755	1.01255	1.00565
2. Production Workers	1.02479	1.02435	1.02260	1.01573
3. Sales and Services	1.01861	1.01830	1.01664	1.01581
4. Professional & Management	1.01995	1.01915	1.01520	1.01324
5. Capital	1.14439	1.17446	1.14656	1.14750

TABLE XXX (Continued)

Items	Increasing Agricultural Laborer Supply by			
	0 Percent Base	5 Percent	15 Percent	25 Percent
	Fertilizer Subsidy 37.5 Percent			
Household Real Income				
6. Agricultural Laborers	1.00000	1.02334	1.04735	1.09188
7. Agricultural Operators	1.00000	1.01497	1.03798	1.06517
8. Non-agricultural Rural-Low	1.00000	1.00120	1.02360	1.03139
9. Non-agricultural Rural-High	1.00000	1.00554	1.02126	1.02868
10. Urban-Low	1.00000	1.00497	1.02207	1.02775
11. Urban-High	1.00000	1.00491	1.02116	1.02735
Total Household Income	1.00000	1.00892	1.02922	1.04526
Institutional Real Income				
12. Private Companies	1.00000	1.00487	1.02632	1.03247
13. Government	1.00000	1.00487	1.00674	1.04041
	Fertilizer Subsidy 25 Percent			
Household Real Income				
6. Agricultural Laborers	0.99210	1.02147	1.08932	1.09050
7. Agricultural Operators	1.00975	1.02689	1.06478	1.11773
8. Non-agricultural Rural-Low	0.99821	0.99887	1.00314	1.00723
9. Non-agricultural Rural-High	0.99414	0.99522	0.99728	0.99971
10. Urban-Low	0.99860	0.99929	1.00117	1.00190
11. Urban-High	0.99219	0.99337	0.99607	0.99810
Total Household Income	1.00100	1.00923	1.02812	1.04864
Institutional Real Income				
12. Private Companies	1.03072	1.03139	1.03290	1.03332
13. Government	1.03071	1.03196	1.03340	1.03715
	Fertilizer Subsidy 15 Percent			
Household Real Income				
6. Agricultural Laborers	0.99024	1.01985	1.08162	1.08750
7. Agricultural Operators	1.01773	1.03470	1.06899	1.10549
8. Non-agricultural Rural-Low	0.99800	0.99850	1.00147	1.00450
9. Non-agricultural Rural-High	0.99169	0.99374	0.99452	0.99873
10. Urban-Low	0.99746	0.99868	0.99878	0.99980
11. Urban-High	0.98993	0.99102	0.99242	0.99364
Total Household Income	1.00304	1.01134	1.02775	1.04243
Institutional Real Income				
12. Private Companies	1.04787	1.04953	1.05048	1.06035
13. Government	1.04527	1.04689	1.04891	1.05738
	Fertilizer Subsidy 0 Percent			
Household Real Income				
6. Agricultural Laborers	0.98277	1.01109	1.04040	1.05460
7. Agricultural Operators	1.03265	1.04851	1.07200	1.11446
8. Non-agricultural Rural-Low	0.99682	0.99758	1.00142	1.00484
9. Non-agricultural Rural-High	0.98423	0.98538	0.98538	0.98774
10. Urban-Low	0.99695	0.99744	0.99744	0.99796
11. Urban-High	0.98275	0.98349	0.98308	0.98449
Total Household Income	1.00621	1.01383	1.02446	1.04161
Institutional Real Income				
12. Private Companies	1.08730	1.08806	1.08859	1.09189
13. Government	1.11311	1.11501	1.11594	1.11722

TABLE XXX (Continued)

Items	Increasing Agricultural Laborer Supply by			
	0 Percent Base	5 Percent	15 Percent	25 Percent
	Fertilizer Subsidy 37.5 Percent			
Production				
14. Paddy (Bimas)	1.00000	1.00000	1.00000	1.00000
15. Paddy (Non-Bimas)	1.00000	1.08318	1.12713	1.47384
16. Food Non-Rice	1.00000	1.01200	1.03715	1.04600
17. Agriculture Non-Food	1.00000	1.00020	1.00064	1.00064
18. Mining, Industry, Gas, etc.	1.00000	1.00063	1.00192	1.00297
19. Chemical and Fertilizer	1.00000	1.00089	1.00111	1.00130
20. Trade, Transport & Commun.	1.00000	1.00007	1.00015	1.00032
21. Services	1.00000	1.00079	1.00182	1.00305
	Fertilizer Subsidy 25 Percent			
Production				
14. Paddy (Bimas)	0.98566	0.98566	0.98566	0.98566
15. Paddy (Non-Bimas)	1.11038	1.13114	1.17493	1.47474
16. Food Non-Rice	0.98821	1.01076	1.01799	1.02994
17. Agriculture Non-Food	0.97191	0.97200	0.97213	0.97228
18. Mining, Industry, Gas, etc.	1.00770	1.01431	1.01485	1.01860
19. Chemical and Fertilizer	1.00063	1.00083	1.00117	1.00121
20. Trade, Transport & Commun.	0.98115	0.98148	0.98299	0.98374
21. Services	0.99667	0.99748	0.99937	1.00414
	Fertilizer Subsidy 15 Percent			
Production				
14. Paddy (Bimas)	0.97609	0.97606	0.97606	0.97605
15. Paddy (Non-Bimas)	1.18908	1.21352	1.23478	1.24669
16. Food Non-Rice	0.99281	0.99352	1.00296	1.00875
17. Agriculture Non-Food	0.97040	0.97041	0.97050	0.97034
18. Mining, Industry, Gas, etc.	1.00923	1.02295	1.02538	1.03009
19. Chemical and Fertilizer	1.00562	1.00772	1.00885	1.00994
20. Trade, Transport & Commun.	0.97988	0.98340	0.98627	0.98676
21. Services	0.99675	0.99821	1.00124	1.00484
	Fertilizer Subsidy 0 Percent			
Production				
14. Paddy (Bimas)	0.96386	0.96386	0.96386	0.96386
15. Paddy (Non-Bimas)	1.23017	1.35365	1.38811	1.41215
16. Food Non-Rice	0.99346	1.01846	1.01846	1.03458
17. Agriculture Non-Food	0.96428	0.96444	0.96451	0.96443
18. Mining, Industry, Gas, etc.	1.03939	1.04069	1.04069	1.04643
19. Chemical and Fertilizer	1.01157	1.01199	1.01260	1.01314
20. Trade, Transport & Commun.	0.94096	0.94113	0.93769	0.93923
21. Services	0.99577	0.99748	0.99748	1.00431

TABLE XXX (Continued)

Items	Increasing Agricultural Laborer Supply by			
	0 Percent Base	5 Percent	15 Percent	25 Percent
	Fertilizer Subsidy 37.5 Percent			
Commodity Prices				
23. Rice	1.00000	0.98709	0.94025	0.92400
24. Food Non-Rice	1.00000	0.99297	0.96800	0.95985
25. Agriculture Non-Food	1.00000	0.99530	0.98045	0.97455
26. Mining, Industry, Gas, etc.	1.00000	0.99970	1.00014	1.00075
27. Chemical & Fertilizer	1.00000	0.99971	1.00025	1.00070
28. Trade, Transport & Commun.	1.00000	0.99944	0.99845	0.99750
29. Services	1.00000	0.99987	0.99900	0.99800
Aggregate Price Index	1.00000	0.99516	0.97823	0.97241
	Fertilizer Subsidy 25 Percent			
Commodity Prices				
23. Rice	1.02324	1.02200	1.02054	1.02002
24. Food Non-Rice	1.00878	1.00875	1.00778	1.00687
25. Agriculture Non-Food	1.00616	1.00615	1.00605	1.00600
26. Mining, Industry, Gas, etc.	1.04339	1.04390	1.04441	1.04460
27. Chemical & Fertilizer	1.04270	1.04215	1.04282	1.04327
28. Trade, Transport & Commun.	1.02802	1.02705	1.02709	1.02704
29. Services	1.02761	1.02700	1.02668	1.02645
Aggregate Price Index	1.02124	1.02086	1.02034	1.01992
	Fertilizer Subsidy 15 Percent			
Commodity Prices				
23. Rice	1.03837	1.03578	1.03375	1.03045
24. Food Non-Rice	1.00987	1.00600	1.00566	1.00507
25. Agriculture Non-Food	1.00709	1.00700	1.00695	1.00680
26. Mining, Industry, Gas, etc.	1.06537	1.06630	1.06680	1.06971
27. Chemical & Fertilizer	1.06430	1.06545	1.06570	1.06966
28. Trade, Transport & Commun.	1.04372	1.04758	1.04700	1.04700
29. Services	1.04124	1.04227	1.04078	1.04075
Aggregate Price Index	1.03123	1.03024	1.02962	1.02944
	Fertilizer Subsidy 0 Percent			
Commodity Prices				
23. Rice	1.06528	1.06180	1.06177	1.05530
24. Food Non-Rice	1.01003	1.01003	1.01000	1.00976
25. Agriculture Non-Food	1.00893	1.00863	1.00850	1.00846
26. Mining, Industry, Gas, etc.	1.11568	1.11570	1.11572	1.11580
27. Chemical & Fertilizer	1.11369	1.11375	1.11378	1.11390
28. Trade, Transport & Commun.	1.08093	1.08090	1.08094	1.08096
29. Services	1.06932	1.06855	1.06860	1.06867
Aggregate Price Index	1.05195	1.05137	1.05136	1.05041

TABLE XXX (Continued)

Items	Increasing Agricultural Laborer Supply by			
	0 Percent Base	5 Percent	15 Percent	25 Percent
	Fertilizer Subsidy 37.5 Percent			
Capital Account				
30.1. Savings (Nominal)	1.00000	1.00054	1.00163	1.00295
Government				
31.1. Subsidy Cost	1.00000	1.00000	1.00000	1.00000
31.2. Total Expenditures (Nominal)	1.00000	1.00103	1.00310	1.00823
Rest of World				
32.1. Total Commodity Imports	1.00000	1.00299	1.00844	1.01231
32.2. Total Commodity Exports	1.00000	0.96491	0.90682	0.84343
	Fertilizer Subsidy 25 Percent			
Capital Account				
30.1. Savings (Nominal)	1.0284	1.0298	1.0302	1.0305
Government				
31.1. Subsidy Cost	0.65710	0.65710	0.65710	0.65710
31.2. Total Expenditures (Nominal)	1.02174	1.02196	1.03495	1.04908
Rest of World				
32.1. Total Commodity Imports	0.99499	1.00178	1.00402	1.00965
32.2. Total Commodity Exports	0.98315	0.89955	0.83219	0.83218
	Fertilizer Subsidy 15 Percent			
Capital Account				
30.1. Savings (Nominal)	1.0437	1.0463	1.0506	1.0557
Government				
31.1. Subsidy Cost	0.33517	0.33517	0.33517	0.33517
31.2. Total Expenditures (Nominal)	1.02830	1.03430	1.05604	1.08121
Rest of World				
32.1. Total Commodity Imports	0.99644	1.00261	1.00624	1.00956
32.2. Total Commodity Exports	0.92425	0.89298	0.87739	0.83220
	Fertilizer Subsidy 0 Percent			
Capital Account				
30.1. Savings (Nominal)	1.0849	1.0906	1.0916	1.0198
Government				
31.1. Subsidy Cost	0.00000	0.00000	0.00000	0.00000
31.2. Total Expenditures (Nominal)	1.06870	1.06926	1.10697	1.14822
Rest of World				
32.1. Total Commodity Imports	1.00307	1.00568	1.00524	1.01136
32.2. Total Commodity Exports	0.90985	0.90644	0.87580	0.83218

TABLE XXX (Continued)

Items	Increasing Agricultural Laborer Supply by			
	0 Percent Base	5 Percent	15 Percent	25 Percent
	Fertilizer Subsidy 37.5 Percent			
Rice Consumption				
33.1. Agricultural Laborers	1.00000	1.03194	1.05735	1.08787
33.2. Agricultural Operators	1.00000	1.01933	1.04934	1.06257
33.3. Non-agriculture Rural-low	1.00000	1.00598	1.02426	1.03192
33.4. Non-agricultural Rural-high	1.00000	1.00514	1.02104	1.03673
33.5. Urban-low	1.00000	1.00792	1.03645	1.04613
33.6. Urban-high	1.00000	1.02235	1.02664	1.03384
	Fertilizer Subsidy 25 Percent			
Rice Consumption				
33.1. Agricultural Laborers	0.98275	1.02220	1.05705	1.08227
33.2. Agricultural Operators	1.00105	1.02604	1.05071	1.06997
33.3. Non-agriculture Rural-low	0.99158	0.99638	1.00043	1.00049
33.4. Non-agricultural Rural-high	0.99492	0.99890	0.99875	0.99964
33.5. Urban-low	0.99817	0.99972	1.00013	1.00037
33.6. Urban-high	0.99686	0.99715	0.99851	0.99905
	Fertilizer Subsidy 15 Percent			
Rice Consumption				
33.1. Agricultural Laborers	0.97526	1.00573	1.04860	1.07866
33.2. Agricultural Operators	1.00353	1.01386	1.03775	1.06265
33.3. Non-agriculture Rural-low	0.98869	0.99083	0.99974	1.00078
33.4. Non-agricultural Rural-high	0.98379	0.98791	0.98940	0.99381
33.5. Urban-low	0.99538	0.99831	1.99902	0.99986
33.6. Urban-high	0.99918	0.99010	0.99157	0.99250
	Fertilizer Subsidy 0 Percent			
Rice Consumption				
33.1. Agricultural Laborers	0.96243	1.01088	1.03900	1.04998
33.2. Agricultural Operators	1.01063	1.03378	1.05599	1.08144
33.3. Non-agriculture Rural-low	0.98732	0.99762	1.00061	1.00419
33.4. Non-agricultural Rural-high	0.97203	0.98655	0.98789	0.98945
33.5. Urban-low	0.99153	0.99178	0.99322	0.99576
33.6. Urban-high	0.98492	0.99155	0.99345	0.99477

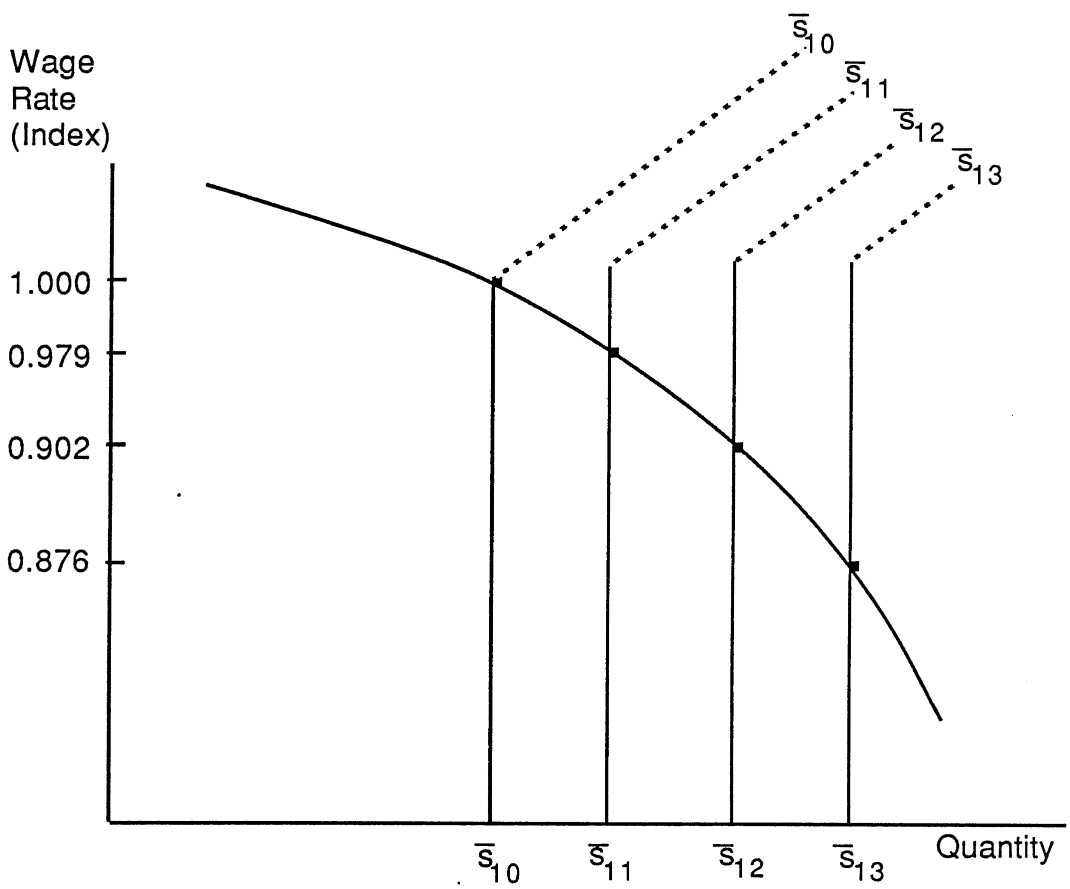

Figure 3. Agricultural Laborer Market Under Alternative Supply Assumptions (Bimas Fertilizer Subsidy at 37.5 Percent), Indonesia

process with fixed proportions. An expansion of labor means an expansion of capital or an increase in the price of capital. And since capital is fixed, the price of capital has to increase. Second, an increase in real income means an increase in the relative demand for commodities with higher income elasticities of demand and these commodities also have higher capital requirements in production.

A reduction in input prices means the aggregate commodity supply function shifts to the right resulting in lower aggregate commodity prices. The aggregate commodity price index decreases in all cases when compared to the base solution. However, not all individual commodity prices decreased. Prices for rice, food non-rice, agriculture non-food, and services decreased in all cases with an increase in laborer supply. Sectors 26 (mining, industry, gas, etc.) and 27 (chemical and fertilizer) increased in price with an increase in agricultural laborer supply. Sector 28 (trade, transport, and communication) decreased in price for fertilizer subsidy at 25 percent and 37.5 percent and increased in price for fertilizer subsidy at zero percent and 15 percent. Those sectors with price increases are also those sectors more dependent on capital in their production processes. Overall, commodity prices change little with an increase in laborer supply. The exceptions are for rice, food non-rice, and agricultural non-food when fertilizer subsidy is at 37.5 percent. In this case, at a 25 percent increase in laborer supply the price of rice decreases by 7.6 percent, the price of food non-rice decreases by 4.0 percent, and the price of agriculture non-food decreases by 2.5 percent.

Production indices show a general progression of increases for all sectors as the supply of agricultural laborers increases. The one difference is in agriculture non-food production with a 25 percent increase in agriculture laborer supply. When fertilizer subsidy for Bimas paddy production is at 15 percent or less, agriculture non-food production decreases slightly. This may be the result of a relative increase in household income and a movement of resources out of the production of export crops and into the production of domestic food crops. The most significant increase in production indices is in paddy (non-Bimas) and food non-rice. This is the result of an increase in incomes of low income households and the corresponding increases in food demand.

The impact of an expansion in agricultural laborer supply on household real incomes is positive and very significant. Real income in all household categories increased. Total household real income increased by about 4 percent with a 25 percent increase in agricultural laborer supply. The largest increases in household real income were in the categories of agricultural laborers and agricultural operators. Institutional income (private companies and government) increased less than the increase in total household income. Rice consumption followed closely the trend of increases in household real income. The lower income groups show higher increases in rice consumption than higher income groups.

Total commodity exports show a decline with the increase in agriculture laborer supply. This is due to an increase in the demand for food commodities with an increase in household real income and a shifting of resources away from the production of agricultural exports and toward the production of paddy and food non-rice.

The comparison of results in Tables XXIX (Policy Simulation IV) with results in Table XXX will show the relative differences in a strategy of increasing household incomes through transfers from government (Policy Simulation IV) versus a strategy of increasing household incomes through employment generation (Policy Simulation V). It takes an increase in agricultural laborer supply of between 5 and 15 percent to equal the total household real income increase due to a complete decrease in fertilizer subsidy and a transfer in income of those savings to households. The major beneficiaries of the employment generation strategy and elimination of the fertilizer subsidy are agricultural operators, agricultural laborers, and rural-low income groups. Rural-high income and both urban groups show a slight decrease in household real income.

Increasing the agricultural laborer supply has a decreasing effect on aggregate commodity prices at the zero fertilizer subsidy when compared with resource savings transferred to households. This is true even though incomes increase more through increasing agricultural laborer supply than through income transfers. Production of all sectors increases more with a 5 percent increase in agricultural laborer supply and zero fertilizer subsidy than a zero fertilizer subsidy and all resource savings transferred to households (Table XXVIII). The loss in agricultural exports because of household real income increases through employment generation (increases in agricultural laborer supply and demand) is less than through household real income increases by means of income transfers.

Development in Indonesia through the strategy of Policy Simulation V may be preferred to the strategy of Policy Simulation III because: (1) Indonesia has abundant human resources and hence, adoption of a labor intensification program is expected to reduce unemployment; (2) distribution of income is more in the direction of low income groups; (3) there is a greater production of food and less of a decrease in agricultural exports; and (4) low income groups are at less risk in basic nutrition. These results should be considered tentative since the government cost of transferring income to households and the cost of generating more employment have not been determined.

Policy Simulation VI: Reducing Fertilizer Subsidy and Increasing Agricultural Non-Food Exports

This policy alternative is designed to simulate an expansion in agricultural non-food exports and at the same time reducing the fertilizer subsidy to Bimas paddy producers. Food non-rice commodity exports are held at the base SAM level and an export price of 1.0. Only non-competitive imports are permitted. The purpose of this policy alternative is to analyze the economic impacts of expanding agricultural non-food exports on production, household and institutional incomes, factor and domestic prices, and basic nutrition. Agricultural non-food exports are held at the normalized price but domestic prices are allowed to be determined by the model.

Results of these policy simulations are presented in Appendix C. A summary of the results are shown in Table XXXI. After a brief analysis of the results are given, comparisons are made of the income generation capability of this policy simulation with results of Policy Simulations IV and V. The entries going down the columns of Table XXXI simulate the effect of reducing fertilizer subsidy, other things ceteris paribus. The entries going across columns simulate the effect of expanding agricultural non-food exports, given certain levels of fertilizer subsidy under the Bimas program.

Expansion in agricultural non-food exports leads to increases in all input prices. The reason is that expanding agricultural non-food exports requires either an expansion of inputs to produce more food and non-food commodities or an increase in those commodity prices to limit domestic demand. Since resources are constrained in this model demand for inputs shifts to the right causing input prices to increase, commodity prices to increase, and thus, limiting domestic demand. Looking at the base results in Table XXXI for input

TABLE XXXI

GENERAL EQUILIBRIUM RESULTS (INDICES) FOR INDONESIA, POLICY SIMULATION VI: REDUCED FERTILIZER SUBSIDY AND INCREASED AGRICULTURAL NON-FOOD EXPORTS

Items	Increasing Agricultural Non-Food Exports by			
	0 Percent Base	5 Percent	15 Percent	25 Percent
	Fertilizer Subsidy 37.5 Percent			
Input Prices				
1. Agricultural Laborers	1.00000	1.01774	1.03009	1.04294
2. Production Workers	1.00000	1.01062	1.03444	1.04634
3. Sales and Services	1.00000	1.01645	1.01678	1.03323
4. Professional & Management	1.00000	1.01185	1.01343	1.02528
5. Capital	1.00000	1.02002	1.03670	1.05004
	Fertilizer Subsidy 25 Percent			
Input Prices				
1. Agricultural Laborers	1.00790	1.01919	1.02537	1.03560
2. Production Workers	1.01574	1.02668	1.03128	1.03982
3. Sales and Services	1.00339	1.01984	1.02165	1.02987
4. Professional & Management	1.01583	1.02413	1.02975	1.04160
5. Capital	1.05740	1.06407	1.08142	1.09477
	Fertilizer Subsidy 15 Percent			
Input Prices				
1. Agricultural Laborers	1.01675	1.01975	1.03505	1.05148
2. Production Workers	1.01823	1.02064	1.03640	1.05107
3. Sales and Services	1.01225	1.01817	1.03380	1.05321
4. Professional & Management	1.01824	1.01954	1.03460	1.05114
5. Capital	1.08295	1.08495	1.10025	1.13216
	Fertilizer Subsidy 0 Percent			
Input Prices				
1. Agricultural Laborers	1.02532	1.03017	1.03667	1.05258
2. Production Workers	1.02698	1.03136	1.03695	1.05391
3. Sales and Services	1.01992	1.02752	1.03452	1.05095
4. Professional & Management	1.02785	1.03417	1.05115	1.06458
5. Capital	1.15340	1.17258	1.19226	1.25131

TABLE XXXI (Continued)

Items	Increasing Agricultural Non-Food Exports by			
	0 Percent Base	5 Percent	15 Percent	25 Percent
	Fertilizer Subsidy 37.5 Percent			
Household Real Income				
6. Agricultural Laborers	1.00000	1.00324	1.00786	1.01067
7. Agricultural Operators	1.00000	1.00514	1.00894	1.00910
8. Non-agricultural Rural-Low	1.00000	1.00060	1.00176	1.00654
9. Non-agricultural Rural-High	1.00000	1.00047	1.00296	1.00803
10. Urban-Low	1.00000	1.00104	1.00153	1.00667
11. Urban-High	1.00000	1.00091	1.00284	1.00768
Total Household Income	1.00000	1.00250	1.00486	1.00797
Institutional Real Income				
12. Private Companies	1.00000	1.00707	1.01018	1.01324
13. Government	1.00000	1.01198	1.01235	1.01251
	Fertilizer Subsidy 25 Percent			
Household Real Income				
6. Agricultural Laborers	0.95412	0.95808	0.96282	0.96811
7. Agricultural Operators	0.97551	0.97798	0.97972	0.98427
8. Non-agricultural Rural-Low	0.97108	0.97208	0.97316	0.97407
9. Non-agricultural Rural-High	0.96757	0.97034	0.97321	0.97392
10. Urban-Low	0.97643	0.97712	0.97962	0.98056
11. Urban-High	0.97592	0.97856	0.98146	0.98403
Total Household Income	0.97338	0.97535	0.97754	0.98023
Institutional Real Income				
12. Private Companies	1.00050	1.00385	1.00448	1.00583
13. Government	1.00089	1.00240	1.00337	1.00368
	Fertilizer Subsidy 15 Percent			
Household Real Income				
6. Agricultural Laborers	0.94883	0.95320	0.95647	0.95926
7. Agricultural Operators	0.97405	0.97603	0.98141	0.98419
8. Non-agricultural Rural-Low	0.96634	0.96693	0.96705	0.96721
9. Non-agricultural Rural-High	0.95031	0.95107	0.95452	0.95795
10. Urban-Low	0.96223	0.96244	0.96299	0.96494
11. Urban-High	0.95708	0.96113	0.96248	0.96355
Total Household Income	0.96501	0.96674	0.96940	0.97135
Institutional Real Income				
12. Private Companies	1.00481	1.00517	1.00566	1.02423
13. Government	1.00160	1.00187	1.00223	1.01347
	Fertilizer Subsidy 0 Percent			
Household Real Income				
6. Agricultural Laborers	0.92462	0.93030	0.93373	0.93614
7. Agricultural Operators	0.97382	0.97427	0.97505	0.97507
8. Non-agricultural Rural-Low	0.96379	0.96399	0.96423	0.96453
9. Non-agricultural Rural-High	0.93820	0.93970	0.94210	0.94310
10. Urban-Low	0.95426	0.95434	0.95515	0.95538
11. Urban-High	0.94218	0.94272	0.94356	0.94419
Total Household Income	0.95864	0.95932	0.96027	0.96065
Institutional Real Income				
12. Private Companies	1.02826	1.02842	1.02878	1.02890
13. Government	1.01455	1.01465	1.01500	1.01514

TABLE XXXI (Continued)

Items	Increasing Agricultural Non-Food Exports by			
	0 Percent Base	5 Percent	15 Percent	25 Percent
	Fertilizer Subsidy 37.5 Percent			
Production				
14. Paddy (Bimas)	1.00000	1.00000	1.00000	1.00000
15. Paddy (Non-Bimas)	1.00000	0.97792	0.97932	0.99001
16. Food Non-Rice	1.00000	0.99955	0.99202	0.99072
17. Agriculture Non-Food	1.00000	1.00062	1.06002	1.09612
18. Mining, Industry, Gas, etc.	1.00000	1.00028	1.01160	1.01521
19. Chemical and Fertilizer	1.00000	1.00043	1.00200	0.99252
20. Trade, Transport & Commun.	1.00000	0.99891	0.98081	0.97625
21. Services	1.00000	0.99900	1.00053	1.00088
	Fertilizer Subsidy 25 Percent			
Production				
14. Paddy (Bimas)	0.98563	0.98561	0.98562	0.98565
15. Paddy (Non-Bimas)	1.00697	0.98423	0.98640	0.99064
16. Food Non-Rice	0.94093	0.93465	0.91553	0.91513
17. Agriculture Non-Food	0.98791	1.00411	1.04604	1.08710
18. Mining, Industry, Gas, etc.	1.01735	1.01741	1.01927	1.02032
19. Chemical and Fertilizer	1.00222	1.00290	1.00315	1.00384
20. Trade, Transport & Commun.	0.98889	0.98984	0.99085	0.99242
21. Services	0.99567	0.99560	0.99563	0.99513
	Fertilizer Subsidy 15 Percent			
Production				
14. Paddy (Bimas)	0.97609	0.97609	0.97609	0.97609
15. Paddy (Non-Bimas)	1.01180	0.99178	1.00146	1.05755
16. Food Non-Rice	0.93976	0.93971	0.91919	0.91683
17. Agriculture Non-Food	0.98412	1.00498	1.03994	1.08795
18. Mining, Industry, Gas, etc.	1.02138	1.02246	1.02319	1.02409
19. Chemical and Fertilizer	1.00747	1.00847	1.00986	1.02185
20. Trade, Transport & Commun.	0.98954	0.98895	0.99276	0.99873
21. Services	0.99565	0.99544	0.99542	0.99506
	Fertilizer Subsidy 0 Percent			
Production				
14. Paddy (Bimas)	0.96386	0.96386	0.96386	0.96386
15. Paddy (Non-Bimas)	1.04170	1.04064	1.01203	0.95549
16. Food Non-Rice	0.88303	0.88206	0.87485	0.86975
17. Agriculture Non-Food	0.96868	0.99420	1.03165	1.06259
18. Mining, Industry, Gas, etc.	1.03857	1.04541	1.04561	1.04595
19. Chemical and Fertilizer	1.01105	1.01590	1.00836	1.00850
20. Trade, Transport & Commun.	0.97882	0.98821	0.98559	0.96930
21. Services	0.99147	0.99344	0.99041	0.98749

TABLE XXXI (Continued)

Items	Increasing Agricultural Non-Food Exports by			
	0 Percent Base	5 Percent	15 Percent	25 Percent
	Fertilizer Subsidy 37.5 Percent			
Commodity Prices				
23. Rice	1.00000	1.01181	1.02335	1.02554
24. Food Non-Rice	1.00000	1.01399	1.02879	1.03610
25. Agriculture Non-Food	1.00000	1.01543	1.03055	1.04822
26. Mining, Industry, Gas, etc.	1.00000	1.01236	1.02162	1.04095
27. Chemical & Fertilizer	1.00000	1.01073	1.02635	1.03675
28. Trade, Transport & Commun.	1.00000	1.01065	1.02392	1.03595
29. Services	1.00000	1.01281	1.02538	1.03927
Aggregate Price Index	1.00000	1.01277	1.02609	1.03611
	Fertilizer Subsidy 25 Percent			
Commodity Prices				
23. Rice	1.02562	1.03524	1.04527	1.05656
24. Food Non-Rice	1.10081	1.10960	1.11020	1.11820
25. Agriculture Non-Food	1.04379	1.05183	1.06581	1.07819
26. Mining, Industry, Gas, etc.	1.04942	1.05701	1.07184	1.08434
27. Chemical & Fertilizer	1.04877	1.05648	1.07086	1.08336
28. Trade, Transport & Commun.	1.03722	1.04771	1.05709	1.06731
29. Services	1.03114	1.04077	1.05015	1.06157
Aggregate Price Index	1.06179	1.07084	1.07792	1.08802
	Fertilizer Subsidy 15 Percent			
Commodity Prices				
23. Rice	1.04016	1.04280	1.05399	1.07987
24. Food Non-Rice	1.11452	1.11532	1.11654	1.11865
25. Agriculture Non-Food	1.06433	1.06664	1.07353	1.10932
26. Mining, Industry, Gas, etc.	1.07085	1.07300	1.07885	1.11698
27. Chemical & Fertilizer	1.06975	1.07193	1.07819	1.11540
28. Trade, Transport & Commun.	1.05326	1.05646	1.06811	1.09417
29. Services	1.04460	1.04729	1.05812	1.08550
Aggregate Price Index	1.07742	1.07934	1.08568	1.10482
	Fertilizer Subsidy 0 Percent			
Commodity Prices				
23. Rice	1.07062	1.08050	1.09034	1.22880
24. Food Non-Rice	1.15830	1.18519	1.21456	1.28456
25. Agriculture Non-Food	1.11742	1.16674	1.17797	1.19689
26. Mining, Industry, Gas, etc.	1.12993	1.14801	1.16339	1.21581
27. Chemical & Fertilizer	1.12783	1.14509	1.16064	1.21269
28. Trade, Transport & Commun.	1.09696	1.10722	1.12057	1.21948
29. Services	1.07982	1.09115	1.10596	1.14132
Aggregate Price Index	1.12106	1.14077	1.16028	1.23468

TABLE XXXI (Continued)

Items	Increasing Agricultural Non-Food Exports by			
	0 Percent Base	5 Percent	15 Percent	25 Percent
	Fertilizer Subsidy 37.5 Percent			
Capital Account				
30.1. Savings (Nominal	1.00000	1.01302	1.02691	1.03709
Government				
31.1. Subsidy Cost	1.00000	1.00000	1.00000	1.00000
31.2. Total Expenditures (Nominal)	1.00000	1.00856	1.01972	1.03676
Rest of World				
32.1. Total Commodity Imports	1.00000	0.99960	1.00305	1.00511
32.2. Total Commodity Exports	1.00000	1.00746	1.02237	1.03729
	Fertilizer Subsidy 25 Percent			
Capital Account				
30.1. Savings (Nominal)	1.0090	1.02800	1.04019	1.0553
Government				
31.1. Subsidy Cost	0.65710	0.65710	0.65710	0.65710
31.2. Total Expenditures (Nominal)	1.01801	1.02258	1.05092	1.08439
Rest of World				
32.1. Total Commodity Imports	1.00000	0.99183	0.99198	0.99530
32.2. Total Commodity Exports	1.00000	1.00746	1.02237	1.03729
	Fertilizer Subsidy 15 Percent			
Capital Account				
30.1. Savings (Nominal)	1.0126	1.03077	1.04225	1.06283
Government				
31.1. Subsidy Cost	0.33517	0.33517	0.33517	0.33517
31.2. Total Expenditures (Nominal)	1.02593	1.02723	1.06013	1.11345
Rest of World				
32.1. Total Commodity Imports	0.99295	0.99453	0.99481	0.99939
32.2. Total Commodity Exports	1.00000	1.00746	1.02237	1.03729
	Fertilizer Subsidy 0 Percent			
Capital Account				
30.1. Savings (Nominal)	1.0357	1.06662	1.09240	1.16677
Government				
31.1. Subsidy Cost	0.00000	0.00000	0.00000	0.00000
31.2. Total Expenditures (Nominal)	1.05079	1.05819	1.12557	1.24470
Rest of World				
32.1. Total Commodity Imports	0.98532	0.99210	0.96051	0.98922
32.2. Total Commodity Exports	1.00000	1.00746	1.02237	1.03729

TABLE XXXI (Continued)

Items	Increasing Agricultural Non-Food Exports by			
	0 Percent Base	5 Percent	15 Percent	25 Percent
	Fertilizer Subsidy 37.5 Percent			
Rice Consumption				
33.1. Agricultural Laborers	1.00000	1.01095	1.02146	1.02397
33.2. Agricultural Operators	1.00000	1.01099	1.02711	1.03471
33.3. Non-agriculture Rural-low	1.00000	1.01235	1.02852	1.04530
33.4. Non-agricultural Rural-high	1.00000	1.00967	1.01914	1.03579
33.5. Urban-low	1.00000	1.00819	1.01976	1.03492
33.6. Urban-high	1.00000	1.00805	1.01924	1.03624
	Fertilizer Subsidy 25 Percent			
Rice Consumption				
33.1. Agricultural Laborers	0.98249	0.99289	0.99298	0.99366
33.2. Agricultural Operators	0.99293	0.99370	0.99428	0.99489
33.3. Non-agriculture Rural-low	0.98776	0.98931	0.99256	0.99683
33.4. Non-agricultural Rural-high	0.98509	0.98647	0.98698	0.99013
33.5. Urban-low	0.99403	0.99945	1.00028	1.00126
33.6. Urban-high	0.97518	0.98042	0.98355	0.98686
	Fertilizer Subsidy 15 Percent			
Rice Consumption				
33.1. Agricultural Laborers	0.95494	0.95895	0.96757	0.97843
33.2. Agricultural Operators	0.98921	0.99124	0.99347	0.99652
33.3. Non-agriculture Rural-low	0.97792	0.98115	0.98207	0.98236
33.4. Non-agricultural Rural-high	0.97209	0.97212	0.97884	0.97934
33.5. Urban-low	0.98599	0.98613	0.98635	0.98898
33.6. Urban-high	0.95601	0.95657	0.95878	0.96001
	Fertilizer Subsidy 0 Percent			
Rice Consumption				
33.1. Agricultural Laborers	0.93992	0.94045	0.94157	0.94490
33.2. Agricultural Operators	0.97809	0.98115	0.98372	0.98465
33.3. Non-agriculture Rural-low	0.97302	0.97724	0.97895	0.98002
33.4. Non-agricultural Rural-high	0.95449	0.95776	0.96004	0.96120
33.5. Urban-low	0.96792	0.96992	0.97068	0.97112
33.6. Urban-high	0.92766	0.90965	0.91124	0.91263

prices, labor input prices increased from 2.0 to 2.8 percent and capital increased by 15 percent as fertilizer subsidy is removed from the Bimas program. Holding fertilizer subsidy at 37.5 percent and increasing agricultural non-food exports by 25 percent increases labor prices from 2.5 to 4.6 percent but capital prices increase by only 5.0 percent. The interaction of reducing fertilizer subsidy and increasing agricultural non-food exports increases labor prices from 5.1 to 6.5 percent and capital price by 25.1 percent.

Reducing the fertilizer subsidy and expanding agricultural non-food exports at the same time leads to a dramatic increase in domestic commodity prices. For instance, removing the fertilizer subsidy and increasing agricultural non-food exports by 25 percent, the price of rice increases by 22.9 percent, the price of food non-rice by 28.5 percent, and the domestic price of agricultural non-food by 19.7 percent. The aggregate price index increases by 23.5 percent. Adoption of this policy alternative, therefore, would hurt domestic consumers. The export price of agricultural non-food crops remains at the normalized price of 1.0. Exports of food non-rice goes to zero rapidly in this policy simulation and the price of food non-rice increases sharply.

Household real incomes decrease in all cases except for subsidized fertilizer at 37.5 percent. This implies that households are worse off with this policy alternative compared to Policy Simulations II, III, IV, and V. However, comparing Simulation VI with Simulation I shows that household real income increases as agricultural non-food exports increase, even if those exports are held at the normalized price of 1.0. This means that if fertilizer subsidy to paddy producers is removed, promoting agricultural non-food exports restores incomes slightly but not to the extent that happens with the other policy simulations. If the value of agricultural non-food exports increased (export price increases), incomes may be restored but this policy experiment was not run.

The impact of expansion in agricultural non-food exports on other sector output varies. Total rice production and food non-rice production tend to decrease. A reallocation of the fixed resources of land (capital) and labor in agriculture tends to decrease production of paddy and food non-rice and increase agricultural non-food. Output of the non-agricultural sectors tends to increase in sectors 18 (mining, industry, gas, etc.) and 19 (chemical and fertilizer) and decrease in sectors 20 (trade, transport and communication) and 21 (services). These results are due to linkages with agriculture non-food.

In conclusion, all households experience lower incomes with this policy compared to policy Simulations II, III, IV, and V. Basic nutrition by means of rice consumption is also lower for this policy simulation. Total commodity exports, however, increase and thus are a source of added foreign exchange. Further, if agricultural non-food exports increase in price, this policy simulation may give significantly different results.

Comparison of the Applied GEM Results with Other Studies

The present study was specifically designed to address the distributional impact of the Bimas program on socio-economic groups and to evaluate alternative policy formulations of the Bimas program for improving social and rural welfare. In this section, the results of this study are compared to other studies.

Much of the growth in food production in Indonesia is attributable to the Bimas program. To bring about increased food production, the government followed a policy of subsidizing farm inputs such as fertilizer, pesticides, etc.

The impact of the fertilizer subsidy program was evaluated by Timmer (1986). His results show a benefit-cost ratio of 1.88 if the government subsidizes fertilizer at Rp 80 per kilogram. According to his results, the fertilizer subsidy program is a socially profitable intervention. The reasons are: (1) the subsidy program speeded up the learning process of optimal fertilizer application, and (2) the subsidy program served both as a substitute for crop insurance and as a widespread rural credit market at reasonable rates of interest. The Timmer study, however, doesn't address the issue of whether the fertilizer subsidy is still needed. Currently, about 87 percent of rice production is from Bimas producers.

Another recent study by Sastrohoetomo (1984) found that adoption of Policy Simulation III (elimination of fertilizer subsidy and rice priced at its opportunity cost) causes rice production to decrease to 23,292 million tons, or 2.3 percent lower than the production level of 1982. Net per capita production drops from 144 kilograms to 141 kilograms. Rice demand (consumption) also drops to 13,306 million tons, or 14.2 percent lower than demand of 1982. He further shows that consumers lose their opportunity to enjoy a 2,991.671 billion rupiah discount in their expenditure for rice. The rice producers, in contrast, enjoy an additional income of 3,745.670 billion rupiah and government gains a budget reduction of 220.370 billion rupiahs by elimination of the fertilizer subsidy. According to his findings, it is clear that eliminating the fertilizer subsidy benefits the rice producers and the government. Consumers though, are worse off.

Results of the present study, which are in the context of a general equilibrium model, support Sastrohoetomo's findings. In all cases, eliminating the fertilizer subsidy causes household real incomes to decrease. Agricultural laborers, rural-high income, and urban-high income households experienced the greatest reduction in real income. On the other hand, agricultural operators, rural-low income, and urban-low income households experienced only minor reductions in real income. It is clear that continuation of the fertilizer subsidy benefits consumers more than producers (agricultural operators). Therefore, elimination of the fertilizer subsidy would hurt rice producers the least and reduce government costs.

Among the six policy simulations discussed in the preceding sections, adoption of policies to transfer government savings from eliminating the fertilizer subsidy and to increase employment opportunities would be in the best interest of society. The reasons are: (1) household real incomes and private company and government real revenues are increased; (2) since Indonesia has abundant human resources, especially unskilled labor, policies promoting "labor intensive programs" will reduce unemployment and increase incomes of low income groups; and (3) goals of basic nutrition and increased self-sufficiency in food are enhanced.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

Summary

Problem Statement

Rice is the staple food of the Indonesian people. Programs to increase rice production have been an important part of national government policies since long before the country gained independence. The first nationwide government rice intensification program, called the Bimas program, was initiated in 1965. The objective of this program was to increase domestic rice production through adoption of improved technologies. The program's basic components, "panca usaha", consisted of: (1) improved water control, (2) use of HYV, (3) use of fertilizer, (4) use of pesticides, and (5) better cultivation methods. The empirical results of the Bimas program are: (1) yield per hectare of rice has steadily increased, and (2) the number of farmers adopting the improved technologies has increased significantly. However, the economic impact of the Bimas program on different socio-economic groups in Indonesia has never been fully determined. Furthermore, the current need to subsidize fertilizer in the Bimas program has been questioned and debated among economists. The main purposes of this study, therefore, were to address the distributional effects of the Bimas program on different socio-economic groups and to evaluate alternative policy formulations of the Bimas program for improving social welfare.

The Objectives of the Study

The overall objective of this study was to develop and apply a criterion for evaluating the Bimas program utilizing the applied general equilibrium framework. Specific objectives of this study were to: (1) develop a social accounting matrix (SAM) for Indonesia identifying agriculture and the Bimas program and disaggregated by socio-economic and institutional groups, production and commodity activities, resources and factor income payments, trade, and other economic variables; (2) estimate the economic and distributional impacts of reduced fertilizer subsidies to Bimas rice producers, direct government income transfers to households, programs encouraging labor employment, and programs expanding agriculture non-food exports; and (3) to evaluate alternative policy formulations of the Bimas program and alternative government programs on variables for improving social and rural welfare such as commodity prices, household real incomes, and basic nutrition.

Hypotheses

Three hypotheses were tested in this study: (1) the development of rice intensification programs such as Bimas have significant direct and indirect (downstream) effects on sector outputs, domestic prices, consumption, and incomes; (2) economic growth in Indonesia can be induced and accelerated at this time by government policies which encourage reduced fertilizer subsidies to Bimas rice producers and promote other programs for maintaining and expanding incomes of producers and consumers; and (3) government policies which encourage employment generation in the agricultural sector have significant impacts on lower income groups and thus narrow the income gap between the poor and the rich.

Procedures

To complete the objectives and test the hypotheses, it was necessary to model both intersectoral linkages and income distribution. This led to the use of an applied general equilibrium model as a framework for analysis. A detailed discussion of this methodology was presented in Chapter IV.

For purposes of analysis and policy formulation, six policy simulations were selected and carried out:

1. Policy Simulation I: reduced fertilizer subsidy for Bimas rice producers and all commodity exports held at the base SAM level.

2. Policy Simulation II: reduced fertilizer subsidy for Bimas rice producers and increased government transfers to households equal to the reduced cost of the subsidy.

3. Policy Simulation III: reduced fertilizer subsidy for Bimas rice producers and with food non-rice and agriculture non-food exports determined endogenously by the model.

4. Policy Simulation IV: reduced fertilizer subsidy for Bimas rice producers, endogenously determined food non-rice and agriculture non-food exports, and increased government transfers to households equal to the reduced cost of the fertilizer subsidy.

5. Policy Simulation V: reduced fertilizer subsidy for Bimas rice producers and expansion of agricultural employment.

6. Policy Simulation VI: reduced fertilizer subsidy for Bimas rice producers, food non-rice exports held constant at the base SAM

level, and agricultural non-food exports increased at constant international prices.

Results of the Policy Simulations

Results of the general equilibrium model indicate that reducing the fertilizer subsidy to Bimas rice producers significantly affect factor and commodity prices, sector outputs, household real income, and government and private companies real revenue. Labor wage rates increased from 2.0 to 2.8 percent depending on the category of labor inputs when the fertilizer subsidy was reduced to zero (Policy Simulation I). The price of capital inputs increased by 15.3 percent. Since capital payments include land rents, the large increase in price of capital relative to the increase in wage rates means fertilizer use substitutes more for land than for labor. Commodity prices increased from 7.1 percent to 15.8 percent with an overall aggregate price increase of 12.1 percent. Rice had the smallest price increase and food non-rice had the largest price increase. This result indicates that the Bimas fertilizer subsidy program has had a significant impact on keeping food prices down but the effect has been more on food non-rice commodities than on rice.

Total household real income decreased by 4.1 percent with total reduction in the Bimas fertilizer subsidy. Agricultural laborers' real household income decreased by 7.5 percent and agricultural operators' (producers) real household income decreased by 2.6 percent. Non-agricultural rural and urban households' real incomes decreased from 3.6 to 5.8 percent. These results on changes in household income and commodity prices indicate that continuation of the Bimas fertilizer subsidy program will benefit consumers of food commodities and agricultural laborers more than the producers (agricultural operators) of food, including rice. This finding is consistent with the previous study by Sastrohoetomo (1984). A disconcerting result of this policy experiment shows that rice consumption decreases by about 6 percent for the complete reduction in fertilizer subsidy.

Institutional real incomes increased with reduction of the fertilizer subsidy in the Bimas program. Private companies real income increased because of the increase in the price of capital. The factor input category of capital does not distinguish between capital in land and other capital stocks. So the assumption is complete fungibility between types of capital inputs. This has probably overinflated the returns to capital owned by private companies and by non-agricultural rural and urban households. Government net revenue increases because of an increase in private company real income and a decrease in fertilizer subsidy cost. In fact, a major reason for the decreases in sector production, increases in commodity prices, and decreases in household incomes is because the reduction in fertilizer subsidy by the government removes an amount of resources from the economy equal to the cost of the subsidy program. The next policy simulation returns these resources to the economy by means of government transfers to households.

Policy Simulation II is based upon Policy Simulation I but restores household real incomes as close as possible to the base SAM by transferring government revenue to households equal to the amount of government savings from reduced fertilizer subsidy. Government revenue transfer weights were determined on the basis of household income reductions from Policy Simulation I. That is, agricultural laborer households received the highest per capital income transfer weight since they had the greatest percentage reduction in household income. Agricultural operators had the lowest per capita income loss but the overall income transfer weight was the highest since this household category represents 48.6 percent of the population. The emphasis was on restoring household incomes to the level under the fertilizer subsidy rather than on the basis of income equality or inequality. Based upon a criteria of household income inequality, the government transfer weights would be very different.

Household real incomes were not completely restored with government income transfers equal to the reduction in fertilizer subsidy costs but were about 2.1 percent less than under the subsidy. This would tend to indicate that the Bimas program is an efficient use of government resources and would thus be consistent with Timmers (1986) results.

Policy Simulation II has somewhat lower input prices, lower commodity prices, and higher sector outputs than for Policy Simulation I. The higher household incomes have an indirect demand effect that increases paddy (Non-Bimas) output and food non-paddy output significantly. Rice consumption under this policy experiment is almost completely restored to the level under the fertilizer subsidy program.

Policy Simulation III reduces the penalty of producing food non-rice and agriculture non-food exports at a domestic price equivalent to the base SAM level. That is, exports of these commodities were held at the base SAM level and were valued at the base SAM domestic prices. As Policy Simulations I and II show, domestic prices of these commodities increased significantly, thus putting domestic consumers at a relative disadvantage. Policy Simulation III endogenizes these commodity exports at an export price equal to the base SAM. This allows these commodities to flow into or out of the export markets and thus permits an equalization of export and domestic prices.

The results of Policy Simulation III is a significant reduction in the aggregate price index -- from 1.12 in Policy Simulation I to 1.05 in Policy Simulation III. Production of paddy by non-Bimas producers increased significantly as well as the production of food non-paddy. The production of agricultural non-food crops decreased slightly. These results indicate that resources have moved out of the production of agricultural exports and into the production of domestic food commodities.

Total household real incomes increase marginally but household incomes of agricultural operator (producers) increase by 3.3 percent. Institutional real revenues of private companies and government increase significantly. Total commodity exports decrease by about 9 percent. Rice consumption increases for all households and is almost restored to levels under fertilizer subsidy except for agricultural laborers. For these households, rice consumption is still about 3.8 percent lower than under the fertilizer subsidy program.

Policy Simulation IV allows for exports of food non-rice and agricultural non-food commodities to be determined endogenously and for government revenue transfers to households equal to the cost of the reduced fertilizer subsidy program. The main purpose for this policy experiment is to form a base against which other policy programs can be compared. That is, instead of transferring government revenue to households, Policy Simulation V considers an expansion of employment and Policy Simulation VI considers an expansion of agricultural non-food exports.

Policy Simulation IV restores real incomes to all household categories and increases incomes of agricultural operators by 3.1 percent over what would have existed with a complete reduction in the Bimas fertilizer subsidy program. The aggregate price index increases only slightly over the level without government income transfers but with exports endogenous. Rice consumption is greater for all household classes than under the conditions for full fertilizer subsidy. However, total commodity exports decrease by about 9 percent and output of agricultural non-food crops decreases by about 6.4 percent.

Policy Simulation V assumes disequilibrium in the agricultural laborer market for the base SAM. The assumption is unemployment of agricultural laborers at the market wage rate determined in the base GEM solution. So instead of $\bar{s}_f$ resource constraint for agricultural laborers at the base GEM normalized price the assumption is that the resource constraint is $\bar{s}_f$ $(1 + e^u)$ where e^u is the percent of unemployment for agricultural laborers. The policy experiment assumes unemployment levels of 5, 15, and 25 percent. The end result is an actual expansion of the agricultural laborer supply by these same levels.

By expanding the agricultural laborer supply and solving for the equilibrium wage rate it will be necessary for the government to establish policies to encourage employment creation through selection of labor intensive technologies or the expansion of labor intensive sectors. Results of the policy experiment indicate a significant decrease in agricultural laborer wage rates for expansions in the agricultural laborer supply. In the case of a 37.5 percent fertilizer subsidy, input price for agricultural laborers decreased by 2.1 percent, 9.7 percent, and 12.3 percent for increases in labor supply of 5 percent, 15 percent, and 25 percent, respectively. Other input prices also marginally decreased with the exception of capital which remained about the same. With decreases in the levels of fertilizer subsidy, input prices increased but at reduced rates as the supply of agricultural laborers increased.

Household real incomes increase as employment of agricultural laborers increases. The most significant increases are in the household categories of agricultural operators and agricultural laborers. The per worker real wage rate decreases in all cases for the agricultural laborers with an increase in supply of labor. However, because of a fixed population of workers and dependents in this household category, the per capita real income increases because of higher employment levels.

The significant comparison of Policy Simulation V is with Policy Simulation IV. It is this comparison that shows agricultural laborer employment needs to increase from 5 to 15 percent to equal the total household real income increases from government revenue transfers at zero fertilizer subsidy. This implies that if government effort is expended towards increasing agricultural employment, government can eliminate completely fertilizer subsidy in the Bimas program, use the available government savings from the subsidy program toward employment generation, and overall household income would be the same. Furthermore, the effort would reach the targeted group of low income agricultural groups at a marginal expense to the rural non-agricultural and urban household groups. In addition, the aggregate price index would be lower, government income would be higher, and commodity exports would be higher. Although rice consumption would be higher for the agricultural households, it would be marginally lower for the rural non-agricultural and urban households.

Policy Simulation VI promotes agricultural non-food exports which have been the traditional exports of Indonesia. The policy experiments include expansion of these exports at levels of 5 percent, 15 percent, and 25 percent. Export prices of these commodities are held at the base SAM international level. Hence, at a fixed exchange rate, as the domestic aggregate price index increases the domestic value of these exports decrease. The level of food non-rice exports are allowed to be determined endogenously, hence, the domestic price of these commodities will center around the normalized price until the market completely shifts out of exports.

The relevant comparisons are Policy Simulation VI with Policy Simulation IV. This again shows what it would take in terms of an increase in export demand of agricultural non-food commodities to equal income levels brought about by government revenue transfers to households from savings in reduced fertilizer subsidies. This comparison shows that none of the assumed increases in agricultural non-food exports will give a comparable overall income level at zero fertilizer subsidy. The fact that the price of agricultural non-food exports are held down reduces significantly the income generating capacity of this policy strategy. Forcing production of these commodities at the reduced price level causes all input prices and commodity prices to increase significantly. Results of this strategy may be significantly different under conditions of a floating exchange rate or with an increase in the international price.

Conclusions

In summary, government policies which stimulate "employment creation" or an expansion of agricultural employment is found to have a significant impact on socio-economic groups. Household incomes and government revenue are increased. Sector outputs (rice, non-rice, etc.) also increase and rice consumption remains stable or increases. On the other hand, the impact of government policies which encourage an increase in agricultural non-food exports on socio-economic groups is found to be moderate. In general, household real incomes increase only slightly. Its impact on basic nutrition is negative. Rice and food non-rice production tends to decrease. Commodity prices tend to increase and for some policy experiments prices increase significantly.

In comparing results of the six policy simulations, it is found that Policy Simulations IV and V gave better results. Real incomes of all household categories and institutional revenues were restored to levels commensurate with results under fertilizer subsidy or surpassed those levels. Therefore, adoption of Policy Simulations IV or V, and/or a combination of the two would be in the best interest of society. For a country which has abundant labor resources, a combination of Policy Simulations IV and V would be the most preferable one. Thus, in socio-economic groups where employment generation is limited, government income transfers may be used to maintain income levels and basic nutrition.

Interestingly, Policy Simulations IV and V are said to be more market oriented. In these policy alternatives, government intervention through subsidies are reduced, input prices are valued close to their opportunity cost, and the decisions to produce and consume are left to the individuals. Therefore, exercising a government policy which encourages reduced fertilizer subsidy and employment generation would be in the best interest of society.

Limitations and Further Research

The results, conclusions, and policy recommendations of this study are limited by the accuracy of the data and assumptions used. The model, for example, required commodity demand parameters which satisfy the homogeneity, Cournot aggregation, Engel aggregation, and Symetry conditions. Owing to a lack of data, representative income elasticities and a direct price elasticity for rice were obtained from other studies. Since these were not calibrated to the same socio-economic groups used in this study, it may affect results of this analysis. Furthermore, some important variables such as the foreign exchange rate and money supply were not included in the model.

Therefore, this study failed to capture the impacts of changes in government budget, money supply, and exchange rates on outputs, incomes, and domestic prices.

An improvement on the limitations expressed above might be accomplished by further research which more completely specifies the model. Estimates of demand parameters for the designated socio-economic groups could be completed using more reliable methods and more accurate data.

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APPENDIXES

APPENDIX A

SOURCES OF DEMAND DATA

TABLE XXXII

BUDGET SHARE, INCOME ELASTICITIES, ORDINARY OWN- AND CROSS-PRICE ELASTICITIES FOR AGRICULTURAL OPERATOR HOUSEHOLDS, INDONESIA

Commodities	Budget Share	Income Elasticity	Share*Income Elasticity	Elasticities							Total Elasticities
	w	ε	$w^*\varepsilon$	Paddy	Nonpaddy	Nonfood	Mindustel	Chemical	Transcomm	Service	
Paddy	0.18649	0.67000[a]	0.12495	-0.30180	-0.18529	-0.02300	-0.04028	-0.01484	-0.04272	-0.06208	-0.67000
Nonpaddy	0.42299	1.14768[a]	0.48546	-0.17077	-0.66359	-0.03939	-0.06899	-0.02542	-0.07318	-0.10634	-1.14768
Nonfood	0.06047	1.43360[b]	0.08669	-0.21332	-0.39646	-0.48165	-0.08618	-0.03175	-0.09141	-0.13283	-1.43360
Mindustel	0.09768	1.27493[b]	0.12454	-0.18971	-0.35259	-0.04376	-0.46122	-0.02824	-0.08129	-0.11813	-1.27493
Chemical	0.03318	1.10220[b]	0.03657	-0.16401	-0.30482	-0.03783	-0.06626	-0.35689	-0.07028	-0.10212	-1.10220
Transcomm	0.08120	0.71187[c]	0.05780	-0.10593	-0.19687	-0.02443	-0.04279	-0.01577	-0.26012	-0.06596	-0.71187
Service	0.11799	0.71187[c]	0.08399	-0.10593	-0.19687	-0.02443	-0.04279	-0.01577	-0.04539	-0.28069	-0.71187
Total	1.00000		1.00000								

Frisch Parameter (Φ) = -3.31512

[a] Obtained from Johnson et al. (1986)
[b] Obtained from Gupta (1977)
[c] Recalculated using Engel Aggregation

TABLE XXXIII

COMPENSATED OWN- AND CROSS-PRICE ELASTICITIES FOR AGRICULTURAL OPERATOR HOUSEHOLDS, INDONESIA

Commodities	Compensated Own- and Cross-Price Elasticities							Total Elasticities
	Paddy	Nonpaddy	Nonfood	Mindustel	Chemical	Transcomm	Service	
Paddy	-0.17685	0.09811	0.01752	0.02517	0.00739	0.01168	0.01698	0.00000
Nonpaddy	0.04326	-0.17813	0.03001	0.04311	0.01266	0.02001	0.02908	0.00000
Nonfood	0.05403	0.20993	-0.39495	0.05386	0.01582	0.02500	0.03632	0.00000
Mindustel	0.04805	0.18670	0.03334	-0.33669	0.01406	0.02223	0.03230	0.00000
Chemical	0.04154	0.16140	0.02882	0.04141	-0.32032	0.01922	0.02793	0.00000
Transcom	0.02683	0.10424	0.01862	0.02674	0.00785	-0.20232	0.01804	0.00000
Service	0.02683	0.10424	0.01862	0.02674	0.00785	0.01241	-0.19670	0.00000

TABLE XXXIV

BUDGET SHARE, INCOME ELASTICITIES, ORDINARY OWN- AND CROSS-PRICE ELASTICITIES FOR NON-AGRICULTURAL RURAL-LOW INCOME HOUSEHOLDS, INDONESIA

Commodities	Budget Share	Income Elasticity	Share*Income Elasticity	Elasticities							Total Elasticities
	w	ε	w*ε	Paddy	Nonpaddy	Nonfood	Mindustel	Chemical	Transcomm	Service	
Paddy	0.15061	0.67000[a]	0.10091	-0.30180	-0.16059	-0.01570	-0.04317	-0.01955	-0.06371	-0.06548	-0.67000
Nonpaddy	0.38831	1.14768[a]	0.44566	-0.13423	-0.65783	-0.02689	-0.07394	-0.03348	-0.10914	-0.11217	-1.14768
Nonfood	0.04490	1.43360[b]	0.06436	-0.16767	-0.34362	-0.51169	-0.09236	-0.04182	-0.13633	-0.14012	-1.43360
Mindustel	0.11208	1.27493[b]	0.14289	-0.14911	-0.30559	-0.02987	-0.50732	-0.03719	-0.12124	-0.12461	-1.27493
Chemical	0.04613	1.10220[b]	0.05084	-0.12891	-0.26419	-0.02583	-0.07101	-0.39973	-0.10481	-0.10773	-1.10220
Transcomm	0.12722	0.75718[c]	0.09633	-0.08856	-0.18149	-0.01774	-0.04878	-0.02209	-0.32452	-0.07400	-0.75718
Service	0.13075	0.75718[c]	0.09900	-0.08856	-0.18149	-0.01774	-0.04878	-0.02209	-0.07200	-0.32652	-0.75718
Total	1.00000		1.00000								

Frisch Parameter (Φ) = -2.99857

[a] Obtained from Johnson et al. (1986)
[b] Obtained from Gupta (1977)
[c] Recalculated using Engel Aggregation

TABLE XXXV

COMPENSATED OWN- AND CROSS-PRICE ELASTICITIES FOR NON-AGRICULTURAL RURAL-LOW INCOME HOUSEHOLDS, INDONESIA

Commodities	Compensated Own- and Cross-Price Elasticities							Total Elasticities
	Paddy	Nonpaddy	Nonfood	Mindustel	Chemical	Transcomm	Service	
Paddy	-0.20089	0.09958	0.01438	0.03193	0.01136	0.02152	0.02212	0.00000
Nonpaddy	0.03862	-0.21217	0.02463	0.05469	0.01946	0.03687	0.03789	0.00000
Nonfood	0.04824	0.21307	-0.44732	0.06832	0.02431	0.04605	0.04733	0.00000
Mindustel	0.04290	0.18949	0.02737	-0.36442	0.02162	0.04096	0.04209	0.00000
Chemical	0.03709	0.16381	0.02366	0.05252	-0.34889	0.03541	0.03639	0.00000
Transcom	0.02548	0.11253	0.01625	0.03608	0.01284	-0.22819	0.02500	0.00000
Service	0.02548	0.11253	0.01625	0.03608	0.01284	0.02432	-0.22751	0.00000

TABLE XXXVI

BUDGET SHARE, INCOME ELASTICITIES, ORDINARY OWN- AND CROSS-PRICE ELASTICITIES FOR NON-AGRICULTURAL RURAL-HIGH INCOME HOUSEHOLDS, INDONESIA

Commodities	Budget Share	Income Elasticity	Share*Income Elasticity	Elasticities							Total Elasticities
	w	ε	w*ε	Paddy	Nonpaddy	Nonfood	Mindustel	Chemical	Transcomm	Service	
Paddy	0.10488	0.58080[a]	0.06091	-0.30180	-0.11062	-0.00560	-0.03528	-0.01938	-0.05820	-0.04991	-0.58080
Nonpaddy	0.38624	1.14768[a]	0.44328	-0.08949	-0.72547	-0.01106	-0.06972	-0.03830	-0.11501	-0.09863	-1.14768
Nonfood	0.02626	1.43360[b]	0.03765	-0.11179	-0.27305	-0.64696	-0.08709	-0.04785	-0.14366	-0.12321	-1.43360
Mindustel	0.13904	1.27493[b]	0.17727	-0.09941	-0.24283	-0.01228	-0.64053	-0.04255	-0.12776	-0.10957	-1.27493
Chemical	0.06503	1.10220[b]	0.07168	-0.08595	-0.20993	-0.01062	-0.06696	-0.52358	-0.11045	-0.09472	-1.10220
Transcomm	0.14995	0.75109[c]	0.11262	-0.05857	-0.14306	-0.00724	-0.04563	-0.02507	-0.40698	-0.06455	-0.75109
Service	0.12860	0.75109[c]	0.09659	-0.05857	-0.14306	-0.00724	-0.04563	-0.02507	-0.07526	-0.39627	-0.75109
Total	1.00000		1.00000								

Frisch Parameter (Φ) = -2.26423

[a] Obtained from Johnson et al. (1986)
[b] Obtained from Gupta (1977)
[c] Recalculated using Engel Aggregation

TABLE XXXVII

COMPENSATED OWN- AND CROSS-PRICE ELASTICITIES FOR NON-AGRICULTURAL RURAL-HIGH INCOME HOUSEHOLDS, INDONESIA

Commodities	Compensated Own- and Cross-Price Elasticities							Total Elasticities
	Paddy	Nonpaddy	Nonfood	Mindustel	Chemical	Transcomm	Service	
Paddy	-0.24089	0.11371	0.00966	0.04547	0.01839	0.02889	0.02478	0.00000
Nonpaddy	0.03088	-0.28219	0.01908	0.08985	0.03633	0.05709	0.04896	0.00000
Nonfood	0.03857	0.28066	-0.60932	0.11224	0.04538	0.07131	0.06116	0.00000
Mindustel	0.03430	0.24960	0.02120	-0.46326	0.04036	0.06342	0.05439	0.00000
Chemical	0.02965	0.21578	0.01883	0.08629	-0.45190	0.05482	0.04702	0.00000
Transcom	0.02021	0.14704	0.01249	0.05880	0.02378	-0.29436	0.03204	0.00000
Service	0.02021	0.14704	0.01249	0.05880	0.02378	0.03736	-0.29968	0.00000

TABLE XXVIII

BUDGET SHARE, INCOME ELASTICITIES, ORDINARY OWN- AND CROSS-PRICE ELASTICITIES FOR URBAN-LOW INCOME HOUSEHOLDS, INDONESIA

Commodities	Budget Share	Income Elasticity	Share*Income Elasticity	Elasticities							Total Elasticities
	w	ε	w*ε	Paddy	Nonpaddy	Nonfood	Mindustel	Chemical	Transcomm	Service	
Paddy	0.08213	0.55240[a]	0.04537	-0.63810	0.04712	0.00717	0.02574	0.00974	-0.00247	-0.00159	-0.55240
Nonpaddy	0.31912	1.12746[a]	0.35980	-0.03511	-1.17111	0.01464	0.05253	0.01988	-0.00505	-0.00325	-1.12746
Nonfood	0.02123	1.43360[b]	0.03044	-0.04464	0.12228	-1.59276	0.06680	0.02527	-0.00642	-0.00413	-1.43360
Mindustel	0.10760	1.27493[b]	0.13718	-0.03970	0.10874	0.01655	-1.37363	0.02248	-0.00571	-0.00367	-1.27493
Chemical	0.07380	1.10220[b]	0.08134	-0.03432	0.09401	0.01431	0.05135	-1.21945	-0.00493	-0.00317	-1.10220
Transcomm	0.24109	0.87315[c]	0.21051	-0.02719	0.07447	0.01134	0.04068	0.01539	-0.98534	-0.00251	-0.87315
Service	0.15502	0.87315[c]	0.13536	-0.02719	0.07447	0.01134	0.04068	0.01539	-0.00391	-0.98394	-0.87315
Total	1.00000		1.00000								

Frisch Parameter (Φ) = -0.88968

[a] Obtained from Johnson et al. (1986)

[b] Obtained from Gupta (1977)

[c] Recalculated using Engel Aggregation

TABLE XXXIX

COMPENSATED OWN- AND CROSS-PRICE ELASTICITIES FOR URBAN-LOW INCOME HOUSEHOLDS, INDONESIA

Commodities	Compensated Own- and Cross-Price Elasticities							Total Elasticities
	Paddy	Nonpaddy	Nonfood	Mindustel	Chemical	Transcomm	Service	
Paddy	-0.59273	0.22340	0.01890	0.08517	0.05051	0.13070	0.08404	0.00000
Nonpaddy	0.05750	-0.81131	0.03858	0.17384	0.10308	0.26677	0.17154	0.00000
Nonfood	0.07311	0.57977	-1.56232	0.22105	0.13107	0.33921	0.21811	0.00000
Mindustel	0.06502	0.51560	0.04362	-1.23645	0.11657	0.30166	0.19397	0.00000
Chemical	0.05621	0.44575	0.03771	0.16995	-1.13810	0.26079	0.16769	0.00000
Transcom	0.04453	0.35312	0.02988	0.13463	0.07983	-0.77483	0.13284	0.00000
Service	0.04453	0.35312	0.02988	0.13463	0.07983	0.20660	-0.84858	0.00000

TABLE XL

BUDGET SHARE, INCOME ELASTICITIES, ORDINARY OWN- AND CROSS-PRICE ELASTICITIES FOR URBAN-HIGH INCOME HOUSEHOLDS, INDONESIA

Commodities	Budget Share	Income Elasticity	Share*Income Elasticity	Elasticities							Total Elasticities
	w	ε	w*ε	Paddy	Nonpaddy	Nonfood	Mindustel	Chemical	Transcomm	Service	
Paddy	0.03483	0.23550[a]	0.00820	-0.50230	0.09533	0.00639	0.05385	0.02401	0.05629	0.03093	-0.23550
Nonpaddy	0.29227	1.12746[a]	0.32952	-0.01971	-1.92866	0.03061	0.25781	0.11496	0.26947	0.14805	-1.12746
Nonfood	0.01336	1.43360[b]	0.01915	-0.02506	0.58034	-2.99376	0.32782	0.14617	0.34264	0.18826	-1.43360
Mindustel	0.13475	1.27493[b]	0.17179	-0.02228	0.51611	0.03461	-2.40550	0.13000	0.30471	0.16742	-1.27493
Chemical	0.07657	1.10220[b]	0.08440	-0.01926	0.44618	0.02992	0.25204	-2.21924	0.26343	0.14474	-1.10220
Transcomm	0.28929	0.86327[c]	0.24973	-0.01509	0.34946	0.02343	0.19740	0.08802	-1.61986	0.11336	-0.86327
Service	0.15894	0.86327[c]	0.13721	-0.01509	0.34946	0.02343	0.19740	0.08802	0.20632	-1.71282	-0.86327
Total	1.00000		1.00000								

Frisch Parameter (Φ) = -0.47272

[a] Obtained from Johnson et al. (1986)

[b] Obtained from Gupta (1977)

[c] Recalculated using Engel Aggregation

TABLE XLI

COMPENSATED OWN- AND CROSS-PRICE ELASTICITIES FOR URBAN-HIGH INCOME HOUSEHOLDS, INDONESIA

Commodities	Compensated Own- and Cross-Price Elasticities							Total Elasticities
	Paddy	Nonpaddy	Nonfood	Mindustel	Chemical	Transcomm	Service	
Paddy	-0.49410	0.16416	0.00954	0.08558	0.04204	0.12441	0.06836	0.00000
Nonpaddy	0.01956	-1.59914	0.04566	0.40973	0.20129	0.59563	0.32726	0.00000
Nonfood	0.02487	0.99933	-2.97462	0.52099	0.25594	0.75736	0.41612	0.00000
Mindustel	0.02212	0.88873	0.05164	-2.23371	0.22762	0.67354	0.37006	0.00000
Chemical	0.01912	0.76832	0.04464	0.40055	-2.13485	0.58228	0.31993	0.00000
Transcom	0.01498	0.60177	0.03496	0.31372	0.15412	-1.37012	0.25057	0.00000
Service	0.01498	0.60177	0.03496	0.31372	0.15412	0.45606	-1.57561	0.00000

APPENDIX B

A PORTION OF THE COEFFICIENTS ASSOCIATED WITH SAM, AND A PORTION OF THE INITIAL TABLEAU OF APPLIED GEM

TABLE XLII

QUANTITY AND REVENUE OF SEGMENTED DEMAND
FOR FOOD NON-RICE BY TYPE OF HOUSEHOLD

Segment	Quantity (Q) Revenue (ρ)	Type of Household: Agricultural Laborers	Agricultural Operators	Rural Low	Rural High	Urban Low	Urban High
1	Q (Billion Rp.)	231.74939	1370.51576	625.47843	172.86323	309.01327	230.36390
	ρ (Billion Rp.)	463.49878	2741.03152	1250.95687	345.72652	525.32256	322.50945
2	Q	325.97613	1821.08528	825.89396	246.99632	576.74499	424.77242
	ρ	597.62290	3338.65635	1514.13893	456.49325	903.56715	552.20415
3	Q	420.20286	2271.65481	1026.30949	325.12937	844.47671	619.18095
	ρ	700.33810	3786.09135	1710.51582	541.88229	1210.41662	743.01714
4	Q	514.42960	2722.22433	1226.72502	401.26243	1112.20843	813.58947
	ρ	771.64439	4083.33650	1840.08753	601.89365	1445.87096	894.94842
5	Q	608.65633	3172.79385	1427.14054	477.39549	1379.94015	1007.99800
	ρ	881.54177	4230.39181	1920.85046	636.52732	1609.93017	1007.99800
6	Q	702.88307	3623.36338	1627.55607	553.52854	1647.67187	1202.40653
	ρ	820.03024	4227.25727	1898.81542	645.78330	1702.59427	1082.16587
7	Q	797.10980	4073.93290	1827.97160	629.66160	1915.40359	1396.81505
	ρ	797.10980	4073.93290	1827.97160	629.66160	1723.86323	1117.45204
8	Q	891.33653	4524.50242	2028.38713	705.79466	2183.13531	1591.22358
	ρ	742.78045	3770.41869	1690.32261	588.16221	1673.73707	1113.85650
9	Q	985.56327	4975.07195	2228.80266	781.92771	2450.86703	1785.63210
	ρ	657.04218	3316.71463	1485.86844	521.28514	1522.21579	1071.37926
10	Q	1079.7900	5425.64147	2429.21818	858.06077	2718.59875	1980.04063
	ρ	539.89500	2712.82073	1214.60909	429.03038	1359.29938	990.02032

TABLE XLIII

QUANTITY AND REVENUE OF SEGMENTED DEMAND FOR AGRICULTURAL NON-FOOD BY TYPE OF HOUSEHOLD

		Type of Household					
Segment	Quantity (Q) Revenue (ρ)	Agricultural Laborers	Agricultural Operators	Rural Low	Rural High	Urban Low	Urban High
1	Q (Billion Rp.)	84.43434	301.89971	103.20513	15.11355	23.23095	18.48144
	ρ (Billion Rp.)	168.86868	603.79942	206.41027	30.22711	34.84643	22.17773
2	Q	94.93528	348.65309	121.22928	19.72963	43.42185	29.20644
	ρ	174.04802	639.19733	222.25368	36.17098	60.30813	32.77611
3	Q	105.43623	395.40647	139.25342	24.34570	63.61275	39.93143
	ρ	175.72704	659.01079	232.08904	40.57617	81.28296	41.70616
4	Q	115.93717	442.15985	157.27757	28.96178	83.80365	50.65643
	ρ	173.90575	663.23978	235.91635	43.44266	97.77093	48.96788
5	Q	126.43811	488.91324	175.30171	33.57785	103.99455	61.38142
	ρ	168.58415	651.88431	233.73562	44.77047	109.77203	54.56126
6	Q	136.93906	535.66662	193.32586	36.19393	124.18545	72.10641
	ρ	159.76223	624.94439	225.54683	44.55959	117.28626	58.48631
7	Q	147.4400	582.4200	211.3500	42.8100	144.37635	82.83141
	ρ	147.4400	582.4200	211.3500	42.8100	120.31362	60.74303
8	Q	157.94094	629.17338	229.37414	47.42607	164.56725	93.55640
	ρ	131.61745	524.31115	191.14512	39.52173	118.85412	61.33142
9	Q	168.44189	675.92676	247.39829	52.04215	184.75815	104.28140
	ρ	112.29459	450.61784	164.93219	34.69477	112.90776	60.25147
10	Q	178.94283	722.68015	265.42243	56.65822	204.94905	115.00639
	ρ	89.47142	361.34007	132.71122	28.32911	102.47452	57.50326

TABLE XLIV

QUANTITY AND REVENUE OF SEGMENTED DEMAND
FOR MINING, INDUSTRY, ELECTRICITY, WATER
AND GAS BY TYPE OF HOUSEHOLD

		Type of Household					
Segment	Quantity (Q) Revenue (ρ)	Agricultural Laborers	Agricultural Operators	Rural Low	Rural High	Urban Low	Urban High
1	Q (Billion Rp.)	42.40382	506.88007	259.94375	81.48134	181.05286	129.35509
	ρ (Billion Rp.)	84.80764	1013.76014	519.88751	162.96268	271.57930	168.16162
2	Q	45.96818	579.20006	304.55479	105.67945	269.28556	228.72247
	ρ	84.27500	1061.86678	558.35046	193.74566	374.00772	277.00833
3	Q	49.53255	651.52005	349.16584	129.87756	357.51826	328.08985
	ρ	82.55424	1085.86675	581.94306	216.46260	456.82888	368.18975
4	Q	53.09691	723.84004	393.77688	154.07567	445.75095	427.45723
	ρ	79.64536	1085.76005	590.66532	231.11350	520.04278	441.70581
5	Q	56.66127	796.16002	438.38792	178.27378	533.98365	526.82461
	ρ	75.54836	1061.54670	584.51722	237.69837	563.64941	497.55658
6	Q	60.22564	868.48001	482.99896	202.47189	622.21635	626.19199
	ρ	70.26324	1013.22668	563.49879	236.21720	587.64877	535.74204
7	Q	63.79000	640.8000	527.6100	226.6700	710.44905	725.55937
	ρ	63.79000	940.8000	527.6100	226.6700	592.04087	556.26219
8	Q	67.35436	1013.11999	572.22104	250.86811	798.68174	824.92675
	ρ	56.12864	844.2666	476.85087	209.05676	576.82570	559.11702
9	Q	70.91873	1085.43998	616.83208	275.06622	886.91444	924.29413
	ρ	47.27915	723.62665	411.22139	183.37748	542.00327	544.30654
10	Q	74.48309	1157.75996	661.44312	299.26433	975.14714	1023.66151
	ρ	37.24155	578.87998	330.72156	149.63217	487.57357	511.83076

TABLE XLV

QUANTITY AND REVENUE OF SEGMENTED DEMAND
FOR CHEMICAL AND FERTILIZER
BY TYPE OF HOUSEHOLD

		Type of Household					
Segment	Quantity (Q) Revenue (ρ)	Agricultural Laborers	Agricultural Operators	Rural Low	Rural High	Urban Low	Urban High
1	Q (Billion Rp.)	6.31995	91.46777	43.54749	50.51056	106.39910	88.26255
	ρ (Billion Rp.)	18.95985	274.40332	130.64248	101.02111	170.23856	114.74131
2	Q	7.30607	123.14864	67.65895	59.76213	165.49780	140.35661
	ρ	19.88874	335.23796	184.18271	109.56390	244.56897	169.98745
3	Q	8.29219	154.82950	91.77041	69.01370	224.59650	192.45067
	ρ	20.26979	378.47212	224.32767	115.02284	304.45304	215.97242
4	Q	9.27830	186.51037	115.88187	78.26528	283.69520	244.54473
	ρ	20.10299	404.10580	251.07739	117.39792	349.89075	252.69622
5	Q	10.26442	218.19123	139.99333	87.51685	342.79391	296.63879
	ρ	19.38835	412.13899	264.43185	116.68914	380.88212	280.15885
6	Q	11.25054	249.87210	164.10479	96.76843	401.89261	348.73285
	ρ	18.12587	402.57171	264.39105	112.89650	397.42714	298.36032
7	Q	12.23666	281.55296	188.21625	106.0200	460.99131	400.82691
	ρ	16.31554	375.40395	250.95500	106.0200	399.52580	307.30063
8	Q	13.22278	313.23383	212.32771	115.27157	520.09001	452.92097
	ρ	13.95738	330.63571	224.12369	96.05965	387.17812	306.97977
9	Q	14.20889	344.91469	236.43917	124.52315	579.18872	505.01503
	ρ	11.05136	268.26698	183.89713	83.01543	360.38409	297.39774
10	Q	15.19501	376.59556	260.55063	133.77472	638.28742	557.10909
	ρ	7.59751	188.29778	130.27531	66.88736	319.14371	278.55454

TABLE XLVI

QUANTITY AND REVENUE OF SEGMENTED DEMAND
FOR TRANSPORT AND COMMUNICATION
BY TYPE OF HOUSEHOLD

		Type of Household					
Segment	Quantity (Q) Revenue (ρ)	Agricultural Laborers	Agricultural Operators	Rural Low	Rural High	Urban Low	Urban High
1	Q (Billion Rp.)	12.59452	375.19027	210.18732	95.21944	274.25943	351.25510
	ρ (Billion Rp.)	100.75614	1125.17942	630.56195	238.04860	493.66697	491.75714
2	Q	14.50469	431.69856	264.17241	117.32767	458.61939	512.87133
	ρ	103.95031	1175.17942	719.13601	267.24636	759.26989	666.73272
3	Q	16.41487	488.20686	318.15751	139.43590	642.97936	674.48755
	ρ	103.96085	1193.39455	777.71835	286.61824	971.61325	809.38506
4	Q	18.32505	544.71516	372.14260	161.54413	827.33932	836.10378
	ρ	100.78776	1180.21617	806.30897	296.16424	1130.69707	919.71415
5	Q	20.23522	601.22345	426.12700	183.65236	1011.69929	997.72000
	ρ	94.43104	1135.64430	804.90787	295.88436	1236.52135	997.7200
6	Q	22.14540	657.73175	480.11279	205.76060	1196.05928	1159.33622
	ρ	84.89070	1059.67893	773.51505	285.77860	1289.08608	1043.40260
7	Q	24.05558	714.24004	534.09789	227.86883	1380.41921	1320.95245
	ρ	72.16673	952.32006	712.13051	265.84696	1288.39127	1056.76196
8	Q	25.96575	770.74834	588.08298	249.97706	1564.77918	1482.56867
	ρ	56.25913	813.56769	620.75426	236.08944	1234.43691	1037.79807
9	Q	27.87593	827.25664	642.06808	272.08529	1749.13914	1644.18490
	ρ	37.16791	643.42183	499.38628	196.50604	1127.22300	986.51094
10	Q	29.78611	883.76493	696.05317	294.19352	1933.49911	1805.80112
	ρ	14.89305	441.88247	348.02659	147.09676	966.74955	902.90056

TABLE XLVII

QUANTITY AND REVENUE OF SEGMENTED DEMAND
FOR SERVICES BY TYPE OF HOUSEHOLD

		Type of Household					
Segment	Quantity (Q) Revenue (ρ)	Agricultural Laborers	Agricultural Operators	Rural Low	Rural High	Urban Low	Urban High
1	Q (Billion Rp.)	28.70875	498.44361	213.56455	85.03345	177.28145	78.71362
	ρ (Billion Rp.)	229.67003	1495.33082	640.69365	212.58362	319.10661	118.07044
2	Q	34.42200	587.04727	269.39170	103.49516	295.65883	183.03948
	ρ	246.69098	1598.07313	733.34406	235.73897	489.47962	254.22151
3	Q	40.13524	675.65094	325.21884	121.95687	414.03620	287.36535
	ρ	254.18986	1651.59118	794.59118	250.68912	625.65471	367.18905
4	Q	45.84848	764.25460	381.04599	140.41858	532.41358	391.69121
	ρ	252.16667	1655.88497	825.59964	257.43402	727.63189	456.97308
5	Q	51.56173	852.85827	436.87313	158.88029	650.79096	496.01707
	ρ	240.62140	1610.95451	825.20481	255.97381	795.41117	523.57357
6	Q	57.27497	941.46193	492.70028	177.34200	769.16834	600.34293
	ρ	219.55406	1516.79978	793.79489	246.30834	828.99254	566.99055
7	Q	62.98822	1030.06560	548.52742	195.80372	887.54571	704.66879
	ρ	188.96465	1373.42080	731.36990	228.43767	828.37600	587.22399
8	Q	68.70146	1118.66927	604.35457	214.26543	1005.92309	808.99465
	ρ	148.85316	1180.81756	637.92892	202.36179	793.56155	584.27392
9	Q	74.41470	1207.27293	660.18172	232.72714	1124.30047	913.32052
	ρ	99.21960	938.99006	513.47467	168.08071	724.54919	558.14031
10	Q	80.12795	1295.8766	716.0086	251.18885	1242.67784	1017.64638
	ρ	40.06397	647.93830	358.00443	125.59493	621.33892	508.82319

TABLE XLVIII

A PORTION OF INITIAL COEFFICIENTS OF THE APPLIED GEM ASSOCIATED WITH SAM

Expenditures / Receipts	Factors of Production 1	2	3	4	5
FACTORS OF PRODUCTION:					
1. Agricultural Laborers					
2. Production Workers					
3. Sales and Services					
4. Professional and Management					
5. Capital					
INSTITUTIONS:					
6. Agricultural Laborers					
7. Agricultural Operators					
8. Non-agricultural Rural-low					
9. Non-agricultural Rural-high			Matrix of b_{fh}		
10. Urban-low					
11. Urban-high					
12. Private Companies					
13. Government					
PRODUCTION SECTORS:					
14. Paddy (Bimas)					
15. Paddy (Non-Bimas)					
16. Food Non-paddy					
17. Agriculture Non-food					
18. Mining, Industrial, Construction, Elgaswater					
19. Chemical and Fertilizer					
20. Trade, Hotel, Transportion, and Comm.					
21. Banking, Real Estate, and Services					
22. TRADE AND TRANSPORT MARGIN					
COMMODITIES:					
23. Rice					
24. Food Non-Rice					
25. Agriculture Non-food					
26. Mining, Industrial, Construction, Elgaswater					
27. Chemical and Fertilizer					
28. Trade, Hotel, Transportation, and Comm.					
29. Banking, Real Estate, and Services					
OTHERS:					
30. CAPITAL ACCOUNT					
31. INDIRECT TAXES MINUS SUBSIDY					

TABLE XLVIII (Continued)

Expenditures / Receipts	Institutions 6	7	8	9	10	11
FACTORS OF PRODUCTION:						
1. Agricultural Laborers						
2. Production Workers						
3. Sales and Services						
4. Professional and Management						
5. Capital						
INSTITUTIONS:						
6. Agricultural Laborers						
7. Agricultural Operators						
8. Non-agricultural Rural-low						
9. Non-agricultural Rural-high			Matrix of H_k TR H_h			
10. Urban-low						
11. Urban-high						
12. Private Companies						
13. Government			Vector of t_h			
PRODUCTION SECTORS:						
14. Paddy (Bimas)						
15. Paddy (Non-Bimas)						
16. Food Non-paddy						
17. Agriculture Non-food						
18. Mining, Industrial, Construction, Elgaswater						
19. Chemical and Fertilizer						
20. Trade, Hotel, Transportion, and Comm.						
21. Banking, Real Estate, and Services						
22. TRADE AND TRANSPORT MARGIN						
COMMODITIES:						
23. Rice						
24. Food Non-Rice						
25. Agriculture Non-food						
26. Mining, Industrial, Construction, Elgaswater						
27. Chemical and Fertilizer			Matrix of $X_{i,h,0}$			
28. Trade, Hotel, Transportation, and Comm.						
29. Banking, Real Estate, and Services						
OTHERS:						
30. CAPITAL ACCOUNT			Vector of s_h			
31. INDIRECT TAXES MINUS SUBSIDY						
32. REST OF THE WORLD						

TABLE XLVIII (Continued)

Expenditures / Receipts	Private Companies 12	Government 13	Production Sectors 14	15	16
FACTORS OF PRODUCTION:					
1. Agricultural Laborers					
2. Production Workers					
3. Sales and Services				Matrix of $r_{f,i,t}$	
4. Professional and Management					
5. Capital					
INSTITUTIONS:					
6. Agricultural Laborers					
7. Agricultural Operators	Vector of	Vector of			
8. Non-agricultural Rural-low					
9. Non-agricultural Rural-high	$COMTRH_h$	GTRHh			
10. Urban-low					
11. Urban-high					
12. Private Companies					
13. Government					
PRODUCTION SECTORS:		(GTRG)			
14. Paddy (Bimas)					
15. Paddy (Non-Bimas)					
16. Food Non-paddy					
17. Agriculture Non-food					
18. Mining, Industrial, Construction, Elgaswater					
19. Chemical and Fertilizer					
20. Trade, Hotel, Transportion, and Comm.					
21. Banking, Real Estate, and Services					
22. TRADE AND TRANSPORT MARGIN					
COMMODITIES:					
23. Rice					
24. Food Non-Rice		Vector of		Matrix of	
25. Agriculture Non-food					
26. Mining, Industrial, Construction, Elgaswater		$GCON_i$		$A_{ij,t}$	
27. Chemical and Fertilizer					
28. Trade, Hotel, Transportation, and Comm.					
29. Banking, Real Estate, and Services					
OTHERS:	(S_c)	(S_g)			
30. CAPITAL ACCOUNT					
31. INDIRECT TAXES MINUS SUBSIDY					
32. REST OF THE WORLD					

Note: $A_{ij,t} = \frac{X_{ij,t}}{X_{j,t}}$

where $A_{ij,t}$ = Input-Output Coefficient

TABLE XLVIII (Continued)

Receipts / Expenditures	Production Sectors 17	18	19	20	21
FACTORS OF PRODUCTION:					
1. Agricultural Laborers					
2. Production Workers					
3. Sales and Services			Matrix of $r_{f,i,t}$		
4. Professional and Management					
5. Capital					
INSTITUTIONS:					
6. Agricultural Laborers					
7. Agricultural Operators					
8. Non-agricultural Rural-low					
9. Non-agricultural Rural-high					
10. Urban-low					
11. Urban-high					
12. Private Companies					
13. Government					
PRODUCTION SECTORS:					
14. Paddy (Bimas)					
15. Paddy (Non-Bimas)					
16. Food Non-paddy					
17. Agriculture Non-food					
18. Mining, Industrial, Construction, Elgaswater					
19. Chemical and Fertilizer			Matrix of $r_{f,i,t}$		
20. Trade, Hotel, Transportion, and Comm.					
21. Banking, Real Estate, and Services					
22. TRADE AND TRANSPORT MARGIN					
COMMODITY					
23. Rice					
24. Food Non-Rice					
25. Agriculture Non-food					
26. Mining, Industrial, Construction, Elgaswater					
27. Chemical and Fertilizer					
28. Trade, Hotel, Transportation, and Comm.					
29. Banking, Real Estate, and Services					
OTHERS:					
30. CAPITAL ACCOUNT					
31. INDIRECT TAXES MINUS SUBSIDY					
32. REST OF THE WORLD					

TABLE XLVIII (Continued)

Receipts / Expenditures	Margin 22	Domestic Commodities 23	24	25	26	27
FACTORS OF PRODUCTION:						
1. Agricultural Laborers						
2. Production workers						
3. Sales and Services						
4. Professional and Management						
5. Capital						
INSTITUTIONS:						
6. Agricultural Laborers						
7. Agricultural Operators						
8. Non-agricultural Rural-low						
9. Non-agricultural Rural-high						
10. Urban-low						
11. Urban-high						
12. Private Companies						
13. Government						
PRODUCTION SECTORS:						
14. Paddy (Bimas)						
15. Paddy (Non-Bimas)						
16. Food Non-paddy						
17. Agriculture Non-food						
18. Mining, Industrial, Construction, Elgaswater						
19. Chemical and Fertilizer						
20. Trade, Hotel, Transportion, and Comm.						
21. Banking, Real Estate, and Services						
22 = TRADE AND TRANSPORT MARGIN		(	Vector of $TRADE_i$			)
COMMODITIES:						
23. Rice						
24. Food Non-Rice						
25. Agriculture Non-food						
26. Mining, Industrial, Construction, Elgaswater						
27. Chemical and Fertilizer						
28. Trade, Hotel, Transportation, and Comm.						
29. Banking, Real Estate, and Services						
OTHERS:						
30. CAPITAL ACCOUNT		(	Vector of $INDTAX_i$			)
31. INDIRECT TAXES MINUS SUBSIDY						
32. REST OF THE WORLD		(	Vector of m_i			)

TABLE XLVIII (Continued)

Receipts / Expenditures	Domestic Commodities 28	29	CAPITAL ACCOUNT 30	INDIRECT TAX 31	REST OF THE WORLD 32	ROW TOTAL
FACTORS OF PRODUCTION:						
1. Agricultural Laborers						
2. Production Workers						
3. Sales and Services						Vector of s_f
4. Professional and Management						
5. Capital						
INSTITUTIONS:						
6. Agricultural Laborers						
7. Agricultural Operators						
8. Non-agricultural Rural-low						
9. Non-agricultural Rural-high					Vector of $REMH_h$	Vector of Y_h
10. Urban-low						
11. Urban-high						
12. Private Companies						
13. Government						
PRODUCTION SECTORS:						
14. Paddy (Bimas)						
15. Paddy (Non-Bimas)						
16. Food Non-paddy						
17. Agriculture Non-food						
18. Mining, Industrial, Construction, Elgaswater						
19. Chemical and Fertilizer						Vector of $q_{i,t}$
20. Trade, Hotel, Transportion, and Comm.						
21. Banking, Real Estate, and Services						
22. TRADE AND TRANSPORT MARGIN	(Vector of $TRADE_i$)					($\Sigma TRADE_i$)
COMMODITIES:						
23. Rice						
24. Food Non-Rice						
25. Agriculture Non-food						
26. Mining, Industrial, Construction, Elgaswater						
27. Chemical and Fertilizer						
28. Trade, Hotel, Transportation, and Comm.						
29. Banking, Real Estate, and Services						
OTHERS:						
30. CAPITAL ACCOUNT						(TINV)
31. INDIRECT TAXES MINUS SUBSIDY	(Vector of $INDTAX_i$)					
32. REST OF THE WORLD	(Vector of m_i)					

TABLE XLIX

A PORTION OF INITIAL TABLEAU OF APPLIED GEM (AGRICULTURAL LABORERS)

Rows	Agricultural Laborers											
	Segmented Demand for Rice				Segmented Demand for Food non-rice				Segmented Demand for Service			
	W111	W112		W1110	W211	W212		W2110	....	W711	W712	....	W7110
Objective function	464.2	510.3	....	224.6	463.5	597.6	......	539.9		229.7	246.7	....	40.1
Commodity balances:												
Rice	154.7	187.5	....	449.3								
Non-rice					231.7	326.0	......	1079.8				
Non-food												
Mindustel												
Chemfert												
Transcomm												
Services										28.7	34.4	....	80.1
Resource Constraint												
Ag. Labor												
Prod. Worker												
Sale & Services												
Prof. & Management												
Capital												
Demand Function												
Rice	-396.4	-480.2		-1150.9								
Non-rice					-290.7	-408.9		-1354.6				
Non-food												
Mindustel												
Chemfert												
Transcomm												
Services										-374.3	-448.8		-1044.7
Budget Constraint												
Ag. Laborers	464.2	510.3		224.6	463.5	597.6		539.9		229.7	246.7		40.1
Household Income												
Ag. Laborers												
Balance of Payments (BOP)												
Marginal Cost Pricing												
Rice Bimas												
Rice non-Bimas												
Non-rice												
Non-food												
Mindustel												
Chemfert												
Transcomm												
Services												
Import Function												
Rice												
Non-rice												
Non-food												
Mindustel												
Chemfert												
Transcomm												
Services												
Convexity Constraint												
Rice	1.0	1.0		1.0								
Non-rice					1.0	1.0		1.0				
Non-food												
Mindustel												
Chemfert												
Transcomm												
Services										1.0	1.0		1.0
Government Revenue												
Government Cost												
Company Revenue												
Saving and Investment												

TABLE XLIX (Continued)

Rows	Rice Production q1BT0	q1BT1	q1BT2	q1BT3	q1NB	Non-rice q2	Non-food q3	Service q7	Factor Prices Labor1 Pf1	Labor2 Pf2	Capital Pf5
Objective function									-5356.1	-4567.7	-29976.4
Commodity balances:											
Rice	-1247.5	-1247.5	-1247.5	-1247.5	-1248.7	14.1					
Non-rice	1.9	1.9	1.9	1.9	1.8	-804.0	1.4	12.9			
Non-food	0.1	0.1	0.1	0.1	0.1	8.3	-1150.9	0.2			
Mindustel	4.1	4.1	4.1	4.1	3.9	28.9	28.9	32.4			
Chemfert	86.6	86.6	86.6	86.6	56.6	16.3	34.5	52.8			
Transcomm	255.5	255.5	255.5	255.5	255.5	149.1	311.9	18.0			
Services	9.7	9.7	9.7	9.7	9.1	8.3	13.7	-982.5			
Resource Constraint											
Ag. Labor	576.4	647.8	724.0	800.2	612.0	189.7	191.6				
Prod. Worker	2.4	2.7	3.1	3.3	2.6	29.0	9.7	28.4			
Sale & Services	1.2	1.3	1.5	1.7	1.3	4.4	6.8	214.0			
Prof. & Management	0.9	1.0	1.1	1.2	0.9	0.9	2.1	293.8			
Capital	309.4	248.3	201.5	162.7	291.3	263.3	540.1	317.4			
Demand Function											
Rice											
Non-rice											
Non-food											
Mindustel											
Chemfert											
Transcomm											
Services											
Budget Constraint											
Ag. Laborers											
Household Income											
Ag. Laborers									-1051.9	-152.4	-163.1
Balance of Payments (BOP)											
Marginal Cost Pricing											
Rice Bimas									-576.4	-2.4	-309.4
Rice non-Bimas									-612.0	-2.6	-291.3
Non-rice									-189.7	-29.0	-263.3
Non-food									-191.6	-9.7	-540.1
Mindustel										-81.3	515.7
Chemfert										-50.9	-275.1
Transcomm										-94.5	-314.3
Services										-28.4	-317.4
Import Function											
Rice	-42.3	-42.3	-42.3	-42.3	-42.3						
Non-rice						-32.8					
Non-food							-36.2				
Mindustel											
Chemfert											
Transcomm											
Services								-57.2			
Convexity Constraint											
Rice											
Non-rice											
Non-food											
Mindustel											
Chemfert											
Transcomm											
Services											
Government Revenue	13.7	13.7	13.7	13.7	13.7	17.3	10.3	12.4			123.4
Government Cost	21.4	21.4	21.4	21.4							
Company Revenue											-17546.8
Saving and Investment											

TABLE XLIX (Continued)

Rows	Domestic Commodity Prices				Import Activities			
	Rice P1	NRice P2	....	Service P7	Rice M1	NRice M2	....	Service M7
Objective function								
Commodity balances:								
Rice					-1.0			
Non-rice						-1.0		
Non-food								
Mindustel								
Chemfert								
Transcomm								
Services								-1.0
Resource Constraint								
Ag. Labor								
Prod. Worker								
Sale & Services								
Prof. & Management								
Capital								
Demand Function								
Rice	-301.8	-257.7		-31.3				
Non-rice	-249.1	-709.3		-53.7				
Non-food	-311.1	-551.3		-67.1				
Mindustel	-276.7	-490.3		-59.6				
Chemfert	-239.2	-423.9		-51.6				
Transcomm	-69.2	-122.7		-14.9				
Services	-69.2	-122.7		-89.4				
Budget Constraint								
Ag. Laborers								
Household Income								
Ag. Laborers								
Balance of Payments (BOP)					1.0	1.0		1.0
Marginal Cost Pricing								
Rice Bimas	978.7	-1.9		-9.7				
Rice non-Bimas	979.9	-1.8		-9.1				
Non-rice	-14.1	640.2		-8.3				
Non-food		-1.4		-13.7				
Mindustel	-0.7	-2.2		-20.7				
Chemfert		-5.2		-15.1				
Transcomm		-64.3		-33.5				
Services		-12.9		970.1				
Import Function								
Rice					1.0			
Non-rice						1.0		
Non-food								
Mindustel								
Chemfert								
Transcomm								
Services								1.0
Convexity Constraint								
Rice		257.7		31.3				
Non-rice	249.1			53.7				
Non-food	311.1	551.3		67.1				
Mindustel	276.7	490.3		59.6				
Chemfert	239.2	423.9		51.6				
Transcomm	69.2	122.7		14.9				
Services	69.2	122.7						
Government Revenue								
Government Cost								
Company Revenue								
Saving and Investment								

TABLE XLIX (Continued)

Rows	Exports Activities: Rice E1	NRice E2	....	Service E7	Trade Activities: Rice TRADE1	NRice TRADE2	....	Service TRADE7	Indirect Tax Activities: Rice INDTAX1		Service INDTAX7
Objective function	301.7	2410.7	....	30.8							
Commodity balances:											
Rice	1.0				-1.0				-1.0		
Non-rice		1.0				-1.0				-1.0	
Non-food											
Mindustel											
Chemfert											
Transcomm											
Services				1.0				-1.0			-1.0
Resource Constraint											
Ag. Labor											
Prod. Worker											
Sale & Services											
Prof. & Management											
Capital											
Demand Function											
Rice											
Non-rice											
Non-food											
Mindustel											
Chemfert											
Transcomm											
Services											
Budget Constraint											
Ag. Laborers											
Household Income											
Ag. Laborers											
Balance of Payments (BOP)	-1.0	-1.0		-1.0							
Marginal Cost Pricing											
Rice Bimas											
Rice non-Bimas											
Non-rice											
Non-food											
Mindustel											
Chemfert											
Transcomm											
Services											
Import Function											
Rice											
Non-rice											
Non-food											
Mindustel											
Chemfert											
Transcomm											
Services											
Convexity Constraint											
Rice											
Non-rice											
Non-food											
Mindustel											
Chemfert											
Transcomm											
Services											
Government Revenue											
Government Cost											
Company Revenue											
Saving and Investment											

TABLE XLIX (Continued)

Rows	Income Formation Ag. labores YI	Company COMREV	Government GREV	Saving Activities Total Saving TINV	RHS
Objective function					Maximize
Commodity balances:					
Rice					<= 0
Non-rice					<= 0
Non-food					<= 0
Mindustel					<= 0
Chemfert					<= 0
Transcomm					<= 0
Services					<= 0
Resource Constraint					
Ag. Labor					<= 5356.08
Prod. Worker					<= 4567.66
Sale & Services					<= 6079.24
Prof. & Management					<= 2531.81
Capital					<= 29976.43
Demand Function					
Rice	412.8				= -1000
Non-rice	707.2				= -1000
Non-food	883.4				= -1000
Mindustel	785.6				= -1000
Chemfert	679.2				= -1000
Transcomm	196.6				= -1000
Services	196.6				= -1000
Budget Constraint					
Ag. Laborers	-935.0				<= 0
Household Income					
Ag. Laborers	1000.0				= 0
Balance of Payments (BOP)					
Marginal Cost Pricing					
Rice Bimas					<= 0
Rice non-Bimas					<= 0
Non-rice					<= 0
Non-food					<= 0
Mindustel					<= 0
Chemfert					<= 0
Transcomm					<= 0
Services					<= 0
Import Function					
Rice					= 0
Non-rice					= 0
Non-food					= 0
Mindustel					= 0
Chemfert					= 0
Transcomm					= 0
Services					= 0
Convexity Constraint					
Rice	-412.8				<= 698.2
Non-rice	-707.2				<= 290.737
Non-food	-883.4				<= 572.669
Mindustel	-785.6				<= 664.74
Chemfert	-679.2				<= 735.4676
Transcomm	-196.6				<= 920.620
Services	-196.6				<= 910.614
Government Revenue	21.3	436.4	-1000.0		= 0
Government Cost					= 0
Company Revenue		985.0			= 0
Saving and Investment	29.3	464.7	304.0	-1000.0	= 0

APPENDIX C

THEORETICAL FRAMEWORK FOR ESTIMATING PADDY BIMAS PRODUCTION FUNCTION

TABLE L

GENERAL EQUILIBRIUM RESULTS (INDICES) FOR INDONESIA, POLICY SIMULATION V A: INCREASED AGRICULTURAL LABOR SUPPLY, FIXED FERTILIZER SUBSIDY AT THE LEVEL OF 37.5 PERCENT, AND VARIABLE AGRICULTURAL EXPORTS

Items	Agricultural Labor Supplied (Percent)			
	0	5	15	25
Input Prices				
1. Agricultural Laborers	1.00000	0.97938	0.90250	0.87650
2. Production Workers	1.00000	1.00000	0.98800	0.98560
3. Sales and Services	1.00000	1.00000	0.99815	0.98855
4. Professional and Management	1.00000	1.00000	0.99566	0.98575
5. Capital	1.00000	1.00000	1.00005	1.00065
Household Real Income				
6. Agricultural Laborers	1.00000	1.02334	1.04735	1.09188
7. Agricultural Operators	1.00000	1.01497	1.03798	1.06517
8. Non-agricultural Rural-low	1.00000	1.00120	1.02360	1.03139
9. Non-agricultural Rural-high	1.00000	1.00554	1.02126	1.02868
10. Urban-low	1.00000	1.00497	1.02207	1.02775
11. Urban-high	1.00000	1.00491	1.02116	1.02735
Total Household Income	1.00000	1.00892	1.02922	1.04526
Institutional Real Income				
12. Private Companies	1.00000	1.00487	1.02632	1.03247
13. Government	1.00000	1.00487	1.00674	1.04041
Production				
14. Paddy (Bimas)	1.00000	1.00000	1.00000	1.00000
15. Paddy (Non-Bimas)	1.00000	1.08318	1.12713	1.47384
16. Food Non-paddy	1.00000	1.01200	1.03715	1.04600
17. Agricultural Non-food Crops	1.00000	1.00020	1.00064	1.00064
18. Mining, Industry, Gas, etc.	1.00000	1.00063	1.00192	1.00297
19. Chemical and Fertilizer	1.00000	1.00089	1.00111	1.00130
20. Trade, Transport and Communication	1.00000	1.00007	1.00015	1.00032
21. Services	1.00000	1.00079	1.00182	1.00305
Total Gross Output	1.00000	1.00299	1.00844	1.01231
Commodity Prices				
23. Rice	1.00000	0.98709	0.94025	0.92400
24. Food Non-rice	1.00000	0.99297	0.96800	0.95985
25. Agricultural Non-food	1.00000	0.99530	0.98045	0.97455
26. Mining, Industry, Gas, etc.	1.00000	0.99970	1.00014	1.00075
27. Chemical and Fertilizer	1.00000	0.99971	1.00025	1.00070
28. Trade, Transport and Communication	1.00000	0.99944	0.99845	0.99750
29. Services	1.00000	0.99987	0.99900	0.99800
Aggregate Price Index	1.00000	0.99516	0.97823	0.97241
Capital Account				
30. Savings	1.00000	1.00099	1.00419	1.00610
Government				
31.1.Subsidy Cost	1.00000	1.00000	1.00000	1.00000
31.2.Net Revenue	1.00000	1.00000	1.00000	1.00000
Rest of World				
32.1.Total Commodity Imports	1.00000	1.00299	1.00844	1.01231
32.2.Total Commodity Exports	1.00000	0.96491	0.90682	0.84343
Rice Consumption				
33.1.Agricultural Laborers	1.00000	1.03194	1.05735	1.08787
33.2.Agricultural Operators	1.00000	1.01933	1.04934	1.06257
33.3.Non-agricultural Rural -low	1.00000	1.00598	1.02426	1.03192
33.4.Non-agricultural Rural-high	1.00000	1.00514	1.02104	1.03673
33.5.Urban-low	1.00000	1.00792	1.03645	1.04613
33.6.Urban-high	1.00000	1.02235	1.02664	1.03384

TABLE LI

GENERAL EQUILIBRIUM RESULTS (INDICES) FOR INDONESIA, POLICY SIMULATION V B: INCREASED AGRICULTURAL LABOR SUPPLY, FIXED FERTILIZER SUBSIDY AT THE LEVEL OF 25 PERCENT, AND VARIABLE AGRICULTURAL EXPORTS

Items	Agricultural Labor Supplied (Percent)			
	0	5	15	25
Input Prices				
1. Agricultural Laborers	1.00702	1.00520	1.00010	1.00000
2. Production Workers	1.01420	1.01300	1.00767	1.00066
3. Sales and Services	1.00310	1.00183	1.00150	1.00085
4. Professional and Management	1.01505	1.00150	1.01300	1.00096
5. Capital	1.05107	1.05313	1.05318	1.05322
Household Real Income				
6. Agricultural Laborers	0.99210	1.02147	1.08932	1.09050
7. Agricultural Operators	1.00975	1.02689	1.06478	1.11773
8. Non-agricultural Rural-low	0.99821	0.99887	1.00314	1.00723
9. Non-agricultural Rural-high	0.99414	0.99522	0.99728	0.99971
10. Urban-low	0.99860	0.99929	1.00117	1.00190
11. Urban-high	0.99219	0.99337	0.99607	0.99810
Total Household Income	1.00100	1.00923	1.02812	1.04864
Institutional Real Income				
12. Private Companies	1.03072	1.03139	1.03290	1.03332
13. Government	1.03071	1.03196	1.03340	1.03715
Production				
14. Paddy (Bimas)	0.98566	0.98566	0.98566	0.98566
15. Paddy (Non-Bimas)	1.11038	1.13114	1.17493	1.47474
16. Food Non-paddy	0.98821	1.01076	1.01799	1.02994
17. Agricultural Non-food Crops	0.97191	0.97200	0.97213	0.97228
18. Mining, Industry, Gas, etc.	1.00770	1.01431	1.01485	1.01860
19. Chemical and Fertilizer	1.00063	1.00083	1.00117	1.00121
20. Trade, Transport and Communication	0.98115	0.98148	0.98299	0.98374
21. Services	0.99667	0.99748	0.99937	1.00414
Total Gross Output	0.99499	1.00178	1.00401	1.00965
Commodity Prices				
23. Rice	1.02324	1.02200	1.02054	1.02002
24. Food Non-rice	1.00878	1.00875	1.00778	1.00687
25. Agricultural Non-food	1.00616	1.00615	1.00605	1.00600
26. Mining, Industry, Gas, etc.	1.04339	1.04390	1.04441	1.04460
27. Chemical and Fertilizer	1.04270	1.04215	1.04282	1.04327
28. Trade, Transport and Communication	1.02802	1.02705	1.02709	1.02704
29. Services	1.02761	1.02700	1.02668	1.02645
Aggregate Price Index	1.02124	1.02086	1.02034	1.01992
Capital Account				
30. Savings	1.18297	1.18449	1.18493	1.18528
Government				
31.1.Subsidy Cost	0.65710	0.65710	0.65710	0.65710
31.2.Net Revenue	1.00300	1.00300	1.00300	1.00300
Rest of World				
32.1.Total Commodity Imports	0.99499	1.00178	1.00402	1.00965
32.2.Total Commodity Exports	0.98315	0.89955	0.83219	0.83218
Rice Consumption				
33.1.Agricultural Laborers	0.98275	1.02220	1.05705	1.08227
33.2.Agricultural Operators	1.00105	1.02604	1.05071	1.06997
33.3.Non-agricultural Rural -low	0.99158	0.99890	1.00043	1.00049
33.4.Non-agricultural Rural-high	0.99492	0.99638	0.99875	0.99964
33.5.Urban-low	0.99817	0.99972	1.00013	1.00037
33.6.Urban-high	0.99686	0.99715	0.99851	0.99905

TABLE LII

GENERAL EQUILIBRIUM RESULTS (INDICES) FOR INDONESIA, POLICY SIMULATION V C: INCREASED AGRICULTURAL LABOR SUPPLY, FIXED FERTILIZER SUBSIDY AT THE LEVEL OF 15 PERCENT, AND VARIABLE AGRICULTURAL EXPORTS

Items	Agricultural Labor Supplied (Percent)			
	0	5	15	25
Input Prices				
1. Agricultural Laborers	1.01576	1.01070	1.00765	1.00015
2. Production Workers	1.01617	1.01600	1.01520	1.01080
3. Sales and Services	1.01172	1.01165	1.01000	1.00670
4. Professional and Management	1.01670	1.01660	1.01275	1.00785
5. Capital	1.08095	1.08136	1.08172	1.08176
Household Real Income				
6. Agricultural Laborers	0.99024	1.01985	1.08162	1.08750
7. Agricultural Operators	1.01773	1.03470	1.06899	1.10549
8. Non-agricultural Rural-low	0.99800	0.99850	1.00147	1.00450
9. Non-agricultural Rural-high	0.99169	0.99374	0.99451	0.99873
10. Urban-low	0.99746	0.99868	0.99878	0.99980
11. Urban-high	0.98993	0.99102	0.99242	0.99364
Total Household Income	1.00304	1.01134	1.02775	1.04243
Institutional Real Income				
12. Private Companies	1.04787	1.04953	1.05048	1.06035
13. Government	1.04527	1.04689	1.04891	1.05738
Production				
14. Paddy (Bimas)	0.97609	0.97606	0.97606	0.97605
15. Paddy (Non-Bimas)	1.18908	1.21352	1.23478	1.24669
16. Food Non-paddy	0.99281	0.99352	1.00296	1.00875
17. Agricultural Non-food Crops	0.97040	0.97041	0.97050	0.97034
18. Mining, Industry, Gas, etc.	1.00923	1.02295	1.02538	1.03009
19. Chemical and Fertilizer	1.00562	1.00772	1.00885	1.00994
20. Trade, Transport and Communication	0.97988	0.98340	0.98627	0.98676
21. Services	0.99675	0.99821	1.00124	1.00484
Total Gross Output	0.99644	1.00261	1.00624	1.00956
Commodity Prices				
23. Rice	1.03837	1.03578	1.03375	1.03045
24. Food Non-rice	1.00987	1.00600	1.00566	1.00507
25. Agricultural Non-food	1.00709	1.00700	1.00695	1.00680
26. Mining, Industry, Gas, etc.	1.06537	1.06630	1.06680	1.06971
27. Chemical and Fertilizer	1.06430	1.06545	1.06570	1.06966
28. Trade, Transport and Communication	1.04372	1.04758	1.04700	1.04700
29. Services	1.04124	1.04227	1.04078	1.04075
Aggregate Price Index	1.03123	1.03024	1.02962	1.02944
Capital Account				
30. Savings	1.33351	1.33686	1.34226	1.34878
Government				
31.1.Subsidy Cost	0.33517	0.33517	0.33517	0.33517
31.2.Net Revenue	1.00540	1.00540	1.00540	1.00540
Rest of World				
32.1.Total Commodity Imports	0.99644	1.00261	1.00624	1.00956
32.2.Total Commodity Exports	0.92425	0.89298	0.87739	0.83220
Rice Consumption				
33.1.Agricultural Laborers	0.97526	1.00573	1.04860	1.07866
33.2.Agricultural Operators	1.00353	1.01386	1.03775	1.06265
33.3.Non-agricultural Rural -low	0.98869	0.99083	0.99974	1.00078
33.4.Non-agricultural Rural-high	0.98379	0.98791	0.98940	0.99381
33.5.Urban-low	0.99538	0.99831	0.99902	0.99986
33.6.Urban-high	0.98918	0.99010	0.99157	0.99250

TABLE LIII

GENERAL EQUILIBRIUM RESULTS (INDICES) FOR INDONESIA, POLICY SIMULATION V D: INCREASED AGRICULTURAL LABOR SUPPLY, REMOVED FERTILIZER SUBSIDY, AND VARIABLE AGRICULTURAL EXPORTS

Items	Agricultural Labor Supplied (Percent)			
	0	5	15	25
Input Prices				
1. Agricultural Laborers	1.02327	1.01755	1.01255	1.00565
2. Production Workers	1.02479	1.02435	1.02260	1.01573
3. Sales and Services	1.01861	1.01830	1.01664	1.01581
4. Professional and Management	1.01995	1.01915	1.01520	1.01324
5. Capital	1.14439	1.14446	1.14656	1.14750
Household Real Income				
6. Agricultural Laborers	0.98277	1.01109	1.04040	1.05460
7. Agricultural Operators	1.03265	1.04851	1.07200	1.11446
8. Non-agricultural Rural-low	0.99682	0.99758	1.00142	1.00484
9. Non-agricultural Rural-high	0.98423	0.98538	0.98538	0.98774
10. Urban-low	0.99695	0.99744	0.99744	0.99796
11. Urban-high	0.98275	0.98349	0.98308	0.98449
Total Household Income	1.00621	1.01383	1.02446	1.04161
Institutional Real Income				
12. Private Companies	1.08730	1.08806	1.08859	1.09189
13. Government	1.11311	1.11501	1.11594	1.11722
Production				
14. Paddy (Bimas)	0.96386	0.96386	0.96386	0.96386
15. Paddy (Non-Bimas)	1.30731	1.35365	1.38811	1.41215
16. Food Non-paddy	1.00930	1.01846	1.01846	1.03458
17. Agricultural Non-food Crops	0.96428	0.96444	0.96451	0.96443
18. Mining, Industry, Gas, etc.	1.03939	1.04069	1.04069	1.04643
19. Chemical and Fertilizer	1.01157	1.01199	1.01260	1.01314
20. Trade, Transport and Communication	0.94096	0.94113	0.93769	0.93923
21. Services	0.99577	0.99748	0.99748	1.00431
Total Gross Output	1.00307	1.00568	1.00524	1.01136
Commodity Prices				
23. Rice	1.06528	1.06180	1.06177	1.05530
24. Food Non-rice	1.01003	1.01003	1.01000	1.00976
25. Agricultural Non-food	1.00893	1.00863	1.00850	1.00846
26. Mining, Industry, Gas, etc.	1.11568	1.11570	1.11572	1.11580
27. Chemical and Fertilizer	1.11369	1.11375	1.11378	1.11390
28. Trade, Transport and Communication	1.08093	1.08090	1.08094	1.08096
29. Services	1.06932	1.06855	1.06860	1.06867
Aggregate Price Index	1.05195	1.05137	1.05136	1.05041
Capital Account				
30. Savings	1.05714	1.57963	1.58112	1.58128
Government				
31.1.Subsidy Cost	0.00000	0.00000	0.00000	0.00000
31.2.Net Revenue	1.00820	1.00820	1.00820	1.00820
Rest of World				
32.1.Total Commodity Imports	1.00307	1.00568	1.00524	1.01136
32.2.Total Commodity Exports	0.90985	0.90644	0.87580	0.83218
Rice Consumption				
33.1.Agricultural Laborers	0.96243	1.01088	1.03900	1.04998
33.2.Agricultural Operators	1.01063	1.03378	1.05599	1.08144
33.3.Non-agricultural Rural -low	0.98732	0.99762	1.00061	1.00419
33.4.Non-agricultural Rural-high	0.97203	0.98655	0.98789	0.98945
33.5.Urban-low	0.99153	0.99178	0.99322	0.99576
33.6.Urban-high	0.98492	0.99155	0.99345	0.99477

TABLE LIV

GENERAL EQUILIBRIUM RESULTS (INDICES) FOR INDONESIA, POLICY SIMULATION VI A: INCREASED NON-FOOD EXPORTS AND FIXED FERTILIZER SUBSIDY AT THE LEVEL OF 37.5 PERCENT

Items	Increasing Non-Food Exports by (Percent)			
	0	5	15	25
Input Prices				
1. Agricultural Laborers	1.00000	1.01774	1.03009	1.04294
2. Production Workers	1.00000	1.01062	1.03444	1.04634
3. Sales and Services	1.00000	1.01645	1.01678	1.03323
4. Professional and Management	1.00000	1.01185	1.01343	1.02528
5. Capital	1.00000	1.02002	1.03670	1.05004
Household Real Income				
6. Agricultural Laborers	1.00000	1.00324	1.00786	1.01067
7. Agricultural Operators	1.00000	1.00514	1.00894	1.00910
8. Non-agricultural Rural-low	1.00000	1.00060	1.00176	1.00654
9. Non-agricultural Rural-high	1.00000	1.00047	1.00296	1.00803
10. Urban-low	1.00000	1.00104	1.00153	1.00667
11. Urban-high	1.00000	1.00091	1.00284	1.00768
Total Household Income	1.00000	1.00250	1.00486	1.00797
Institutional Real Income				
12. Private Companies	1.00000	1.00707	1.01018	1.01324
13. Government	1.00000	1.01198	1.01235	1.01251
Production				
14. Paddy (Bimas)	1.00000	1.00000	1.00000	1.00000
15. Paddy (Non-Bimas)	1.00000	0.97792	0.97932	0.99001
16. Food Non-paddy	1.00000	0.99955	0.99202	0.99070
17. Agricultural Non-food Crops	1.00000	1.00062	1.06002	1.09612
18. Mining, Industry, Gas, etc.	1.00000	1.00028	1.01160	1.01521
19. Chemical and Fertilizer	1.00000	1.00043	1.00200	0.99252
20. Trade, Transport and Communication	1.00000	0.99891	0.98081	0.97625
21. Services	1.00000	0.99900	1.00053	1.00088
Total Gross Output	1.00000	0.99968	1.00313	1.00518
Commodity Prices				
23. Rice	1.00000	1.01181	1.02335	1.02554
24. Food Non-rice	1.00000	1.01399	1.02879	1.03610
25. Agricultural Non-food	1.00000	1.01543	1.03055	1.04822
26. Mining, Industry, Gas, etc.	1.00000	1.01236	1.02162	1.04095
27. Chemical and Fertilizer	1.00000	1.01073	1.02635	1.03675
28. Trade, Transport and Communication	1.00000	1.01065	1.02392	1.03595
29. Services	1.00000	1.01281	1.02538	1.03927
Aggregate Price Index	1.00000	1.01277	1.02609	1.03611
Capital Account				
30. Savings	1.00000	1.01794	1.03296	1.04538
Government				
31.1.Subsidy Cost	1.00000	1.00000	1.00000	1.00000
31.2.Net Revenue	1.00000	1.00000	1.00000	1.00000
Rest of World				
32.1.Total Commodity Imports	1.00000	0.99960	1.00305	1.00511
32.2.Total Commodity Exports	1.00000	1.00746	1.02237	1.03729
Rice Consumption				
33.1.Agricultural Laborers	1.00000	1.01095	1.02146	1.02397
33.2.Agricultural Operators	1.00000	1.01099	1.02711	1.03471
33.3.Non-agricultural Rural -low	1.00000	1.01235	1.02852	1.04530
33.4.Non-agricultural Rural-high	1.00000	1.00967	1.01914	1.03579
33.5.Urban-low	1.00000	1.00819	1.01976	1.03492
33.6.Urban-high	1.00000	1.00805	1.01924	1.03624

TABLE LV

GENERAL EQUILIBRIUM RESULTS (INDICES) FOR INDONESIA, POLICY SIMULATION VI B: INCREASED NON-FOOD EXPORTS AND FIXED FERTILIZER SUBSIDY AT THE LEVEL OF 25 PERCENT

Items	Increasing Non-Food Exports by (Percent)			
	0	5	15	25
Input Prices				
1. Agricultural Laborers	1.00790	1.01919	1.02537	1.03560
2. Production Workers	1.01574	1.02668	1.03128	1.03982
3. Sales and Services	1.00339	1.01984	1.02165	1.02987
4. Professional and Management	1.01583	1.02413	1.02975	1.04160
5. Capital	1.05740	1.06407	1.08142	1.09477
Household Real Income				
6. Agricultural Laborers	0.95412	0.95808	0.96282	0.96811
7. Agricultural Operators	0.97551	0.97798	0.97972	0.98427
8. Non-agricultural Rural-low	0.97108	0.97208	0.97316	0.97407
9. Non-agricultural Rural-high	0.96757	0.97034	0.97321	0.97392
10. Urban-low	0.97643	0.97712	0.97962	0.98056
11. Urban-high	0.97592	0.97856	0.98146	0.98403
Total Household Income	0.97338	0.97535	0.97754	0.98023
Institutional Real Income				
12. Private Companies	1.00050	1.00385	1.00448	1.00583
13. Government	1.00089	1.00240	1.00337	1.00368
Production				
14. Paddy (Bimas)	0.98563	0.98561	0.98562	0.98565
15. Paddy (Non-Bimas)	1.00697	0.98423	0.98640	0.99064
16. Food Non-paddy	0.94093	0.93465	0.91553	0.91513
17. Agricultural Non-food Crops	0.98791	1.00411	1.04604	1.08710
18. Mining, Industry, Gas, etc.	1.01735	1.01741	1.01927	1.02032
19. Chemical and Fertilizer	1.00222	1.00290	1.00315	1.00384
20. Trade, Transport and Communication	0.98889	0.98984	0.99085	0.99242
21. Services	0.99567	0.99560	0.99563	0.99513
Total Gross Output	0.99186	0.99190	0.99206	0.99538
Commodity Prices				
23. Rice	1.02562	1.03524	1.04527	1.05656
24. Food Non-rice	1.10081	1.10960	1.11020	1.11820
25. Agricultural Non-food	1.04379	1.05183	1.06581	1.07819
26. Mining, Industry, Gas, etc.	1.04942	1.05701	1.07184	1.08434
27. Chemical and Fertilizer	1.04877	1.05648	1.07086	1.08336
28. Trade, Transport and Communication	1.03722	1.04771	1.05709	1.06731
29. Services	1.03114	1.04077	1.05015	1.06157
Aggregate Price Index	1.06179	1.07084	1.07792	1.08802
Capital Account				
30. Savings	1.18297	1.18538	1.18681	1.18801
Government				
31.1.Subsidy Cost	0.65710	0.65710	0.65710	0.65710
31.2.Net Revenue	1.00300	1.00300	1.00300	1.00300
Rest of World				
32.1.Total Commodity Imports	1.00000	0.99183	0.99198	0.99530
32.2.Total Commodity Exports	1.00000	1.00746	1.02237	1.03729
Rice Consumption				
33.1.Agricultural Laborers	0.98249	0.99289	0.99298	0.99366
33.2.Agricultural Operators	0.99293	0.99370	0.99428	0.99489
33.3.Non-agricultural Rural -low	0.98776	0.98931	0.99256	0.99683
33.4.Non-agricultural Rural-high	0.98509	0.98647	0.98698	0.99013
33.5.Urban-low	0.99403	0.99945	1.00028	1.00126
33.6.Urban-high	0.97518	0.98042	0.98355	0.98686

TABLE LVI

GENERAL EQUILIBRIUM RESULTS (INDICES) FOR INDONESIA, POLICY SIMULATION VI C: INCREASED NON-FOOD EXPORTS AND FIXED FERTILIZER SUBSIDY AT THE LEVEL OF 15 PERCENT

Items	Increasing Non-Food Exports by (Percent)			
	0	5	15	25
Input Prices				
1. Agricultural Laborers	1.01675	1.01975	1.03050	1.05148
2. Production Workers	1.01823	1.02064	1.03640	1.05107
3. Sales and Services	1.01225	1.01817	1.03380	1.05321
4. Professional and Management	1.01824	1.01954	1.03460	1.05114
5. Capital	1.08295	1.08495	1.10025	1.13216
Household Real Income				
6. Agricultural Laborers	0.94883	0.95320	0.95647	0.95926
7. Agricultural Operators	0.97405	0.97603	0.98141	0.98419
8. Non-agricultural Rural-low	0.96634	0.96693	0.96705	0.96721
9. Non-agricultural Rural-high	0.95031	0.95107	0.95452	0.95795
10. Urban-low	0.96223	0.96244	0.96299	0.96494
11. Urban-high	0.95708	0.96113	0.96248	0.96355
Total Household Income	0.96501	0.96674	0.96940	0.97135
Institutional Real Income				
12. Private Companies	1.00481	1.00517	1.00566	1.02423
13. Government	1.00160	1.00187	1.00223	1.01347
Production				
14. Paddy (Bimas)	0.97609	0.97609	0.97609	0.97609
15. Paddy (Non-Bimas)	1.01180	0.99178	1.00146	1.05755
16. Food Non-paddy	0.93976	0.93971	0.91919	0.91683
17. Agricultural Non-food Crops	0.98412	1.00498	1.03994	1.08795
18. Mining, Industry, Gas, etc.	1.02138	1.02246	1.02319	1.02409
19. Chemical and Fertilizer	1.00747	1.00847	1.00986	1.02185
20. Trade, Transport and Communication	0.98954	0.98895	0.99276	0.99873
21. Services	0.99565	0.99544	0.99542	0.99506
Total Gross Output	0.99302	0.99460	0.99427	0.99946
Commodity Prices				
23. Rice	1.04016	1.04280	1.05399	1.07987
24. Food Non-rice	1.11452	1.11532	1.11654	1.11865
25. Agricultural Non-food	1.06433	1.06664	1.07353	1.10932
26. Mining, Industry, Gas, etc.	1.07085	1.07300	1.07885	1.11698
27. Chemical and Fertilizer	1.06975	1.07193	1.07819	1.11540
28. Trade, Transport and Communication	1.05326	1.05646	1.06811	1.09417
29. Services	1.04460	1.04729	1.05812	1.08550
Aggregate Price Index	1.07742	1.07934	1.08568	1.10482
Capital Account				
30. Savings	1.32000	1.32446	1.33196	1.33257
Government				
31.1.Subsidy Cost	0.33517	0.33517	0.33517	0.33517
31.2.Net Revenue	1.00540	1.00540	1.00540	1.00540
Rest of World				
32.1.Total Commodity Imports	0.99295	0.99453	0.99481	0.99939
32.2.Total Commodity Exports	1.00000	1.00746	1.02237	1.03729
Rice Consumption				
33.1.Agricultural Laborers	0.95494	0.95895	0.96757	0.97843
33.2.Agricultural Operators	0.98921	0.99124	0.99347	0.99652
33.3.Non-agricultural Rural -low	0.97792	0.98115	0.98207	0.98236
33.4.Non-agricultural Rural-high	0.97209	0.97212	0.97884	0.97934
33.5.Urban-low	0.98599	0.98613	0.98635	0.98898
33.6.Urban-high	0.95601	0.95657	0.95878	0.96001

TABLE LVII

GENERAL EQUILIBRIUM RESULTS (INDICES) FOR INDONESIA, POLICY SIMULATION VI D: INCREASED NON-FOOD EXPORTS AND REMOVED FERTILIZER SUBSIDY AT ALL

Items	Increasing Non-Food Exports by (Percent)			
	0	5	15	25
Input Prices				
1. Agricultural Laborers	1.02532	1.03017	1.03667	1.05258
2. Production Workers	1.02698	1.03136	1.03695	1.05391
3. Sales and Services	1.01992	1.02752	1.03452	1.05095
4. Professional and Management	1.02785	1.03417	1.05115	1.06458
5. Capital	1.15340	1.17258	1.19226	1.25131
Household Real Income				
6. Agricultural Laborers	0.92462	0.93030	0.93373	0.93614
7. Agricultural Operators	0.97382	0.97427	0.97505	0.97507
8. Non-agricultural Rural-low	0.96379	0.96399	0.96423	0.96453
9. Non-agricultural Rural-high	0.93820	0.93970	0.94210	0.94310
10. Urban-low	0.95426	0.95434	0.95515	0.95538
11. Urban-high	0.94218	0.94272	0.94356	0.94419
Total Household Income	0.95864	0.95932	0.96027	0.96065
Institutional Real Income				
12. Private Companies	1.02826	1.02842	1.02878	1.02890
13. Government	1.01455	1.01465	1.01500	1.01514
Production				
14. Paddy (Bimas)	0.96386	0.96386	0.96386	0.96386
15. Paddy (Non-Bimas)	1.04170	1.04064	1.01203	0.95549
16. Food Non-paddy	0.88303	0.88206	0.87485	0.86975
17. Agricultural Non-food Crops	0.96868	0.99420	1.03165	1.06259
18. Mining, Industry, Gas, etc.	1.03857	1.04541	1.04561	1.04595
19. Chemical and Fertilizer	1.01105	1.01590	1.00836	1.00850
20. Trade, Transport and Communication	0.97882	0.98821	0.98559	0.96930
21. Services	0.99147	0.99344	0.99041	0.98749
Total Gross Output	0.98539	0.99165	0.99145	0.98903
Commodity Prices				
23. Rice	1.07062	1.08050	1.09034	1.22880
24. Food Non-rice	1.15830	1.18519	1.21456	1.28456
25. Agricultural Non-food	1.11742	1.16674	1.17797	1.19689
26. Mining, Industry, Gas, etc.	1.12993	1.14801	1.16339	1.21581
27. Chemical and Fertilizer	1.12783	1.14509	1.16064	1.21269
28. Trade, Transport and Communication	1.09696	1.10722	1.12057	1.21948
29. Services	1.07982	1.09115	1.10596	1.14132
Aggregate Price Index	1.12106	1.14077	1.16028	1.23468
Capital Account				
30. Savings	1.53137	1.53148	1.53197	1.53215
Government				
31.1.Subsidy Cost	0.00000	0.00000	0.00000	0.00000
31.2.Net Revenue	1.00820	1.00820	1.00820	1.00820
Rest of World				
32.1.Total Commodity Imports	0.98532	0.99210	0.96051	0.98922
32.2.Total Commodity Exports	1.00000	1.00746	1.02237	1.03729
Rice Consumption				
33.1.Agricultural Laborers	0.93992	0.94045	0.94157	0.94490
33.2.Agricultural Operators	0.97809	0.98115	0.98372	0.98465
33.3.Non-agricultural Rural -low	0.97302	0.97724	0.97895	0.98002
33.4.Non-agricultural Rural-high	0.95449	0.95776	0.96004	0.96120
33.5.Urban-low	0.96792	0.96992	0.97068	0.97112
33.6.Urban-high	0.90766	0.90965	0.91124	0.91263

APPENDIX D

THEORETICAL FRAMEWORK FOR ESTIMATING
PADDY BIMAS PRODUCTION FUNCTION

APPENDIX D

ESTIMATING THE PARAMETERS OF PADDY PRODUCTION FUNCTION

This Appendix describes in some detail how parameters of the paddy Bimas production functions are estimated. It was assumed that the paddy production function is a Cobb-Douglas type which permits substitution between inputs. The main objective of this appendix, however, is to set a grid linearization of technology used in the present study.

The Theoretical Basis for Estimating Paddy Bimas Production Function

Let the paddy Bimas production function be homogenous of degree one as follows:

$$X = f(L, K, F, 0) \qquad (1)$$

where:

X = quantity of paddy Bimas produced
L = quantity of labor used
K = quantity of capital used
F = quantity of fertilizer used
0 = quantity of other variables used

Using Euler's Theorem, equation (1) can be expressed as:

$$X = \frac{\partial X}{\partial L} L + \frac{\partial X}{\partial K} K + \frac{\partial X}{\partial F} F + \frac{\partial X}{\partial O} O \qquad (2)$$

where:

$\frac{\partial X}{\partial L}$ = marginal physical product subject to labor used

$\frac{\partial X}{\partial K}$ = marginal physical product subject to capital used

$\frac{\partial X}{\partial F}$ = marginal physical product subject to fertilizer used

$\frac{\partial X}{\partial O}$ = marginal physical product subject to other variables used

Pre multiplying equation (2) by P_x (output price) results in the following:

$$P_x X = P_x \frac{\partial X}{\partial L} L + P_x \frac{\partial X}{\partial K} K + P_x \frac{\partial X}{\partial F} F + P_x \frac{\partial X}{\partial O} O \qquad (3)$$

Under competitive market and profit maximization the following results:

$$P_x \frac{\partial X}{\partial L} = w$$

$$P_x \frac{\partial X}{\partial K} = r$$

$$P_x \frac{\partial X}{\partial F} = P_F$$

and $$P_x \frac{\partial X}{\partial O} = P_o \qquad (4)$$

where: P_x = output price

w = wage rate

r = capital price

P_F = fertilizer price

P_o = price of other inputs

Substituting (4) into (3) results in the following:

$$P_X X = wL + rK + P_F F + P_o O \qquad (5)$$

Since $P_X X$ = Revenue (R), and

$wL + rK + P_F F + P_o O$ = Cost (C). Therefore

Profit (π) can be written as:

$$\pi = R - C = P_X X - wL - rK - P_F F - P_o O = 0 \qquad (6)$$

Equation (6) is true only for constant returns to scale technology.

As discussed earlier, the paddy Bimas production function is assumed to be determined by a Cobb-Douglas production function as follows:

$$X = A L^{\alpha} K^{\beta} F^{\gamma} O^{s} \qquad (7)$$

where:

L = Labor

K = Capital

F = Fertilizer

O = Other variables

$\alpha + \beta + \gamma + s = 1$

Since this study is concerned only with labor (L), capital (K), and Fertilzier (F), therefore, the levels of other variables in the base SAM are assumed to be constant, at least in the short-run. Thus equation (6) can be written as:

$$X = (AO^{s}) L^{\alpha} K^{\beta} F^{\gamma}$$

or

$$X = A^{*} L^{\alpha} K^{\beta} F^{\gamma} \qquad (8)$$

where:

$A^{*} = AO^{s}$

and $\alpha + \beta + \gamma \leq 1$

Take partial derivatives of equation (8) subject to labor (L), capital (K), and fertilizer (F).

$$\frac{\partial X}{\partial L} = A^* \alpha L^{\alpha-1} K^{\beta} F^{\gamma} = \frac{\alpha X}{L}$$

$$\frac{\partial X}{\partial K} = A^* \beta L^{\alpha} K^{\beta-1} F^{\gamma} = \frac{\beta X}{K}$$

$$\frac{\partial X}{\partial F} = A^* \gamma L^{\alpha} K^{\beta} F^{\gamma-1} = \frac{\gamma X}{F} \qquad (9)$$

Substituting equation (9) into (2), we have the following:

$$X = \frac{\alpha X}{L} L + \frac{\beta X}{K} K + \frac{\gamma X}{F} F + \frac{sX}{O} 0$$

or

$$(1 - s) X = \alpha X + \beta X + \gamma X \qquad (10)$$

Both sides divided by X results in:

$$(1 - s) = \alpha + \beta + \gamma,$$

or

$$\alpha + \beta + \gamma \leq 1 \qquad (11)$$

Based on equations (10) and (11) output shares may be divided as:

αX = share going to labor (L)

βX = share going to capital (K)

γX = share going to fertilizer (F)

The Results

Paddy Bimas Production Function

Based on the theroetical framework above, the steps to estimating a Cobb-Douglas production function are as follows:

(1) estimate the share going to labor (αX)

(2) estimate the share going to capital (βX), and

(3) estimate the share going to fertilizer (γX)

Using base year data/information from the 1980 SAM, the following are thus estimates of the production parameters of the paddy Bimas production function:

$\hat{\alpha} = 1512.6082/2604.00058 = 0.58088$

$\hat{\beta} = 805.74560/2604.00058 = 0.3090$

$\hat{\gamma} = 187.8700/2604.00058 = 0.07215$

$$\hat{A}^* = \frac{2604.00058}{1512.6082^{0.58088}\ 805.7456^{0.3090}\ 187.87^{0.07215}} = 3.2106$$

Therefore, the following is an estimate of the paddy Bimas production function:

$$\hat{X} = 3.2106\ L^{0.58088}\ K^{0.3090}\ F^{0.07215} \qquad (12)$$

As shown in equation (12), labor (L) and capital (K) are dominant variables for the paddy Bimas production function. Output elasticities subject to labor (L), capital (K) and fertilizer (F) are 0.58088, 0.3090, and 0.07215, respectively. This implies that with a one percent increase of labor, capital, and fertilizer used, paddy output will increase by 0.58088 percent, 0.3090 percent, and 0.07215 percent, respectively. Or if all three inputs are increased simultaneously of one percent, output will increase by 0.96 percent.

Compared with the study by Sastrohoetomo (1984), the result for the fertilizer production elasticity is consistent. For example, Sastrohoetomo (1984) found that the output elasticity with respect to fertilizer averaged about 0.06619 - with a range from 0.05661 (the smallest value) to 0.08573 (the largest value). The production elasticity derived from the 1980 SAM of 0.07215 falls within this range.

Estimating the Marginal Value Product of Fetilizer

Estimating the marginal value product of fertilizer (MVP) for paddy Bimas is a necessary step to set up the grid linearization (technology activities) of paddy production. Since it shows the relationship between the quantity of fertilizer demanded and its corresponding prices, it is sometimes called the "derived demand" for fertilizer.

Given the estimate of the paddy Bimas production function in equation (12), the marginal value product (MVP) of fertilizer is estimated as:

$$MVP_F = P_X \frac{\partial X}{\partial F} = P_X \frac{\gamma X}{F} = P_F \qquad (13)$$

At the normalized prices of $P_X = 1.0$ and $P_F = 1.0$ it must also hold that $\frac{\partial X}{\partial F} = 1.0$. With the output elasticity of 0.07215 for fertilizer and the base SAM paddy Bimas output level of X = 2,604 billion rupiahs.

The relationship between the market price for fertilizer and the subsidized price is the following:

$$P_F^m = \frac{P_F^s}{(1-s)} \qquad (14)$$

where:

P_F^m = market fertilizer price (equilibrium price)

P_F^s = subsidized fertilizer price

s = percent subsidy

The market price must be multiplied by (1 - s) to equal the price paid by Bimas producers. The relevant price indices for the different levels of fertilizer subsidy are the following:

P_F^m (indice)	s (percent)	P_F^s (indice)	P_x (indice)	MVP (indice)
1.60	37.5	1.00	1.00	1.00
1.60	25.0	1.20	1.00	1.20
1.60	15.0	1.36	1.00	1.36
1.60	0.0	1.60	1.00	1.60

The relationships between the marginal value product of fertilizer, fertilizer level, and production level with all other inputs held constant at the base SAM are the following:

MVP (indice)	Fertilizer Demanded (Billion rupiah)	Bimas Paddy Production (Billion rupiah)
1.00	187.87	2604.00
1.20	254.30	2566.65
1.36	134.80	2541.74
1.60	113.20	2509.92

The relationship between the MVP and quantity of fetilizer is graphed in Figure 4.

Setting a grid Linearization (Technology) of Paddy Bimas

As discussed earlier, the central purpose of this appendix is to set a grid linearization of technology used in the present study.

To illustrate this possibility, we start first with equation (12). To find points along the Cobb-Douglas isoquant, the procedure is to select a series of values of L (Labor), ex-ante, and then to use equation (12) to compute the corresponding values of K (Capital) while holding $\hat{X}$ and F constant at

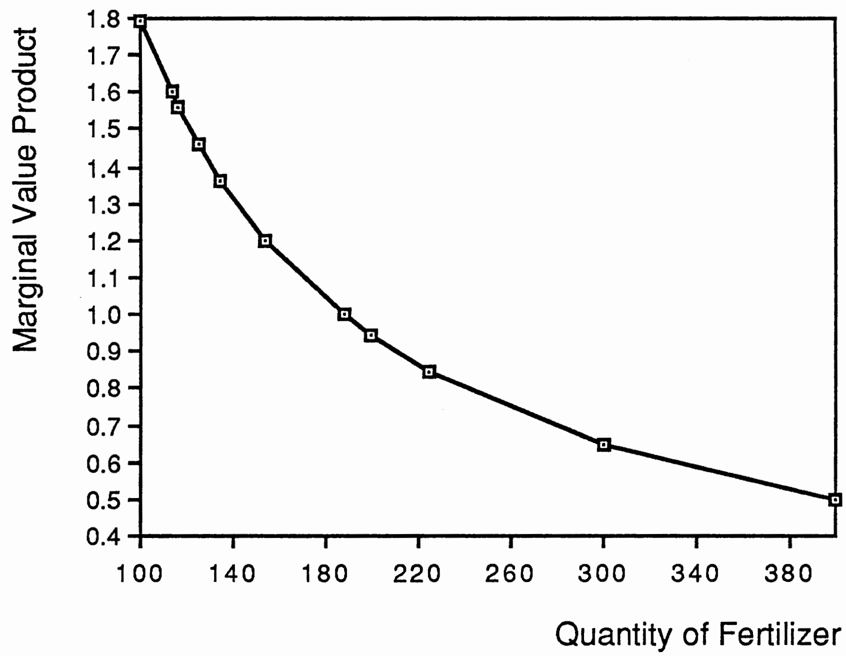

Figure 4. Marginal Value Product of Fertilizer
for Paddy Bimas

the various levels of fertilizer subsidy. For example, at 37.5 percent fertilizer subsidy total paddy Bimas preduced ($\hat{X}$) and the level of fertilizer used are 2604.00 billion rupiah and 187.87 billion rupiah, respectively. Letting L vary from 700 to 2500.00 billion rupiah, the corresponding values of K (Capital) are:

$$K_t = \left[\frac{2604.00}{3.2106 \ L_t^{0.58088} \ F^{0.07215}} \right]^{\frac{1}{0.3090}}$$

The relationship of capital (K) and labor (L) at the various levels of fertilizer subsidy and output levels are presented in Table LVIII.

Since paddy Bimas producers do not pay the market price for fertilizer, adjustment must be made for the input-output coefficient for chemical and fertilizer use. As the subsidy is removed this adjustment must increase making fertilizer more costly to the producers. Let s indicate the percent of fertilizer subsidy and a_{51} the observed input-output coefficient for chemical and fertilizer use in the base SAM. Then using equation (14) the following holds for defining the observed input-output coefficient:

$$a_{51} = \overset{*}{a}_{51}(1 - s) \qquad (15)$$

where:

a_{51} = observed input-output coefficient from base SAM adjusted for the base subsidy

$\overset{*}{a}_{51}$ = input-output coefficient unadjusted

s = subsidy and equals 37.5 percent for base SAM

TABLE LVIII

LABOR, CAPITAL, TOTAL SUBSIDY, AND ADJUSTED INPUT-OUTPUT COEFFICIENTS
FOR VARIOUS LEVELS OF FERTILIZER SUBSIDY, INDONESIA

Technology (Paddy)	37.5 Percent Fertilizer Subsidy Output Level is 2604.00 (Billion Rp.)				25 Percent Fertilizer Subsidy Output Level is 2566.65 (Billion Rp.)			
	Labor (Billion Rp.)	Capital (Billion Rp.)	Total Subsidy (Billion Rp.)	a_{51}	Labor (Billion Rp.)	Capital (Billion Rp.)	Total Subsidy (Billion Rp.)	a_{51}
XRICET0	1512.61	804.75	83.60	0.07215	1512.61	804.65	54.907	0.08658
XRICET1	1700.00	646.45	83.60	0.07215	1700.00	646.12	54.907	0.08658
XRICET2	1900.00	524.63	83.60	0.07215	1900.00	524.21	54.907	0.08658
XRICET3	2100.00	434.77	83.60	0.07215	2100.00	434.30	54.907	0.08658

Technology (Paddy)	15 Percent Fertilizer Subsidy Output Level is 2604.00 (Billion Rp.)				0 Percent Fertilizer Subsidy Output Level is 2566.65 (Billion Rp.)			
	Labor (Billion Rp.)	Capital (Billion Rp.)	Total Subsidy (Billion Rp.)	a_{51}	Labor (Billion Rp.)	Capital (Billion Rp.)	Total Subsidy (Billion Rp.)	a_{51}
XRICET0	1512.61	804.65	33.44	0.098120	1512.61	804.50	0	0.115435
XRICET1	1700.00	646.12	33.44	0.098120	1700.00	646.03	0	0.115435
XRICET2	1900.00	524.21	33.44	0.098120	1900.00	524.14	0	0.115435
XRICET3	2100.00	434.30	33.44	0.098120	2100.00	434.25	0	0.115435

The observed input-output coefficient for base SAM is the following:

$$a_{51} = \frac{X_{51}}{X_1} = \frac{187.87}{2604.00058} = 0.07215 \quad (16)$$

Therefore, $$a_{51}^{*} = \frac{a_{51}}{(1-0.375)} = 0.11544 \quad (17)$$

The calculated a_{51} coefficients for the following various subsidy levels are the following:

a_{51}^{*}	s (percent)	a_{51}
0.11544	37.5	0.07215
0.11544	25.0	0.08658
0.11544	15.0	0.09812
0.11544	0.0	0.11544

The complete set of technology activities for paddy Bimas production under various levels of fertilizer subsidy is given in Table LVIII.

VITA

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