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ANALYSIS OF SELECTED POLICY ALTERNATIVES
IN THE AGRICULTURAL SECTOR
OF THE PHILIPPINES

A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee

Leonardo A. Gonzales

June 1976

1286702

DEDICATION

To my wife, Vivian,
for her love, sacrifices, understanding,
courage and lost weekends.

Also to my daughter, Ava Vivian,
for not having been able to enjoy the luxury
of her papa's presence during her birth.

ACKNOWLEDGMENTS

The author is very grateful to the people of the United States and their government for making it possible for him to study for the Ph.D. under the Fulbright-Hays Scholarship Program. The author also extends his gratitude to the Philippine American Educational Foundation (PAEF), the Institute of International Education (IIE), The U.S. Agency for International Development (USAID), The Economic Research Service of the U.S. Department of Agriculture (USDA-ERS), and The University of Tennessee Graduate School and Department of Agricultural Economics, for the financial assistance awarded to him during his study in the United States.

This research undertaking has been a team effort and could not have been possible without the help of so many individuals. The author recognizes the contributions of the following to this dissertation:

Dr. Luther H. Keller, the author's major professor, for his professional insights, counsel, guidance and understanding.

Dr. David E. Kunkel, for his tremendous assistance in the shaping of this dissertation. He was the author's major consultant, supervisor, critic and friend during the author's 14-month field work in the Philippines.

Director Leonardo A. Paulino, Asistant Director Jose V. Castillo, Acting Director Jesus C. Alix and Chief Economist Ramon C. Alcachupas, of the Bureau of Agricultural Economics (BAEcon), for providing the author physical facilities, continued cooperation, moral support and permission to use the Bureau's available data for the dissertation.

Dr. Charles B. Sappington, for his valuable comments and trip to the Philippines to help delineate the author's scope of research. Dr. S. Darrell Mundy and Dr. Keith Phillips, for their constructive criticisms.

Drs. Clark Edwards, Jerry Sharples, Hilarius Fuchs and Arlo Minden, the USDA-ERS panel of consultants to Project ADAM, for their guidance and professional assistance to the author during the early stages of the study.

Dr. Joe Martin, for his moral support and workshop extended to the author during the latter's stay at The University of Tennessee Department of Agricultural Economics; Drs. William Faught, Frank Sheppard and Norman Ulsaker for their constructive criticisms, financial and moral support; also to Mr. Harry Mattox for his help in seeking funds for the printing of this dissertation.

Drs. Brady Deaton and L. J. Atkinson for their help in arranging the author's participation to Project ADAM in the Philippines. Dr. Larry Bauer, who taught the author the rudiments of linear programming; Dr. David W. Brown, who was the author's advisor while he was taking courses; the faculty members and graduate students of the U.T. Department of Agricultural Economics who provided moral support and spirit of camaraderie to the author while he was in the graduate program.

Appreciation is also extended to all the members of Project ADAM and Bureau of Agricultural Economics who were involved in "Operation MAAGAP." Special recognition is due to Mr. Florentino Atienza, Mr. Gil Rodriguez and Moises Sardido who helped in the build-up of the I/O coefficients; to Miss Josefina Ferrer, for estimating the demand and

income elasticities incorporated in the model; Mr. Porfirio B. Tunque, for devising the computer program to estimate the production and demand segments; and Miss Josefina Deoquino, for spending her valuable time beyond the call of duty, to run the computer program for this dissertation.

The graphs were made by Mr. Buddy Fabros and Miss Jo Ella Washburn. The major portion of the preliminary drafts of the manuscripts were typed by Miss Melitta Stoutt, Mrs. Anne Norwood, Miss Ersie Hood, and Miss Theresa Bell.

Recognition is also due to Louis and Betty Thacker and members of the Thacker family, for their hospitality, friendship, sympathy and concern; to Dixon and Carrie Jo Johnson, Bernard and Ann LaBerge, for their friendship and moral support while the author was at school at The University of Tennessee.

Acknowledgment is also extended to Vic and Ellen Landingin for their generous concern and care to the author's wife and daughter while the author was abroad; to Miss Eliza Buenaventura, Mr. Rafael Buenaventura, Attorney Miguel Fabie, Jr., the faculty members and students of the Asian Social Institute who provided the encouragement to the author to go on with the Ph.D. program.

To the author's parents, Mr. and Mrs. Nicasio Gonzales, who never totally understood the meaning of his graduate study but nevertheless, provided their son constant love and encouragement.

Above all, deepest recognition is due to the author's wife Vivian and daughter Ava, who provided love and inspiration to the author—to them this dissertation is lovingly dedicated.

ABSTRACT

The primary objective of this study was to estimate and evaluate the economic effects of selected policy alternatives on prices, output, employment and income in the agricultural sector of the Philippines. The policies evaluated were: fertilizer subsidy; efficiency of irrigation systems; rice price ceilings; mechanization; and natural calamities.

The study used a national production-processing-distribution programming model (MAAGAP) and had the following assumptions: a given set of national demands for agricultural commodities; a set of national supplies of resources; and a set of production technologies. Given these sets of conditions and with the further assumption that Philippine agriculture approximated a perfectly competitive market, the MAAGAP model's objective function was the maximization of the sum of the producer's and consumer's surplus (net social benefit). The model isolated the agricultural sector and equated aggregate supply with derived aggregate demand under a linear programming static framework. This procedure would endogenously determine equilibrium prices and quantities at the sectoral level.

The input-output (I/O) coefficients for crops used by this study were taken from the national cost of production survey conducted by the Bureau of Agricultural Economics (BAEcon) in 1972; the farm management surveys made by the University of the Philippines College of Agriculture (UPCA); and the Philippine Sugar Institute (PHILSUGIN). For the input-output coefficients on livestock, the primary sources were the studies

made by the Development Bank of the Philippines (DBP); the UPCA; and other specialized studies made by Gapuz (poultry) and Drilon (piggery). The demand estimates on the other hand came from two basic studies: the Foote's econometric model based on a time series, fitted by three-stage least squares (3 SLS) and the regression analysis made by Ferrer based on a crossed section data from a consumption survey conducted by Dosayla and Darrah.

Results from the study showed that removing the fertilizer subsidy to the food crop subsector would lead to a lower production of rice, lower employment, a decline in usage of tractor services, a decline in capital usage and a lower marginal productivity of land because of lower fertilizer consumption in the food crop subsector. Consumer's surplus would likewise decline while producer's surplus would increase as the fertilizer subsidy to the food crop subsector would be removed.

A uniform fertilizer subsidy for both subsectors at high levels (100 to 72 percent subsidy) would result into a significant decrease in domestic prices compared to their 1974 base levels (which was 53 percent subsidized only for the food crop subsector); higher employment; and increase in capital usage as compared to the 1974 base. Higher uniform subsidy levels for both subsectors, however, would tend to reduce the use of four-wheel tractor services and animal labor as compared to the 1974 base. At low levels of uniform subsidy for both export and food crops, domestic production would decline and prices of commodities would tend to rise. Employment, four-wheel tractor usage and animal services would also decline.

The imposition of a 4 percent tax on the export subsector would adversely affect the levels of exports. A uniform fertilizer subsidy scheme whether a tax is imposed or not would generally result in higher net social benefits for both consumers and producers, with the proportion of shares differing between the two conditions (generally lower benefits when tax is imposed).

Increasing the efficiency of the irrigation systems would result in higher production of rice, increase in employment, higher usage of capital by crops, increase in fertilizer usage (especially palay), a higher net social benefit for the agricultural sector with consumers benefiting from relatively lower prices.

Results of the study also showed that a rice price ceiling of ₱843 per metric ton (₱1.90 per kilogram at 1974 current prices) would result to lower rice production relative to the 1974 base when no price ceiling was in effect. Furthermore, to maintain the rice price ceiling at ₱1.90 per kilogram, the estimates indicate that .9371 thousand metric tons of rice must be imported, incurring an approximate import subsidy cost of ₱2.8 million. Low price ceilings would tend to depress domestic production, and producer's surplus would be relatively lower while consumer's surplus would be somewhat higher. Higher rice price ceilings on the other hand would eliminate rice import subsidy costs and producer's surplus would be greater while consumer's surplus would be less.

The simultaneous increase in the availability of both hand and four-wheel tractor services (0 to 200 percent of 1972 levels) would

result in increases in the production of rice and sugar but decreases in the production of corn and commercial hogs. Results in the variation of tractor services also demonstrated the substitutability of both man labor and animal labor for tractor services, while fertilizer showed a complementary relationship with tractor services.

Variations in the availability of hand tractor services with four-wheel tractors held constant at 1972 levels, showed the decline in palay production below 1972 base levels but would be offset more than proportionately by the substitution of corn grain production for palay. Increasing hand tractor services above the 1972 base levels on the other hand would lead to the higher production of palay but a probable displacement of man and animal labor in the production of rice and corn.

Results also indicated that four-wheel tractor services were very vital in the production of sugar and palay but not corn. Reducing the availability of four-wheel tractor services below the 1972 levels would reduce the production of sugar and rice. Results from parametric variation of four-wheel tractors showed that fertilizer was complementary input to four-wheel tractor while animal and man labor services were competing inputs to four-wheel tractor usage.

The net effects of floods and/or natural calamities would be higher agricultural prices and lower net social benefits.

Finally, the study also evaluated the different policies relative to target variables such as net social benefit for the agricultural sector, value of production, usage levels of inputs, trade, government budget and prices. Results showed that there was no one policy mix

that would provide a perfect economic alternative to all relevant macroeconomic variables. Well defined trade-offs were evident among the different policies. For example, producer's surplus and consumer's surplus were almost always in conflict. In the two exceptions (higher uniform fertilizer subsidy and rice price ceiling of ₦1,143 per metric ton) both may be increased at the expense of a decline in animal labor services, tractor services and export levels.

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CHAPTER I

INTRODUCTION

I. SOCIOECONOMIC PROFILE OF THE PHILIPPINES

The Republic of the Philippines is an archipelago of approximately 7,100 islands lying about 600 miles southeast of the coast of mainland Asia. It is bounded by Taiwan to the north and Indonesia to the south. The western Pacific Ocean and the South China Sea border its eastern and western limits, respectively.

The total land area of the Philippines is 115,600 square miles divided into three major regions: Luzon, Visayas and Mindanao. In general the islands have a central core of mountains and plateaus interrupted by river basins descending to narrow coastal plains.

The climate is generally tropical. Average temperature is 80°F, with humidity ranging from 75-80 percent. There are two pronounced seasons: the rainy season from June to October, and the dry season from November to May. Rainfall averages 92-95 inches a year. The warmest months are April and May, the coldest, December through February.

The population estimated at 40 million in 1973 has an annual growth rate of slightly above 3 percent. The country ranks sixteenth largest among the nations of the world in total population. At the end of the century the country's population is projected to reach the vicinity of 90 million.

The Filipino racial heritage is basically Malayan, blended with Chinese, Spanish, Japanese, Indian and American strains. Culturally, the society is pluralistic due to the mixture of oriental and western influences. Ninety percent are Christians, 5 percent are Moslems and the rest are mixtures of minor religious sects.

The Philippines, as of November 1973, had a total labor force of 14.6 million. Of these, 13.9 million were actively employed in both agriculture and industry. For unskilled and semiskilled workers, a minimum wage of eight pesos (P8.00) per day is fixed by law.

Literacy rate in the country, estimated at 83 percent, is one of the highest in Southeast Asia. Education enjoyed the biggest share (approximately 24 percent) in the government budget in 1972-73.

In 1973, the new Constitution was adopted, including a parliamentary form of government whereby the legislative power is vested in the National Assembly, the executive power in the Prime Minister and the Cabinet and the judicial power in the Supreme Court and lower courts.

The provisions of the new Constitution prescribe the establishment of an ad interim National Assembly with the incumbent President serving as the Prime Minister. In accordance with the powers granted by the new Constitution, the President suspended the convening of the National Assembly and proclaimed the continuance of martial law which was earlier declared on September 21, 1972. Currently the Philippine government continues to function with a presidential form of government under martial law.

II. STATEMENT OF THE PROBLEM

To date the Philippine national economy faces a number of issues which are very crucial to the country's economic development. Among the major ones are:

The Race between the Rate of Population Growth and Food Production

The country's population is relatively young and growing at the rate of 3 percent yearly. At this rate, the United Nations Demographic Office estimated that by 1980 the population will reach 54 million. On the other hand, the agricultural sector's productivity lags behind.

Alix (3) estimated that from periods 1955-60 and 1960-67, incremental productivity was negative. If there were increases in output, they were due to increases in inputs; only a small portion was explained by the increases in productivity.¹ From calendar years 1967 to 1971, the National Economic Development Authority (NEDA), estimated the combined annual growth rates of agriculture, fishery and forestry as components of GNP, to be slightly over 6 percent from 1967 to 1968, but dropping to 0.9 percent, 1.4 percent, and 1.3 percent, respectively, from 1969 to 1971 (Table 1).

It is obvious that if population growth outruns that of food supply, and the added labor force is not assimilated into the work force, national economic dislocations are likely to occur. The acute

¹For other studies in agricultural productivity in the Philippines, see (25, 70).

Table 1. Annual Growth Rates: Gross National Product, National Income and Net Domestic Product, Philippines, 1967 to 1971 (in Percent at 1967 Prices)^a

Industry/Item	Calendar Year				
	1967	1968	1969	1970	1971
1. Agriculture, Fishery, and Forestry	6.2	6.3	0.9	1.4	1.3
2. Mining and Quarrying	17.0	15.0	19.2	16.5	5.1
3. Manufacturing	6.9	5.3	7.4	8.5	5.9
4. Construction	(15.9)	7.6	(17.6)	17.2	28.0
5. Transportation, Communication, Storage and Utilities	4.3	3.2	3.6	4.0	3.9
6. Commerce	5.3	3.8	4.8	3.3	4.5
7. Services	4.9	3.7	3.4	3.9	3.2
Net Domestic Product at Factor Cost	<u>5.3</u>	<u>5.2</u>	<u>3.2</u>	<u>4.5</u>	<u>4.1</u>
Net National Product	<u>5.0</u>	<u>5.8</u>	<u>2.3</u>	<u>5.1</u>	<u>3.9</u>
8. Indirect Taxes Net of Subsidies	3.2	(0.8)	31.1	12.6	2.8
9. Capital Consumption Allowance	12.5	12.9	12.2	12.8	8.6
Gross National Product	<u>5.5</u>	<u>6.0</u>	<u>5.2</u>	<u>6.5</u>	<u>4.3</u>

^aRevised estimates as of February 12, 1973.

Source: National Economic Development Authority.

pains of food shortages in the Philippines were recently dramatized in the 1972 floods when a series of typhoons damaged the agricultural crops of Luzon and a long drought struck the South.

The President, realizing the urgency of the food problem, enjoined all Filipinos to cooperate with his massive agricultural campaign. Several government package programs were initiated.

The "Masagan 99" rice production program is a massive rice productivity campaign involving farmers' educational training and supervised credit. The immediate aim is to attain a production target of at least 99 cavans² of palay per hectare. The program is coordinated by the NEDA, the National Food and Agricultural Council (NFAC) and ably supported by government financing agencies, agricultural bureaus and the private sector.

The "Masagana Maisan" is another program exclusively for corn, sorghum and soybeans. It was adopted from the "Masagana 99" package of technology and credit schemes.

Likewise, the First Lady, Mrs. Imelda Marcos, initiated the "Green Revolution" project, encouraging all Filipinos to have and cultivate their own vegetable gardens in their backyards and vacant adjacent lands. Further she also embarked the "Palayan ng Bayan" on a larger scale. This consists of the planting of virgin public lands to rice and staple crops.

²A cavan is approximately 44 kilograms.

High Incidence of Poverty, Unemployment and Malnutrition

Unemployment,³ poverty and malnutrition are interrelated problems. From 1961 to the latter part of 1973, the unemployment rate of the nation varied from 5 to 8 percent (Table 2). With this rate, the capacity of the labor force to produce goods and services is not being utilized. Most of the underutilization is in the rural areas where agriculture can provide subsistence to low income families but can release potential nonfarm workers when demand for them arises.

The GNP in 1972 was 55 billion pesos (67), and annual growth rate in real terms ranged from a low of 4.3 percent to a high of 6.5 percent within the five-year period 1967 to 1971 (Table 1, page 4). Even so, the average level of income is low and steady real growth above current rates is desirable as a means of improving the quality of life. Measures are needed to improve both the levels and distribution of income among the population. The poorest fifth of the population receives only 2.5 percent of the income compared to 5 percent in the United States (38). Some of the poor are urban dwellers but most are rural.

The high incidence of poverty and lower per capita income bring forth another problem: malnutrition. The diet of many Filipinos is primarily rice. A balanced diet requires a variety such as meat, fish, as well as vegetables and fruits in order to achieve the goal of a healthier population. But where food is scarce and per capita income low, the

³Underemployment too is a problem but there are no existing studies to estimate its magnitude.

Table 2. The Size and Employment Status of the Philippine Labor Force, 1961 to 1973 (Thousand Workers)

Year	Total	Employed		Unemployed	
		Number	Percent	Number	Percent
1961	9,713	9,095	94.0	618	6.0
1962	10,266	9,603	94.0	663	6.0
1963	10,233	9,764	95.0	469	5.0
1964	11,296	10,572	94.0	724	6.0
1965	10,764	10,101	94.0	663	6.0
1966	11,757	10,936	93.0	821	7.0
1967	11,776	10,867	92.0	909	8.0
1968	11,371	10,471	92.0	900	8.0
1969	12,046	11,234	93.0	812	7.0
1970	12,297	11,355	92.0	942	8.0
1971	12,288	11,627	95.0	661	5.0
1972	14,200	13,217	93.0	983	7.0
1973 ^a	14,559	13,925	95.0	634	5.0

^aAs of November 1973.

Source: National Census and Statistics Office, Household Survey Division.

ideal goal of attaining a well balanced diet is hard to come by. The urgency of the problem prompted the First Lady to launch the "green revolution" and nutrition projects with the twin objectives of solving the food-diet problem.

Unfavorable Balance of Trade and Inflation

The Philippines has been closely tied to its import-export sector. From 1967 to 1972, the balance of trade was a deficit (67). Consequently, rising world prices have contributed to domestic inflation. The wholesale price index of selected items in Manila showed that food items increased 104 percentage points from 1965 to 1972 and 241.9 percentage points in 1974 (Table 3). This uptrend could be partly explained by the series of floods that struck the Philippines in 1972 and the international inflationary pressure caused by the energy shortage in 1974. But domestic inflation can also be partly attributed to the pressures from the rapidly increasing populace. In this regard, the government has recently adopted monetary and fiscal trade policies to reduce such pressures and to decrease the dependence of the domestic economy on the world market.

Limited Natural Resources

New land on which to expand agriculture is limited. It is estimated that of the country's total land area of 29.7 million hectares, approximately 8 million hectares are under cultivation and only 4 million are potentially productive (24). The Bureau of Agricultural Economics (BAEcon) estimated the ten-year growth rates in area planted

Table 3. General Wholesale Price Index for Manila, Selected Items, 1969-1975 (1965=100)

Period	All Items	Food	Mineral Fuels
1969	111.4	116.0	104.5
1970	137.7	141.6	129.2
1971	159.3	176.8	151.6
1972	175.4	204.2	165.0
1973	218.4	234.1	188.1
1974	337.5	341.9	413.9
January	288.8	288.1	235.4
February	309.7	308.8	337.5
March	324.1	316.2	402.4
April	336.9	321.9	428.8
May	344.7	336.8	436.6
June	352.4	347.3	446.4
July	352.3	353.3	446.3
August	351.7	355.3	446.3
September	345.0	357.6	446.9
October	347.4	363.1	446.9
November	347.1	371.5	446.9
December	350.7	383.0	446.9
1975 ^a	349.4	387.0	446.9

^aIncludes January-April average only.

Source: Department of Economic Research, Central Bank of the Philippines.

for the four major crops in the Philippines, 1964 to 1974. The estimates range from a low of 1.0 percent for rice to a high of 4.8 percent for sugar cane (Table 4).

Conservation and development of the country's natural resources are desirable. This could be achieved by conservation practices among natural resource users along with use of more capital in the form of fertilizer, irrigation and other modern inputs.

As a partial remedy to the critical issues discussed above, the Philippine government has adopted certain national policies which have a direct economic impact on the agricultural sector. These policies are:

1. The fertilizer subsidy. The government sells fertilizer to the food crop (rice, corn, vegetable) producers at a subsidized price of approximately 53 percent, and the export crop (sugar, coconut) producers at the market price.

2. The imposition of a rice price ceiling. To stabilize the domestic price of rice, the staple food, the government imposes a rice price ceiling of ₱1.90 per kilogram. During times of food shortages, rice is imported at the world market prices (which are higher than the imposed price ceiling) and sold domestically at the domestic price ceiling.

3. The importation of hand and four wheel tractors. This is encouraged by the government under a credit program with the objective of modernizing Philippine agriculture.

Table 4. Changes in Land Used for the Four Main Crops, Philippines,
1964 to 1974

Crop	Land Area		Growth Rates
	1964	1974	
	--1,000 hectares---		--Percent---
Palay	3,087	3,436	1.0
Corn	1,897	2,763	3.8
Sugarcane (Centrifugal)	292	468	4.8
Coconut (Copra and Dissicated)	1,483	2,206	4.0

Source: Bureau of Agricultural Economics (BAEcon).

4. Investment in irrigation systems. This is done by either improving the existing irrigation facilities or making them more efficient to increase the water availability which is very crucial in the production of rice paddies.

The fact remains that the Philippines, like any developing economy, is predominantly agricultural. The agricultural sector of the country consistently contributed no less than 30 percent to GNP (Table 5) from 1967 to 1972. Likewise, in 1970 to 1973, the sector's net foreign trade balance was within the range of \$500-700 million (Table 6). Furthermore, as a source of employment by industry and by occupation (Table 7) the sector provided no less than 50 percent in 1973.

Since the agricultural sector performs the classic role of providing food for the country's rapidly growing populace, raw materials for industry, income and employment, any national policy directed toward the economic well being of the people must incorporate the agricultural sector.

As the major sector of the economy, there is therefore a need to unravel some of the complexities and interdependencies of economic activities within agriculture. This would provide a better integrated picture of the sector and assist in appraising the impacts of national policy decisions on prices and flow of goods in the economy as a whole.

A systematic way of analyzing national policies relative to the agricultural sector is needed to provide alternatives for decision makers and national planners of the country to restructure the Philippines' developmental goals. Such modeling efforts do not provide

Table 5. Annual Estimates: Percent Distribution of Net Domestic Product by Industrial Origin, Philippines, 1967 to 1972, at 1967 Prices^a

Industry/Item	Calendar Year					
	1967	1968	1969	1970	1971	1972
1. Agriculture, Fishery and Forestry	33.3	33.8	34.2	33.4	32.4	31.5
2. Mining and Quarrying	1.5	1.7	1.8	2.1	2.3	2.4
3. Manufacturing	18.3	18.6	18.6	19.4	20.1	20.5
4. Construction	3.8	3.1	3.1	3.5	2.8	3.4
5. Transportation, Communication, Storage Utilities	4.0	3.9	3.9	3.9	3.9	3.9
6. Commerce	15.4	15.4	15.2	15.4	15.3	15.3
7. Services	23.7	23.5	23.2	23.3	23.2	23.0
Net Domestic Product at Factor Cost	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>

^a Revised estimates as of February 12, 1973.

Source: The National Economic Development Authority.

Table 6. Contribution of the Agricultural Sector to the Philippine Balance of Trade, in Million Dollars, 1970 to 1973

Item	1970	1971	1972	1973
Agricultural Exports	744	776	767	953
Agricultural Imports	-172	-207	-234	-228
Estimated Balance	<u>572</u>	<u>569</u>	<u>533</u>	<u>725</u>

Source: National Census and Statistics Office.

Table 7. Distribution of Employment by Industry, by Occupation and by Class of Worker, Philippines, May 1973

Category	Percent Distribution
By Industry:	
Agriculture, forestry, hunting and fishing	52.9
Commerce	12.6
Manufacturing	10.8
Combined government community business and recreational services	8.2
Domestic services	5.1
Construction	3.9
Transport, storage and communication	3.8
Personal services, other than domestic	1.9
Mining and quarrying	0.5
Electricity, gas, water and sanitary services	0.3
By Occupation:	
Farmers, farm laborers, fishermen, hunters, loggers and related workers	52.5
Craftsmen, production process and related workers	12.0
Sales workers	11.3
Service, sport and related workers	8.5
Professional, technical and related workers	4.9
Workers in transport and communication occupation	3.8
Clerical workers	3.5
Administrative, executive and managerial workers	1.0
Manual workers and laborers	2.2
Miners, quarrymen and related workers	0.3
By Class of Workers:	
Wage and salary workers	37.6
Self-employed	39.3
Unpaid family workers	23.1

Source: National Census and Statistics Office, Survey of Household Bulletin, Series No. 38.

all answers to the policy issues confronting the Philippine economy today, but to the extent that agricultural prices and quantities influence national levels of income, employment and trade, a national research study can be helpful in appraising alternative policy approaches to meeting national objectives.

III. OBJECTIVES OF THE STUDY

On February 1, 1972, the Economic Research Service, United States Department of Agriculture and the Bureau of Agricultural Economics (BAEcon), Department of Agriculture of the Philippines initiated a research project focusing on Agricultural Diversification and Markets (ADAM) in the Philippines.

The ADAM Project had the following objectives (71):

1. To obtain an integrated picture of Philippine agriculture within which various policy goals can be formulated and analyzed.
2. To analyze the various constraints limiting farm income, employment and productivity in the country.
3. To develop the economic data and analysis needed to identify realistic agricultural production and market opportunities and alternatives at farm, regional, national and international levels in order to increase and stabilize farm income, increase its contribution to national growth, increase employment and increase foreign exchange earnings.
4. To develop in the Philippines, with the combined effort of the Department of Agriculture (DA), the University of the Philippines,

the Economic Research Service of the United States Department of Agriculture (USDA-ERS), the United States Agency for International Development (USAID), the mechanisms for continuous analysis and reevaluation of these opportunities and alternatives as production and market conditions change.

The above objectives of ADAM were within the context of the Philippines' societal goals and in line with the current general policy directions being pursued by the government. These policies are:

1. To obtain increased agricultural production from existing resources.
2. To modernize agriculture through adoption of new technology.
3. To diversify production to achieve self-sufficiency for increased exports.
4. To implement reforms at all levels of society.

The ADAM Project in order to operationalize its broad objectives and be able to follow the policy paths of the government, needs a tremendous amount of research undertakings at all levels. This need was easily recognized by a panel of United States Department of Agriculture-Economics Research Service (USDA-ERS) consultants who spent several months in the Philippines during the model building stage of the Project. Thus, in 1974 (38), the group recommended that relative to the modeling effort, at least five different models should be developed:

1. A detailed regional model of total Philippine agriculture;
2. A detailed national model of total Philippine agriculture;

3. A partial national prototype model;
 4. An aggregated national model of total Philippine agriculture;
- and
5. A miniature testing model.

The ADAM Linear Programming version used in this study resembled the "partial national prototype model."³ It had the following objectives:

To estimate the impact of the following on agricultural prices, output, employment and income.

- A. Variations in fertilizer prices.
- B. Variations in the fertilizer subsidy policy through:
 1. The removal of the fertilizer subsidy in the food crop subsector.
 2. The adoption of a uniform pricing of fertilizer for both food crop and export crop subsectors at different subsidy levels.
 3. The adoption of a uniform pricing of fertilizer for both subsectors at different levels of subsidy with a 4 percent tax⁴ on the product prices of the export subsector.

³ Actually the model used here is larger and more sophisticated than the "prototype" discussed in the Consultants' Report (38). The model used in this study, henceforth to be called MAAGAP, incorporated more realistic crop and livestock activities; used the constant elasticity concept in generating the demand segments; and made use of the Haverly System for data handling and manipulation.

⁴ The tax rate used here was in accordance to the provisions of an act approved in 1970, imposing a 4 percent tax to the Freight on Board (FOB) peso proceeds of copra and centrifugal sugar exports received from July 1, 1973, to June 30, 1974.

- C. Variations in the efficiency of irrigation systems.
- D. Variations in the price ceilings for rice.
- E. Variations in the levels of mechanization:
 - 1. For both hand and four-wheel tractors.
 - 2. For hand tractors only.
 - 3. For four-wheel tractors only.
- F. The 1972 flood.

CHAPTER II

REVIEW OF RELATED LITERATURE AND METHODOLOGICAL ISSUES

I. REVIEW OF RELATED LITERATURE

Sectoral planning models and the problems of spatial equilibrium programming models under competitive conditions have been receiving an increased emphasis by economists and planners. Evidently this great emphasis stems from two factors: the increased use of governmental policy to encourage economic development and the emergence of high speed computers to facilitate large-scale applications (92).

According to Bassoco and Norton (9), the principal aim of sectoral models is to simulate market conditions that approximate a perfectly competitive model. This is in contrast to the adding-up approach that has characterized the construction of supply response models in the United States (81) for the past decades.

Samuelson (79) initiated the classic methodology when he demonstrated that in spatially separated markets with fixed transportation costs between the markets, there exists an objective function (defined by him as "net social payoff"), such that the conditions for its being a maximum coincide with well-known conditions for competitive market equilibrium. Years later, Smith (83) further developed the concept and provided a dual interpretation of Samuelson's analysis by showing that under identical situations to that discussed by Samuelson, the minimization of "economic rent" will lead toward price competitive equilibrium.

Since then a flurry of extensions and applications of this modeling effort gained recognition. It was extended to multiproduct cases (92) with given independent demand functions (44, 52), and to the maximization of a given social function defined by Takayama and Judge (85, 86, 87) as the sum of the producer's and consumer's surplus.

The most recent application of this type of study, where multiple products and various inputs of the agricultural sector were programmed to simulate competitive market equilibrium, has been in Mexico (36) and Portugal (39).

II. THEORETICAL SETTING

The sector is described by a downward sloping demand curve for its products; an upward sloping supply curve for inputs; and a technological process by which the inputs are transformed into outputs (62). The conditions under which the sector is in equilibrium are:

- (a) $P_o = AC$ output price is equal to average cost;
 - (b) $P_i = MVP$ input price is equal to marginal value product;
- and where $Q_o = f(Q_i)$ output is a function of inputs.

This can be stated in the usual neoclassical maximization problem:

Maximize:

$$(1) W = \int_0^{\infty} P_o \, dQ_o - \int_0^{\infty} P_i \, dQ_i$$

where

W is the sum of the producer's and consumer's surplus
or net social benefit;

$P_o = f(Q_o)$ is the inverse of the product demand curve which
satisfies the condition of consumer demand theory;
and

$P_i = f(Q_i)$ is the supply curve for inputs.

Subject to:

$$(2) Q_o = f(Q_i)$$

where Q_o is a twice differentiable production function. The augmented function of this is:

Maximize:

$$(3) Z = \int_0^{\infty} P_o \, dQ_o - \int_0^{\infty} P_i \, dQ_i - \lambda \{ Q_o - f(Q_i) \} ,$$

where Z is the sum of producer's and consumer's surplus subject to a given production function.

Taking the partial derivatives with respect to Q_o , Q_i and λ and setting them equal to zero, we have

$$(4) \frac{\partial Z}{\partial Q_o} = P_o - \lambda = 0$$

$$(5) \frac{\partial Z}{\partial Q_i} = -P_i + \lambda \frac{df(Q_i)}{dQ_i} = 0$$

$$(6) \frac{\partial Z}{\partial \lambda} = -Q_0 + f(Q_1) = 0 .$$

The solution of these gives:

$$(7) P_0 = \lambda$$

$$(8) P_1 = P_0 \frac{df(Q_1)}{dQ_1}$$

$$(9) Q_0 = f(Q_1)$$

From this it follows that λ is the average cost which meets condition (a); and condition (b) is met since input price is equal to the marginal value product; finally, the production function acts as a constraint in achieving conditions (a) and (b). This means that the sector production function is an average function for all firms in the sector.

The above sectoral conditions imply the firm level assumptions for equilibrium (40) which are:

- | | |
|-------------------------------|--|
| (c) $AC = MC = P_0 = AR = MR$ | the firms equate their marginal cost to marginal revenue which is equal to their average cost, average revenue and the market price of output; |
| (d) $MVP = P_1$ | firms equate marginal value product with market price of inputs; and |
| (e) $Q_0 = f(Q_1)$ | firms produce output using their given production function. |

The competitive equilibrium conditions for both firm and sector levels can be illustrated in Figure 1. In the usual linear programming adding-up approach, the equilibrium market price $\bar{P}$ is assumed exogenous to the firm. Given the sector's equilibrium price, the firms in the industry are assumed to adjust to attain their optimal levels of output—they equate their $MC = MR$. In sectoral modeling, the market equilibrium prices and quantities are endogenously determined, with the implied assumption, that the firms in the industry have adjusted to their optimal levels of output. Obviously in the real world, equilibrium conditions will at best be only approximations and model results based on assumed equilibrium conditions will be subject to possible errors.

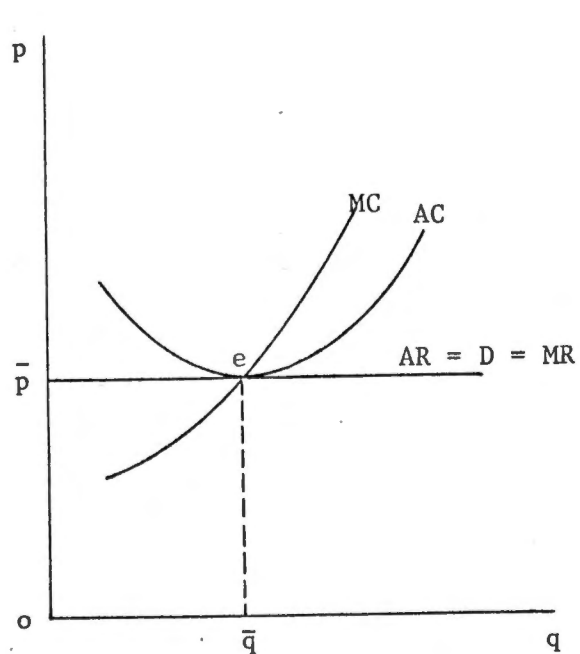
III. WELFARE IMPLICATIONS

The objective function used was maximization of the sum of consumer's and producer's surplus or net social benefit which was slightly modified from the Duloy-Norton (36) formulation. Taking (1) and manipulating by the addition and subtraction of total revenue,

$$(10) \quad W = \int_0^{Q_0^*} P_0 \, dQ_0 - P_0^* Q_0^* - \int_0^{Q_1^*} P_1 \, dQ_1 + P_0^* Q_0^*$$

where $P_0^* Q_0^*$ is the equilibrium price and quantity of output. The first part is easily recognized as consumer's surplus (CS).

$$(11) \quad CS = \int_0^{Q_0^*} P_0 \, dQ_0 - P_0^* Q_0^* .$$



(a) Firm level

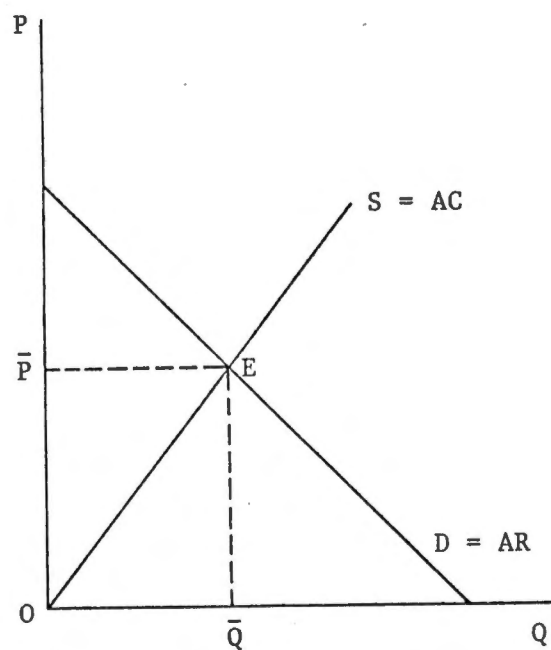
(b) Sector level, $E_{qi} = \bar{Q}$

Figure 1. Equilibrium conditions for firm and sector levels under perfect competition.

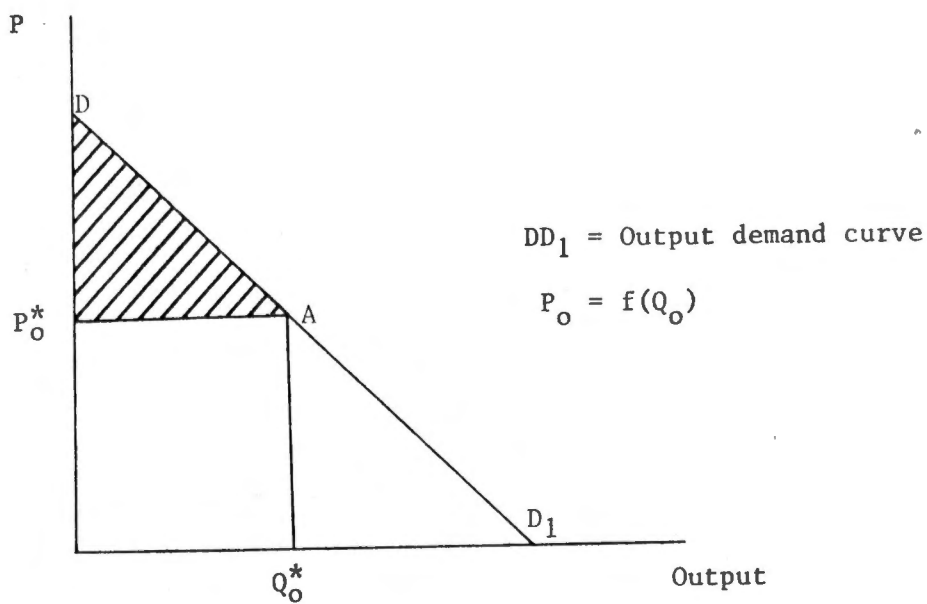
Graphically, this is the same as the shaded areas P_0^*AD in part (a) of Figure 2. The consumer's surplus is the difference between the marginal value of each succeeding unit as expressed by the demand curve DD , and what consumers must pay for a commodity at price P_0^* .

It is not obvious that the second part is producer's surplus. To obtain producer's surplus, it is necessary to remember one of the conditions for competitive equilibrium: total revenue is equal to total cost or $P_0^*Q_0^* = P_1^*Q_1^*$, where P_1^* and Q_1^* are the equilibrium price and quantity of inputs, respectively. Thus,

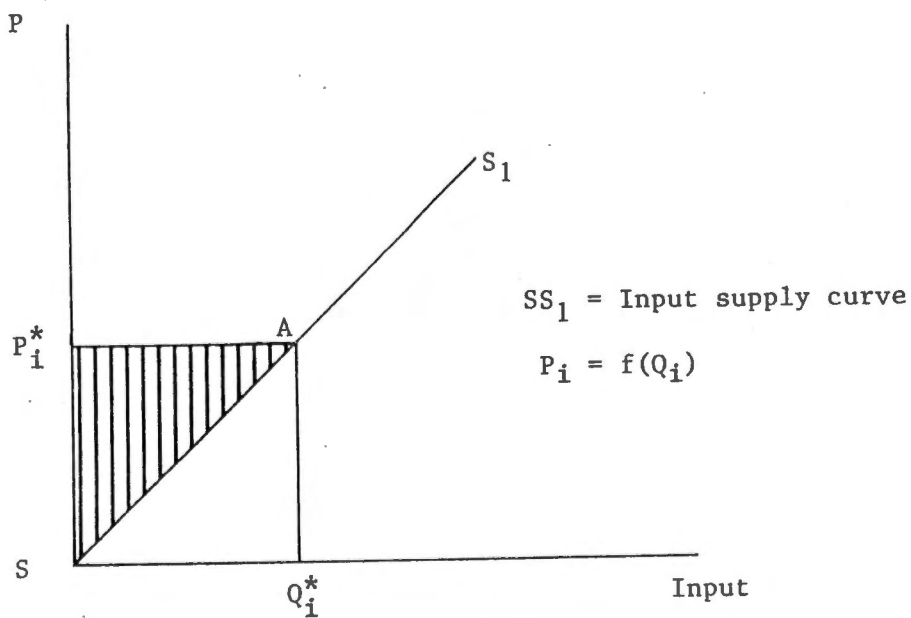
$$(12) \text{ PS} = P_1^*Q_1^* - \int_0^{Q_1^*} P_1 \, dQ_1 .$$

While this is not the usual formulation, it has considerable meaning. Graphically in part (b) of Figure 2, the producer's surplus is the shaded area SAP_1^* and represents the returns to the owners of the fixed factors while the area SAQ_1^* is the cost of variable inputs.

The producer's surplus is the difference between the price (P_0^*) received from the product and the marginal production cost of each succeeding unit which is expressed by the supply curve SS_1 . Supply curves in programming analysis are actually step-functions and can only be graphed a posteriori because the nature of supply curve is only determined on the final equilibrium solution (39). In part (b) of Figure 2, therefore, this means that the supply curve SS_1 may take different shapes and levels from solution to solution, and may not necessarily start from the point of origin.



(a) Consumer's Surplus



(b) Producer's Surplus

Figure 2. Consumer's and producer's surplus in market equilibrium.

IV. PROCEDURES

This study follows the basic programming methodology of Takayama-Judge (85, 86, 87); Dujoy-Norton (36); and Egbert-Kim (39) models and applies it to the national agricultural sector of the Philippines.

The Philippines is politically divided into 11 regions and 70 provinces but the unit of inquiry is not focused on the individual province/regions but on the basis of an aggregated homo-agro-economic area (HAE).

The stratification of the country into a HAE was based on economic, agronomic and environmental characteristics such as rainfall, physical landscape, soil, predominant crops and other factors.

The delineation made it possible to identify areas within which only particular types of agricultural products can be raised. Furthermore, the stratification facilitates the identification of the existing and potential patterns of agricultural production in the country.

The overall objective was to be able to aggregate and analyze the majority of the agricultural activities in a sufficient detail to obtain probable adjustments on the production patterns, resource requirements, processing-distribution and transportation needs at the national levels.

With the use of a mathematical programming framework, an integrated picture of Philippine agriculture can be depicted. The framework permitted the identification of production-processing-distribution opportunities and specifications of alternative activities competing for the sector's limited resources.

The general analytic framework was a production-processing-distribution model. This model used a linear programming technique to simplify the complexities of the varied roles of Philippine agriculture as mentioned earlier.

Activities were provided for four major crop categories (rice, corn, sugar, coconut) and three main livestock products (pork, poultry meat and eggs). The four crops taken together comprise 88 percent of the total area and 72 percent of the total value of Philippine agriculture. Table 8 summarizes the total area and value of the corresponding crops in the study.

The analysis took the initial form of describing a normalized planning period (1969/70-1971/72) for which data were available. An equilibrium programming solution was obtained to approximate the three-year base. Because some policies, like the fertilizer subsidy and the variations in rice price ceilings could be better analyzed within the context of a 1974 time frame, the 1972 base was then shifted to 1974.

In shifting the base period from 1972 to 1974, several measures¹ were undertaken. A wholesale price index (WPI) deflator of 2.23 for all items was generated by dividing the WPI of 1974 with the average of the WPI of 1970-1972. The WPI deflator was then utilized in deflating the current 1974 input prices and prices of domestic, export and imported products. The rationale for this was to be able to visualize changes in the MAAGAP model in real terms.

¹For specific details refer to (47).

Table 8. Crops Incorporated in the MAAGAP Model by Area and Value of Production, Philippines, 1969/70-1971/72

Crop	Land Area	Value
	--1,000 hectares--	--in million pesos--
Palay	3,147.4	2,561.5
Corn	2,414.0	763.5
Sugar	360.0	1,927.4
Coconut	<u>2,019.0</u>	<u>1,282.3</u>
Total	7,940.4 ^a	6,534.7 ^a

^aApproximately 88 percent and 72 percent, respectively, of the total area (9,072.4 thousand hectares) and value (9,0921 million pesos) of Philippine agriculture.

Source: Bureau of Agricultural Economics.

Further, the model was also adjusted relative to the effects of energy crisis. A mineral fuel price inflator of 78 percent was computed by getting the difference between the new mineral fuel WPI with the WPI for all items. This 78 percent mineral fuel inflator was used in computing for the new costs of rice, corn and sugar milling operations.

Resource availabilities were likewise adjusted. Irrigated lands, livestock inventories, sugar capacity constraints, tractor services and other right-hand-side elements of the model were all reformulated to reflect the 1974 conditions. Finally the demand segments were also recalculated based on growth rates of population and income.

For development planning purposes, the 1972 and 1974 base solutions were then utilized as benchmarks in estimating the likely macroeconomic effects on agricultural prices, output, employment and income of the various policy alternatives as stated in the objectives of this study.

Several programming procedures were followed to attain the different objectives of the study.

A. Variations in fertilizer prices.

From the 1972 base solution the input cost of fertilizer (food and export crops) was varied from 25 percent lower than the base to 300 percent greater than the base. This was done to trace the nature of the marginal value product (MVP) for fertilizer.

B. Variations in the fertilizer subsidy policy.

1. In 1973, the Philippine government adopted a two-price system for fertilizer between the food crop and export crop subsectors. From the 1974 base only the price of fertilizer used

in the food crop subsector was varied upward to approximate a uniform fertilizer pricing for both food crop and export crop subsectors. This took care of the short run policy of removing the fertilizer subsidy.

2. A major administrative problem in implementing the two-price systems of fertilizer was blackmarketing. To remedy this problem prices of fertilizer for both subsectors must be equally priced and/or subsidized. In the procedure, the 1974 base prices of fertilizer for both subsectors were simultaneously subsidized from zero to 100 percent.

3. An additional alternative involved equal pricing (or subsidizing) of fertilizer in the sector plus the addition of a 4 percent tax in the export crop subsector. The rationale for the imposition of a tax was from the viewpoint of income distribution between the two subsectors.

C. Variations in the efficiency of irrigation system.

The ratio between the twice irrigated lands to once irrigated was varied from the base ratio of 53:47 percent to 63:37 percent and 75:25 percent. This was done to trace the effect of an increase in water input in the production of palay and the possible effects of the increased production of palay on prices of other crops like corn and sugar cane.

D. Variations in the price ceilings for rice.

The Philippine government has followed a policy designed to maintain a low price of rice by subsidizing imports. To evaluate

this policy the price of rice (price ceiling) was parameterized from a low of ₦843 per metric ton to a high of ₦1,153 per metric ton.

E. Variations in the levels of mechanization.

To trace the effects on employment and output, the tractor services (from a given stock of hand and four-wheel tractors in 1972), were varied:

1. From zero to 500 percent of the 1972 base for both hand and four-wheel tractor simultaneously.
2. From zero to 800 percent of the 1972 base for hand tractors only (four-wheel tractors held constant).
3. From zero to 180 percent of the 1972 base for wheel tractors only (hand tractors held constant).

F. Effect of 1972 flood.

This variation was included to test how accurate the model could simulate changes in agricultural prices and income as a result of a natural disaster. A negative right hand side was substituted in the commodity balance equations of the four crops, reflecting the highest percentage of crop damage in 1972.

CHAPTER III

THE MAAGAP MODEL

I. AN OVERVIEW

The MAAGAP¹ is a mathematical programming model that evaluates the economic aspects of Philippine agricultural sector at the national level.

The model assumes the following conditions: A given set of national demand for agricultural commodities; a set of national supplies of resources (land, labor and capital); and a set of production technologies.

Figure 3 schematically illustrates the production processing-distribution mix of MAAGAP. The arrows trace the flow of goods and services from the input side (resources) through production and processing activities to final demand (domestic and export). As the arrows indicate, land, labor and capital inputs were not only utilized in the primary production activities but processing as well.

By-products of rice and corn milling were complemented with the commercial feed requirements of the livestock (hogs and poultry) activities. Aside from this, corn grain could be directly fed to broilers and pigs. For simplicity, only copra is produced from coconut as a final product. Sugar and copra could be exported or consumed domestically while the other final products (rice, corn grits, pork, poultry and eggs) find their consumption in the domestic markets.

¹MAAGAP is a dynamic Filipino word meaning "alert," "ahead"—symbolic of the spirit of planning. One may translate it literally as: Model analysis of agricultural adjustments in the Philippines.

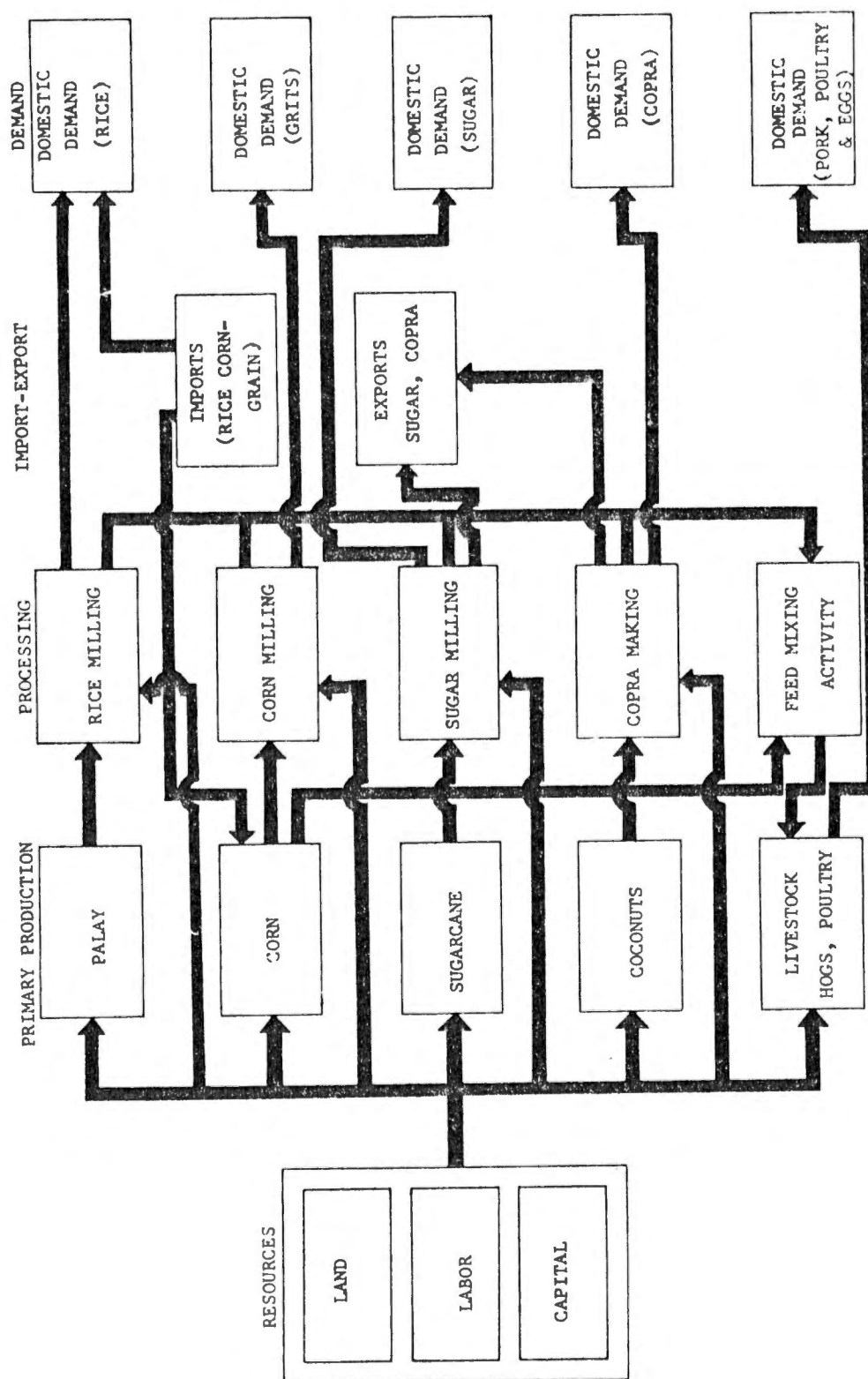


Figure 3. Schematic diagram of the MAAGAP model.

The MAAGAP model contained the following primary production activities: 65 activities each for palay and corn; 30 for sugar; 4 for coconuts; 3 each for hogs and poultry; 6 intermediate activities in milling; 17 feed mix alternatives; 6 for capital borrowing; 8 activities providing nitrogen, phosphorous and potassium (NPK) of fertilizer; 3 chemical buying activities; 8 transfer activities; 4 import-export activities; 12 activities for tractor services; and 84 sale activities (stepped or segmented demand functions).

Resource constraints were man, animal and tractor constraints, all expressed in bimonthly periods; five land capability classes, divided semiannually; capital and chemical constraints expressed in peso units; fertilizer constraints expressed in pure NPK forms; crop area and sugar capacity constraints; restraints on livestock inventory and feed requirements; import-export quotas; 25 miscellaneous balance equations; and convex combination constraints for the demand segments of the seven final products treated in the model. For a complete picture of the linear programming tableau of MAAGAP, refer to Figure 4.

II. OBJECTIVE FUNCTION

The general intent of the model was to determine the optimum production-processing-distribution mix of Philippine agricultural activities, under a given set of conditions with respect to prices, resource availabilities, technology, institutions and markets.

The model assumed that the agricultural sector approximates that of a perfectly competitive market. With this assumption, it isolates

ROWS	PRIMARY PRODUCTION					DEMAND SEGMENTS										TYPE OF CONSTRAINTS	RHS			
	PALAY A1...05	COCONUT A1...05	SUGAR A1...30	HOGS A1...3	POULTRY A1...3	Processing A1...6	Buying Fertilizer A1...8	Buying Chemicals A1...3	Capital Raising A1...6	Tractor Hiring A1...12	Food Rotation A1...12	Transfer Activities A1...8	Export - Import A1...4	RICE A1...12	CORN A1...12			COFFEE A1...12	COPRA A1...12	POULTRY A1...12
Land (1 - 10)	1	1	1	1	1															Absolute land area by class, by season
Crop Area Constraints (1 - 4)	1	1	1	1	1															Effective crop area by crop category
Man Labor (1 - 6)	-	+	+	+	+	+														Available bi-monthly Man labor supply
Animal Labor (1 - 6)	-	+	+	+	+	+														Available bi-monthly Animal labor supply
Hand Tractor (1 - 6)	-	+	+	+	+	+														
Four Wheel Tractor (1 - 6)	-	-	+	+	+	+														
Fertilizer (1 - 3)	+	+	+	+	+	+														0
Chemicals (1 - 3)	+	+	+	+	+	+														0
Capital Requirements (1 - 5)	-	-	+	+	+	+	+													Available loanable cash for crops, livestock and milling
Sugar Capacity Constraints (1 - 3)			+																	Total sugar milling capacity
Livestock Inventory (1 - 2)			+	+	+															Total number of hogs and poultry at the farm level
Feed Constraints (1 - 5)			+	+	+															0
Tractor Rows (1 - 12)																				Available bi-monthly supply of hand and four wheel tractor machines
Commodity balances (1 - 4)	-	-	-	-	-	+														0
Output Balance Equations (1 - 13)						-														0
Export-Import (1 - 3)																				0
National D.S Foreign Balance (1 - 8)																				0
Convex Combinations (1 - 7)																				1
Objective function																				+ [Value of Sales]

Figure 4. Linear programming tableau of the MAAGAP model.

the agricultural sector and equilibrates aggregate supply with derived aggregate demand under a static framework. The procedure implies the endogenous determination of equilibrium prices and quantities, that is, at their intersection point, the sector is at equilibrium.

The model's maximand under the assumption of a perfectly competitive market is the sum of the producer's and consumer's surplus (net social benefit). It is the integral of the area bounded by our aggregate demand curve and supply curve. Mathematically, this is the same as equation (1) discussed earlier:

$$(1) \quad \text{Max } W = \int_0^{\infty} P_0 \, dQ_0 - \int_0^{\infty} P_1 \, dQ_1$$

where

$P_0 = f(Q_0)$ is the inverse of the usual product demand curve;

and

$P_1 = f(Q_1)$ is the supply curve of inputs.

III. THE ACTIVITY SET

Activities in the MAAGAP Model represented a variety of choices at the national level. They were developed for the various enterprises according to land capability classes, availability of water, usage of fertilizer and modern inputs, and yield levels. They were distinguished by type of technology and time period whenever relevant. These production activities transformed the production inputs into either final outputs or intermediate products which were in turn used as inputs in other activities.

Intermediate activities transformed output into final form used for consumption. Examples of such activities are rice and corn milling, cane milling, copra making and livestock production.

Input supply activities were provided for fertilizer, chemicals, short-term capital as well as for tractor services. Labor supply activities represented on-farm and nonfarm agricultural labor supply distributed on a bimonthly period throughout the year.

Sales and revenue activities were formulated to represent segmented demand functions using constant elasticities. Elasticities for each of the different products were estimated outside the model. The approach in calculating the objective functions for the products was by grid linearization and separable programming. A graphic representation of the demand segments for rice and its corresponding objective function,² as an example, can be seen in Figures 5 and 6, respectively. Likewise the demand tableau for a single commodity case is shown in Table 9. Because of the assumption of convexity, and the use of separable programming, the solution will never use more than two of the segmented activities in the demand set of a particular commodity.

IV. THE CONSTRAINT SET

The model likewise assumed a finite set of constraining factors, each member of which was identified by a unique arbitrary index i

²For a single commodity case, the objective function (W) is the integral of the area under the demand segments. Thus the integral of the first segment of Figure 5 is equivalent to W_1 of Figure 6; the second segment to W_2 . . . up to 12 segments or W_{12} . For a complete discussion on how these demand segments and their objective functions were calculated, refer to Chapter IV.

Pesos per Kilo

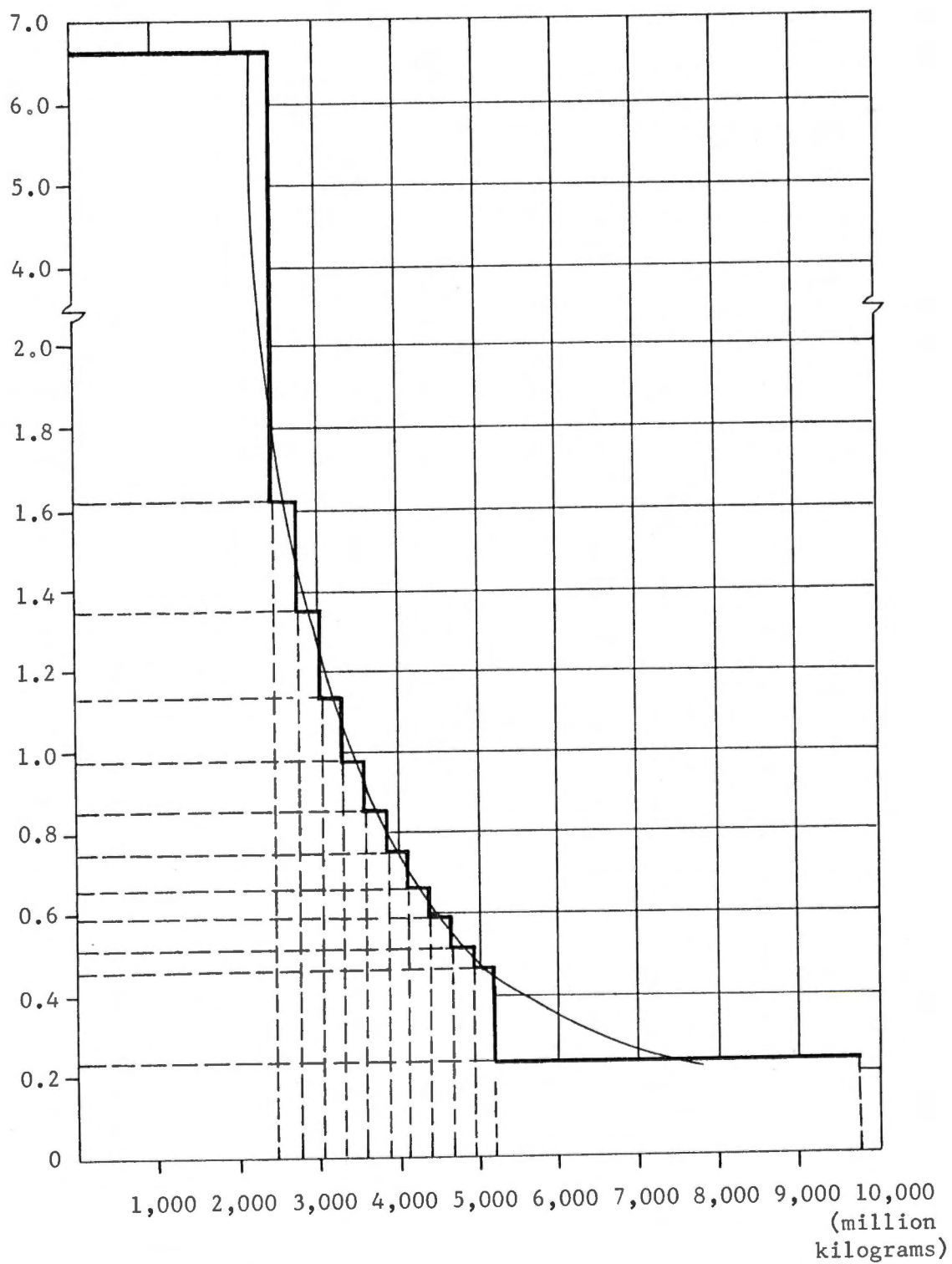


Figure 5. National demand segments for rice, MAAGAP, 1972 base.

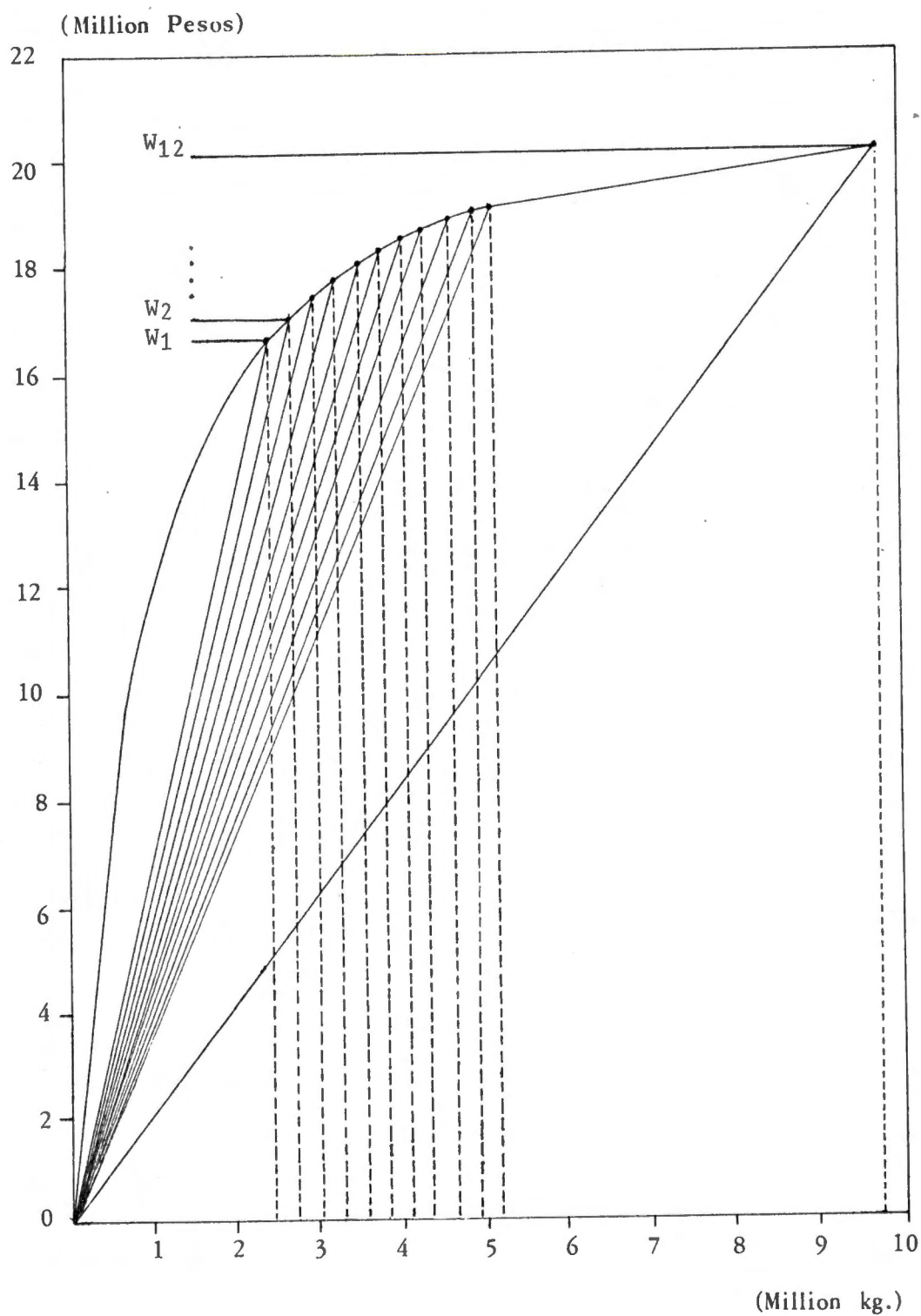


Figure 6. Objective function for rice.

Table 9. Single Commodity Demand Tableau

Row/Activities	1	2	3	. . .	n	Output	RHS
Objective function	w_1	w_2	w_3	. . .	w_n		≥ 0
Commodity balance	q_1	q_2	q_3	. . .	q_n	$-Q$	≤ 0
Convex combination	1	1	1		1		≤ 1

belonging to a given set. These constraints can be generally broken down into land, labor, capital and demand. The technical coefficients (b_{ij}) were assumed to be constant over time (all technology assumed to be embodied) and were defined as such that if:

$b_{ij} > 0$ implies that factor i is a "net input" to activity j ;

$b_{ij} = 0$ implies that factor i is not involved in activity j ; and

$b_{ij} < 0$ implies that factor i is a "net output" of activity j .

The limitation c_i coefficients are also defined at the national level and follow the rules:

$c_i > 0$ implies that factor i forms an upper bound on activity combinations;

$c_i = 0$ implies that factor i forms a "balance constraint"; and

$c_i < 0$ implies that factor i forms a lower bound on activity combinations.

The general nature of the constraints are specified in equations (13) through (35).³

Land

Land constraint is broken down by type of land and time of use. Equation (13) states that the amount of land used in the production activities (j a subset of primary production activities), c^{th} capability class, in time t is less than or equal to the amount of land available at the national level.

³For a specific discussion on the resource constraints in the model refer to Chapter IV.

$$(13) \quad \sum_{j \in P} L_{ij}^{c,t} X_j \leq L_i^{c,t}$$

$$\begin{aligned} c &= 1 \dots 5 \\ t &= 1, 2 \end{aligned}$$

where

$L_i^{c,t}$ is the total available land for the nation classified into five classes and two seasons a year;
 $L_{ij}^{c,t} X_j$ is the amount of land used by activity X_j ; and
 $j \in P$ means that activity j is a subset of primary production activities P . This notation holds true for all activities which are subsets to the primary production activities.

Labor

Equation (14) insures that the amount of labor used at the national level and the t^{th} time period is less than or equal to amount supplied from family and hired resources.

$$(14) \quad \sum_{j \in P} H_{ij}^t X_j \leq H_{if}^t \quad t = 1 \dots 6$$

where

H_{if}^t is the total amount of hired and family labor for the nation available into six bimonthly periods; and
 $H_{ij}^t X_j$ is the amount of hired labor used by activity X_j in period t .

Capital Inputs

This category covered items needed in the production process such as fertilizers, chemicals, machinery services as well as cash inputs. Equation (15) states that the use of machinery service at the national level by types of machines used in period t must be less than or equal to the available supply

$$(15) \quad \sum_{j \in P} C_{ij}^{m,t} X_j \leq S_i^{m,t}$$

$$\begin{aligned} m &= 1, 2 \\ t &= 1 \dots 6 \end{aligned}$$

where

$S_i^{m,t}$ is stock of capital input for the nation in the form of machinery services (hand and four-wheel tractors) available on a six bimonthly period throughout the year; and

$C_{ij}^{m,t} X_j$ is the amount of tractor services in period t , used by activity X_j .

Equation (16) reiterates that the usage levels of fertilizer nutrients (in pure form) cannot exceed the available supply of fertilizer nutrients for all types of fertilizer.

$$(16) \quad \sum_{j \in P} C_{ij}^f X_j - \sum_{j \in P} S_{ij}^f X_{ij} \leq 0$$

$$f = 1 \dots 3$$

where

$\sum_{j \in P} S_{ij}^f X_{ij}$ is the fertilizer nutrients (n, p, k) supply equation; and

$\sum_{j \in P} C_{ij}^f X_j$ is the amount of pure nutrients (nitrogen, phosphorous, potassium), used by activity X_j .

Equation (17) stands for chemicals. What is used must be less than or equal to their supply in money terms.

$$(17) \quad \sum_{j \in P} C_{ij}^c X_j \leq S_i^c$$

where

S_i^c is the amount of cash available for buying chemical; and
 $C_{ij}^c X_j$ is the amount of cash spent by activity X_j in buying chemicals.

For operating capital, equation (18) insured that the amount needed for each production activity (e.g., planting, harvesting, etc.) plus the amount used for cash inputs, plus the amount paid to hired labor must be less than or equal to the short term capital available.

$$(18) \quad \sum_{j \in P} C_{ij} X_j + \sum_{j \in P} S_i^c X_j + \sum_{j \in P} H_{ij}^t X_j \leq S_{ki}$$

where

S_{ki} is the amount of available short term capital while
 $C_{ij} X_j$,
 $S_i^c X_j$,
 and $H_{ij}^t X_j$ are the same variables as defined in equations (14) to (17).

Equation (19) insured that the animal labor days used by the production activities should not exceed the available supply in any time period.

$$(19) \quad \sum_{j \in P} A_{ij}^t X_j \leq A_i^{-t} \quad t = 1 \dots 6$$

where

A_i^{-t} is the total number of working animals in the nation available at six bimonthly periods throughout the year; and

$\sum_{j \in P} A_{ij}^t X_j$ is the amount of animal services used by activity X_j in period t .

Capacity Constraints

These served similar functions as the land constraints at the primary production level. Equation (20) stated that the amount of palay, corn, sugar cane and coconuts milled must be less than or equal to the milling capacity in the country (j a subset of the processing activities).

$$(20) \quad \sum_{j \in M} M_{ij}^n X_j \leq M_i^{-n}$$

where

M_i^{-n} is the total milling capacity for the nation;

$\sum_{j \in M} M_{ij}^n X_j$ is milling or processing cost used by activity X_j ;

and

$j \in M$ means that activity j is a subset of milling activities M . This notation holds true to all activities where processing is involved.

Commodity/Output Balance Constraints

For palay, equation (21) insured that the amount produced $(-\sum_{j \in P} q_{ij}^p X_j)$ was equal to the amount milled $(\sum_{j \in M} M_{ij}^r X_j)$.

$$(21) \quad -\sum_{j \in P} q_{ij}^p X_j + \sum_{j \in M} M_{ij}^r X_j = 0.$$

Equation (22) likewise states that the amount of milled rice $(-\sum_{j \in M} q_{ij}^{rm} X_j)$ is equal to the amount sold (q^{rs}) .

$$(22) \quad -\sum_{j \in M} q_{ij}^{rm} X_j + q^{rs} = 0.$$

Equation (23) represents the rice balance equation. The amount of rice produced $(-\sum_n q_n^r)$ equals the amount sold $(+\sum_s q_s^{*r})$ minus exports $(+q^{rx})$ plus imports $(-q^{rI})$ where q_s^{*r} represents the separable demand function requiring an additional constraint.

$$(23) \quad -\sum_n q_n^r + \sum_s q_s^{*r} - q^{rI} + q^{rx} = 0$$

$$\sum_s q_s^{*r} \leq 1$$

For corn [equation (24)], the amount of corn produced $(-\sum_{j \in P} q_{1j}^c X_j)$ equals the amount milled $(+\sum_{j \in M} M_{1j}^c X_j)$ sold plus the amount for other uses $(+q^c)$.

$$(24) \quad -\sum_{j \in P} q_{1j}^c X_j + \sum_{j \in M} M_{1j}^c X_j + q^c = 0.$$

For corn grit [equation (25)], the amount of corn grit produced $(-\sum_n q_n^g)$ equals the amount consumed, where q_s^{*g} represents the segmented demand function.

$$(25) \quad -\sum_n q_n^g + \sum_s q_s^{*g} = 0$$

$$\sum_s q_s^{*g} \leq 1$$

Equation (26) states that the corn balance for other purposes $(-\sum q^c)$ equals the amount fed to livestock $(+\sum_{j \in L} f_{1j}^c X_j)$ minus the amount exported $(+q^{cx})$ plus imports $(-q^{cI})$ (j a subset of the primary livestock production activities, L).

$$(26) \quad -\sum q^c + \sum_{j \in L} f_{1j}^c X_j + q^{cx} - q^{cI} = 0.$$

On the other hand equation (27) reiterates that the by-products of rice, corn, sugar and coconuts used for feed $(+\sum_{j \in L} f_{1j}^B)$ or exported $(+f^{Bx})$ are less than or equal to the amount produced $(-\sum_{j \in M} m_{1j}^B X_j)$ plus imports $(-f^{BI})$.

$$(27) \quad - \sum_{j \in M} m_{ij}^B X_j + \sum_{j \in L} f_{ij}^B + f^{BX} - f^{BI} = 0$$

$$B = 1 \dots 9$$

Equation (28) insures that the amount of sugar cane milled ($+\sum_{j \in M} m_{ij}^S X_j$) equals the amount of sugar produced ($-\sum_{j \in P} q_{ij}^S X_j$).

$$(28) \quad - \sum_{j \in P} q_{ij}^S X_j + \sum_{j \in M} m_{ij}^S X_j = 0 .$$

For the final output balance for sugar, however, equation (29) states that the quantity of sugar produced ($-\sum_n q_n^{sg}$) is equal to the amount consumed ($+\sum_s q_s^{*sg}$) minus exports ($+q^{*gx}$), where q_s^{*sg} is the separable demand function for sugar.

$$(29) \quad - \sum_n q_n^{sg} + \sum_s q_s^{*sg} + q^{*gx} = 0$$

$$\sum_s q_s^{*sg} \leq 1$$

Equation (30) insures that the amount of coconuts processed ($+\sum_{j \in M} m_{ij}^{cc} X_j$) equals the amount of copra produced ($-\sum_{j \in P} q_{ij}^{cc} X_j$).

$$(30) \quad - \sum_{j \in P} q_{ij}^{cc} X_j + \sum_{j \in M} m_{ij}^{cc} X_j = 0 .$$

For the final output balance for copra equation (31) states that the amount of copra produced ($-\sum_n q_n^{cc}$) is equal to the amount consumed ($+\sum_s q_s^{*cc}$) minus exports ($+q^{ccx}$) where q_s^{*cc} is the separable demand function for copra.

$$(31) \quad - \sum_n q_n^{cc} + \sum_s q_s^{*cc} + q^{ccx} = 0$$

$$\sum_s q_s^{*cc} \leq 1$$

For livestock, equation (32) states that the amount of livestock products produced $(-\sum_{j \in L} q_{ij}^{\ell} X_j)$ is equal to the quantities consumed $(+\sum_s q_s^{*\ell})$ plus imports $(-q^{\ell I})$ minus exports $(+q^{\ell X})$, where $q_s^{*\ell}$ represents the segmented demand function for livestock.

$$(32) \quad - \sum_{j \in L} q_{ij}^{\ell} X_j + \sum_s q_s^{*\ell} - q^{\ell I} + q^{\ell X} = 0$$

$$\sum_s q_s^{*\ell} \leq 1$$

$$\ell = 1 \dots 3$$

For products consumed directly without processing, equation (33) reiterates that the amount consumed $(+q^{*d})$ is equal to the amount produced $(-\sum_{j \in P} q_{ij}^d X_j)$ plus imports $(-q^{dI})$ minus exports $(+q^{dX})$.

$$(33) \quad - \sum_{j \in P} q_{ij}^d X_j + q^{*d} - q^{dI} + q^{dX} = 0 .$$

Equation (34) is the standard linear programming constraint which states that all programming activities and prices cannot be at negative levels.

$$(34) \quad X_{ij}, P_{gj}, P_{xj}, P_{Ig}, q_{ij}, M_{ij} \leq 0 .$$

In addition to the real constraints there are IJ "pseudoconstraints"⁴ that are necessary to convert this nonlinear programming problem into a linear problem. The objective function is nonlinear because the demand functions are included in place of fixed prices for selling or consumption activities. Equation (35) states that the weighted sum of all the products sold in the nation through all demand segments, s , cannot exceed x_j^u where x_j^u/k_j is the maximum amount that can be sold through demand segment s .

$$(35) \quad x_j^u \geq \sum_s k_{js} x_{js}.$$

The upper bound x_j^u would never be set above the amount for which total quantity demanded is maximum.

Finally, our objective function can thus be rewritten as:

$$(36) \quad \text{Max } f(w) = \sum_j P_{gj} x_j^g + \sum_j P_{xj} x_j^E - \sum_j q_{1j} x_j^{a1} - \sum_j M_{1j} x_j^{a1} - \sum_j M_{1j} x_j^{a1} - \sum_j P_{Ig} x_j^I$$

where

- P_{gj} is price of the output at domestic sales;
- x_j^g is the level of output sold;
- P_{xj} is the export price;
- x_j^E is the level of export;

⁴For a thorough discussion of this, see (39), p. 301.

q_{ij} is unit cost of all primary production activities for both crops and livestock activities;

x_j^{ai} is the level of all inputs (resources) for all activities from primary production to processing;

M_{ij} is the unit cost of processing (milling) activities;

P_{ig} is the import price; and

x_j^I is the level of import.

Subject therefore to equations (13) to (35) the objective function of the programming model was to maximize: [the sum of all revenues from domestic sales] + [the value of net exports of goods] - [all miscellaneous costs at the primary production level for both crops and livestock] - [all processing (milling) costs] - [the value of net imports of goods] = [the sum of producer's and consumer's surplus (net social benefit) of goods originating from the agricultural sector], given consumer's income.

CHAPTER IV

TECHNOLOGY SET AND DATA BASE OF THE MAAGAP MODEL

I. BASIC DATA SOURCE

Crops

The technical production coefficients for palay and corn were generated from the 1972 Cost of Production Survey¹ conducted by the Bureau of Agricultural Economics (BAEcon) and the Farm Management Surveys made by the University of the Philippines, College of Agriculture (UPCA). For sugarcane,² the input-output coefficients were taken from the preliminary results of the farm survey conducted by the Philippine Sugar Institute (PHILSUGIN) in 1969.

The coconut cost of production estimates were likewise taken from the BAEcon, and preliminary results of the Farm Management Surveys of the UPCA, Department of Agricultural Economics, Los Banos, Laguna.³

Livestock

The livestock data used in the model had the weakest data base. Since the BAEcon poultry study was not yet completed at the time, the

¹For the BAEcon study which was a nationwide survey during the first and second semesters of crop year 1972, a total of 3,822 sample farmers for rice and 1,864 for corn were interviewed. For details on the special features of the survey, see (21).

²Most of these data were for internal use only and secured with special arrangements between the ADAM project researchers and the agencies concerned.

³See also Albert John Nyberg (68, pp. 81-88).

input-output coefficients for poultry were derived from two major sources: the farm level coefficients for small scale and commercial production of poultry developed by the Development Bank of the Philippines (DBP) in connection with their International Bank Reconstruction Development (IBRD) livestock loan program (29, 30), and the study made by Gapuz (45).

The data on hog production were compiled from several sources: for backyard hog production, the input-output coefficients were constructed after a series of consultations with the UPCA, Animal Husbandry Department. For commercial and semicommercial piggery, the technical input-output coefficients were derived from the DBP study (31) and the case study made by Drilon (35).

Demand Segments

There were two major demand studies utilized by the MAAGAP Model in estimating demand structural relationships for the seven commodities. One was an econometric model based on time series data fitted by three stage least squares (3SLS) for the major crops and livestock products (43). The other was a regression analysis by Josefina Ferrer (41), based on cross section data from survey conducted by Dosayla and Darrah for the Philippines (34). Table 10 summarizes the demand level, the price and income elasticities for selected agricultural products in the Philippines. Only seven commodities (rice, corn grits, sugar, copra, pork, poultry meat, and eggs), however, were incorporated in MAAGAP.

Table 10. Estimated Consumption of Agricultural Products and Price and Income Elasticity Estimates^a

Product	Estimated Per Capita Consumption Per Year ---kilos---	Total Consumption ^b Average for 1970-72 million kgs.	Elasticity Estimates	
			Price	Income
Rice	94.9	3,596.0	-.528	-.019
Corn grits	22.5	852.7	-.90	-.56 ^d
Sugar (raw value 96°) ^c	16.31	618.0	-.24	.54 ^d
Copra ^c	—	189.1	—	—
Coconut oil	3.19	119.0	-.93	.583
Pork	8.32	315.3	-.60	.30
Beef	4.16	157.7	-.47	.30
Eggs	2.11	79.9 ^e	-.50 ^c	.30 ^d
Poultry meat	1.12	42.4 ^e	-.50	.20
Fresh fish	19.5	739.0	-.60	.21
All vegetables	49.92	1,892.0	-.81	.30
Fruit vegetables	18.5	701.1	-.75	.20
Leafy vegetables	9.88	374.4	-.60	.24
Banana	17.66	669.3	-.70	.21

^aPrice and Income Elasticities are obtained by the ADAM Regression Analysis of National Food and Agricultural Council (NFAC) Consumption Survey Data except where noted.

^bPopulation level was 37.9 million.

^cTime series analysis. Quantity demanded for copra were generated from the coconut oil demand equation. Copra contains approximately 63 percent oil.

^dFor corn grits and sugar, arc income elasticities were generated from Dosayla/Darrah study, op. cit., p. 26. The latter arc income elasticities for meat and eggs are much higher than those obtained from the ADAM regression analysis. Both studies agree in general directions, that is, beef and pork elasticities are higher than poultry. Furthermore, since they agree in the same direction, eggs, whose income elasticity in the Dosayla/Darrah study is the same with beef and pork, was also assumed in the MAAGAP Model as having the same income elasticity for beef and pork. The completed analysis shows a .47 price elasticity and .31 income elasticity.

^eConsumption levels adjusted to be constant with feed supplies and livestock inventories.

In constructing the 12 demand segments using constant elasticities,⁴ only the price elasticities were used for the 1972 base. In moving the base, however, from 1972 to 1974, adjustments in the demand function were made taking into account, income elasticities, income growth rates and population growth rates. The calculated demand growth rates for various products are shown in Table 11.

II. TECHNICAL PRODUCTION COEFFICIENTS

Information on agricultural production costs was computed in the form of estimates of total expenses per activity or operation. These estimates included costs of input materials, labor, draft animals, and machinery services. To form linear programming activities for the MAAGAP Model, these sets of information were converted into statements of required economic inputs such as labor, fertilizer, chemicals, and credit. Generally, the conversion of per unit activity for the four crops were defined in terms of per hectare basis. For livestock, the activities were expressed as per unit of output since little land was involved in the production of hogs and poultry.

Labor

Man labor, tractor service and animal labor requirements for crops were specified in total days per hectare by operation. By the use of

⁴In the earlier prototypes of the MAAGAP Model, only eight demand segments were constructed using the linear demand functional form. Switching from linear to logarithmic form has two advantages: the availability of other research that estimated demand elasticities. The assumption is more realistic and manageable as prices and quantities move away from historical levels. For a discussion of this, see (38).

Table 11. Estimated Growth Rates of Demand for Selected Agricultural Products, Philippines, 1972 to 1974^a

Product	High	Medium
	-----Percent-----	
Rice	3.14	2.71
Corn grits	1.14	1.54
Coconut oil	(2.09) ^b	(2.12) ^b
Pork	5.21	3.96
Beef	4.32	3.72
Poultry meat	3.95	3.47
Eggs	4.32	3.04
Fresh fish	3.98	3.49
All vegetables	4.32	3.72
Fruit vegetables	3.95	3.47
Leafy vegetables	4.10	3.57
Banana	3.98	4.49
Sugar	5.20	4.33

^aGrowth rate equation:

$$q = (eY)(Y) + N$$

where

- q = change in demand quantity;
 eY = income elasticity;^c
 Y = income per capita growth rate; and
 N = population growth rate.

High	Medium
$Y = 3.69$	$Y = 2.54$
$N = 3.21$	$N = 2.96$

^bTrue only if the income to corn consumers grows at the same rate as per capita income. Since this is not likely, a more reasonable assumption would be a high of 2 percent and a low of 1.5 percent.

^cIncome elasticities for various products are shown in Table 10, p. 55.

Source: (61)

cropping calendar, these requirements were specified on a bimonthly period. The specific activities requiring man, animal and machine services were: seedbed preparation and care; land preparation (plowing, harrowing, furrowing); planting/transplanting; cultivation/weeding; fertilizer application; chemical spraying; harvesting/husking/threshing/shelling; hauling/drying; and others. Livestock activities, on the other hand, did not use tractor and animal power. Total human labor per unit of output in hogs and chickens were also expressed in bimonthly periods.

Land

The amount of each class of land required was also specified on a seasonal basis. Land activities were specified in per hectare basis.⁵

Variable Inputs

The three variable inputs (capital, chemicals, and fertilizer) incorporated in the model were specified differently. The short-term capital requirements included only the variable costs like: hired labor for planting, transplanting, harvesting labor, seeds, and other variable costs. Chemicals were specified in peso terms due to the large number and type of farm chemicals used in crop production. Finally, the amount of fertilizer required in the production activities was specified in terms of the pure nutrients: nitrogen, phosphorous, and potassium (NPK). Four types of fertilizer activities supplied primary production with

⁵ A more detailed description of land capability classes is given in the later sections of this chapter.

these nutrients. Contained in a sack of 50 kilograms each, the four (urea, ammosul, ammophos, and complete) were converted into pure nutrients every time they were used in activities, by using the following conversion procedure:

Urea	=	45-0-0	
		$.45 \times 50 = 22.5$	kg. of pure N
Ammosul	=	21-0-0	
		$.21 \times 50 = 10.5$	kg. of pure N
Ammophos	=	16-20-0	
		$.16 \times 50 = 8.0$	kg. of N
		$.20 \times 50 = 10.0$	kg. of P
Complete	=	12-12-12	
		$.12 \times 50 = 6$	kg. of N
		$.12 \times 50 = 6$	kg. of P
		$.12 \times 50 = 6$	kg. of K

Yield

Yield levels were estimated from the BAEcon's crop production estimates for 3 crop years, 1970-72. Yields for different types of land were taken from the 1960 census.⁶ Some fertilizer response data were available from farm management surveys.

III. THE PRODUCTION TECHNOLOGY SET

The MAAGAP Model contained a total of 164 primary cropping activities for the four crops and six for livestock.⁷ The palay and

⁶Census data for 1970 were not available at the time yield estimates were being made.

⁷Overall, the MAAGAP Model 1972 base solution had a total of 107 rows and 318 columns.

corn activities were generally divided into 13 types of technology levels each; 6 for sugarcane; 4 for coconuts; 3 each for hogs and poultry.

Each technology level of cropping activity defined a given yield per hectare together with fixed proportions of the following inputs: land (five classes divided into two seasons each class); man labor, animal labor, and tractor services all in bimonthly periods; purchased seeds; chemicals; short-term capital from institutional and noninstitutionalized sources.

Crops

Among crops, the relations between inputs and outputs were those which were observed from the farm management surveys mentioned earlier. For each technology then, a set of alternate activities was generated which represented points (segments) on a Cobb-Douglas production function. The procedure can be summarized as follows:

For each level of technology, it was necessary to have some sort of an average production function within crops. Given some information on production elasticities and assuming that farmers were profit maximizers, a representative production function for each type of technology using observed levels of output and input usage could then be constructed.

The analysis was limited to the most responsive factor of production (fertilizer) and assumed that all other inputs were either constant or linearly associated with yield levels. The production function can thus be expressed as:

$$(37) \quad Y = A [(\bar{x}_1 \dots \bar{x}_i, x_j \dots x_k) x_n^\alpha]$$

where

Y = level of output;

$\bar{x}_1 \dots \bar{x}_i$ = factors which were fixed in quantity or which do not directly affect yield;

$x_j \dots x_k$ = factors which were linearly related to output; and

x_n^α = the factor with given elasticity of production, in our case, nitrogen fertilizer.

Equation (37) can be further expressed into the usual Cobb-Douglas type of production functions:

$$(38) \quad Y = B x_n^\alpha$$

where B includes the effects of the factors $|\bar{x}_1 \dots \bar{x}_i, x_j \dots x_k|$.

Using observed data, equation (38) can be written as:

$$(39) \quad Y_o^t = B^t (x_{n_o}^t)^\alpha$$

where t referred to a given level of technology and Y_o , and x_{n_o} were at their observed values. Given, therefore, some range of α equation (39) could be used to apply to a wide class of technologies. By solving for B^t , a representative production function for that technology could be obtained.

$$(40) \quad B^t = \frac{(Y_o^t)}{(N_o^t)^\alpha}$$

where $x_{n_o}^t = N_o^t$, the observed level usage of nitrogen.

Plugging back the value of (40) to (39) the production function for a given technology level t could be represented as:

$$(41) \quad \tilde{Y}^t = \tilde{B}^t (\tilde{N}^t)^\alpha .$$

Starting with N at a low level, the value of Y^t could then be derived. For five segments⁸ along the production function, the procedure could be expressed as follows:

$$Y_1^t = B^t$$

$$Y_2^t = B^t \Delta N, \text{ where } \Delta N = \frac{N_o}{3}$$

$$Y_3^t = B^t (2 \Delta N)$$

$$Y_4^t = B^t (3 \Delta N), \text{ where } 3 \Delta N = N_o$$

$$Y_5^t = B^t (4 \Delta N)$$

where the production function was centered at Y_4^t , the observed level.

⁸At positive levels of α , N was never computed at zero. The observed level of nitrogen use at a given technology was centered on segment four (Y_4^t). There were 3 segments using nitrogen levels below and one segment above the fourth segment.

The procedure insured that output levels were consistent (met convexity requirements) and had diminishing marginal physical product for each level of input usage.

Example: NI1NP = national once irrigated first crops, nonmechanized type of technology High Yielding Variety (HYV) of palay.

Given: $Y_0 = 1.57$ metric tons

$N_0 = 14$ kg.

$\alpha = .123$

For 5 segments: $N = \frac{N_0}{3}$

$$B = \frac{1.57}{14 \cdot .123} = 1.13$$

<u>Segment</u>	Y (tons)	N (kg.)	ΔY (kg.)	ΔN (kg.)	Ratio Y:N
1	1.130	0.00	—	—	51:1
2	1.370	4.67	240	4.67	25:1
3	1.490	9.33	120	4.66	17:1
4	1.570	14.00	80	4.67	12:1
5	1.630	18.67	60	4.67	

Vectors were then constructed for each segment of the production function based on input requirements for the modal level of technology. The above methodology was applied to palay and corn which had 13 observed technology levels each and sugar with 6.

The palay production elasticities for fertilizer use in the Philippines for 1969-1970 were based on the regression analysis of a

subsample of BAEcon's Integrated Agricultural Surveys (IAS) using the form,

$$Y = AF^B$$

where Y = yield in metric tons, A = intercept, F = quantity N + P or amount of nitrogen plus phosphorous fertilizer applied per hectare and B = production elasticity for fertilizer. The palay production elasticities (7) were:

Irrigated Lowland	
High Yielding Variety (HYV)	= .123
Traditional Variety	= .10
Rainfed Lowland	
HYV	= .084
Traditional	= .069
Upland	= .055

The production elasticities for corn were calculated by using the actual usage levels of nitrogen, phosphorous, and potassium as specified in the 1973 BAEcon Cost of Production Survey for Corn in the Philippines. These elasticities (59) were:

Lowland, Rainfed or Irrigated	
High Yielding Variety (HYV)	= .1285
Traditional Variety	= .152
Upland	
HYV	= .0735
Traditional	= .0668
Sugar Elasticities (77) Used Were:	
Rainfed and Irrigated	= .096 (ton cane)
Upland farms	= .0792 (ton cane)

Tables A-1 to A-4 of Appendix A provide a summary of the per hectare input-output requirements of the four crops at different observed levels of technology.

Palay has 13 observed levels of technology depending on the type of land use, water availability, use of machine power, and type of seeds purchased. Table A-1 summarizes the input requirements of palay per hectare. Man, animal, and tractor labor are in man/machine days spread into 6 bimonthly periods; the form of N, P, and K of fertilizer were expressed in kilograms; chemicals, short-term capital, and the objective function (competitive) were in peso units, while the yields were expressed in metric tons. For a specific breakdown of the inputs by different type of observed levels of technology refer to Table A-1.

Similar input-output information for corn is given in Table A-2. The units are the same. Corn cropping activities also included 13 levels of observed technology concentrated mainly on rainfed (R), once irrigated (I) and upland areas (U & V). It was only allowed to compete at two-crop irrigated land (J) during the second season. There was also lesser usage of tractor power, fertilizer, and chemicals with corn compared to rice (Table A-2).

Sugar was an annual crop. It had six levels of observed technology in the MAAGAP Model. Cane sugar was principally grown on once irrigated (I), rainfed (R), and upland (U & V) classes of land. It required the most amount of fertilizer and chemicals among the four crops. Sugar culture too, was a heavy user of four-wheel tractor services (Table A-3).

Finally, the coconut input-output coefficients are presented in Table A-4. Since the model assumed a given stock of established coconut farms, the major inputs were maintenance labor, harvest labor, and labor for copra-making. On the average, coconuts were harvested three times a year. Animal labor was also used to transport nuts for drying.

Livestock

A total of six types of activities were incorporated in the model for livestock; three each for hogs and poultry, categorically grouped into backyard, semicommercial, and commercial production.

Hogs. The I/O coefficients for backyard swine were estimated on the basis of a herd of three. The pigs were fed with rice bran or straight corn and supplemented with camote and sugarcane tops, banana core, rootcrops and food leftovers, grated coconuts (without milk), and others. For rice bran or straight corn feeds, consumption per head was approximately .5 kilograms per day beyond weanling age and .3 kilograms per head per day for a month at weanling age. The estimated total feed requirement for the operation was 490 kilograms per year. Small backyard swine did not use any veterinary medicine. It was estimated to require short-term capital of ₱40 per year. Labor requirements were estimated at a total of 45 man days per year (7.5 man days, bimonthly) which handled feed preparation, feeding and care. Finally at 70 percent recovery rate, the total dressed yield of the operation was 110 kilograms of meat per year (Table A-5, Appendix A).

For commercial pig operation, the I/O coefficients were generated from those of Drilon.⁹ The commercial pig operation was calculated for a unit of 600 sows and 30 boars. For the entire operation, a total of 11,478 man days was required. Production cost totaled 2.4 million pesos, included feed costs (2,155 tons of feeds valued at ₱650 per ton),

⁹See (35), op. cit., pp. 105-117.

veterinary medicine and other costs. The short-term capital incorporated in the model was one-fourth of the total costs, while the objective function (P1,276,000) was 40 percent of the feed costs plus veterinary medicine and other expenses. The operation produced 2,160 weaners (20 percent of total output) and dressed output of 486 metric tons. The model assumed that the commercial hog operation was the primary source of weaners for the semicommercial hog activity (Table A-5).

For semicommercial swine activity, the operation started with six weanlings purchased at different monthly periods. At the end of the year, a total of 27 pigs were produced. In January, two weanlings were bought. One was raised for fattening and sold at the end of April. The other weanling was bred and farrowed seven weanlings. These were further finished and sold as market hogs at the end of the year.

In February, two weaners were likewise bought. Both were bred and farrowed for 14 weanlings which were raised to "lechon" (roasted pig) age and sold at the close of the year. The last batch of two was bought in March. These two were raised and fattened to be sold at the end of June. All the original six weaners were assumed to be purchased from commercial hog producers. All sows and bred were also sold after weaning the pigs. Feeds to semicommercial hogs were about 60 percent of the total commercial feed requirement. The remaining 40 percent was supplemented with farm product refuses and forage crops. The semicommercial hog operation, consumed a total of 2,210 kilos of commercial feeds; P185.00 veterinary medicine and short-term capital of P3,123.00. On the other hand, the 3 sows, 3 fattening and 21 gilts gave an output of 820 kilos of meat (dressed weight). (Refer to Table A-5, Appendix A.)

Poultry. Backyard poultry production was operated without any short-term capital. It started with 14 birds: 3 hens, one rooster, 3 cockerels and 6 pullets. Over the year, they would be fed a total of 1.15 tons of rice or corn bran from kiskisan. Caring was minimal. For instance, the activity required only one man day every two months. Output per unit was 7 metric tons of meat and .018 ton of eggs (Table A-6, Appendix A).

Commercial layers¹⁰ required a capital investment of ₱45,000 for a batch of 10,000 birds. The basic assumptions were: 18 eggs per hen per month; each cull hen would weigh approximately 1.5 kilos; 20 percent mortality rate; hens replaced every 21 months; 2.5 kilos of layer feed per dozen eggs; 2.0 kilos starter per bird and 2.2 kilos grower per bird.

The total man labor required for the operation was 150 days per two months. Veterinary medicine was estimated at .05 percent of total feed value. Total feed required was 428 tons; 11 tons for starter, 12 tons for growers and 405 for layers. Total costs incurred in the operation summed to ₱371,161, broken down as follows: labor, ₱16,800; chicks, ₱12,825; maintenance and depreciation (20 percent), ₱9,000; feed costs, ₱302,400; veterinary and fuel, ₱6,830; and marketing (6.71 percent),¹¹ ₱23,306. Only 40 percent of feed costs (₱120,960) and all other costs (₱45,455) plus marketing (₱23,306) or a total of ₱189,721 was used in the objective function of the model. The short-term capital (₱79,230)

¹⁰ See Gapuz (45), op. cit., pp. 234-308.

¹¹ Taken from (65).

was composed of chick costs, feeds and man labor plus 20 percent for contingencies. The activity yielded 6.3 metric tons of dressed meat and 62 metric tons of eggs (see Table A-6, Appendix A).

Finally, for commercial broilers (29), the assumptions made were: there were four batches a year (40,000); the capital investment was P33,000; mortality rate was 5 percent; medicine comprised 6 percent of total feed cost. It took 56 man days per 15,000 birds, a total of 448 man days per year or 75 man days per two months; the total feed consumed for starter and growers was approximately 144 metric tons. Short-term capital requirement composed of feed costs, labor, chicks, light and water (2 percent); depreciation (10 percent capital investment) and marketing (6.7 percent of total cost) was P43,850, while the objective function totaled P113,200. Output per unit was 34.58 metric tons of dressed poultry meat (Table A-6).

IV. THE PROCESSING ACTIVITIES

The model provided for economic activities by which primary products, palay, corn grain, cane sugar, and coconuts were transformed into final goods. For livestock, only poultry activities had processing costs embedded in the transfer activities. For hog production, the model failed to specify in economic detail, the processing costs.

Rice and Corn Milling

Two general types of mills were utilized in processing palay and corn grain into rice and grits, respectively. They were the cono and kiskisan type of mills. Information on rice milling rates, costs,

labor requirements and milling recovery rates were provided by the BAEcon, Research Division.¹²

For corn milling, information on milling rates, costs, labor requirement and recovery rates were obtained from a study done by UPCA, Department of Agricultural Economics.¹³

Sugar Milling

Sugarcane (expressed in tons of cane at the farm level) was processed in modern sugar mills with normal milling capacity range at 1,300 to 10,000 metric tons of cane per day. At the time of the study there were 38 sugar mills in the country of which 45 percent of the number and 50 percent of the capacity were located in Negros Occidental.¹⁴

Under Philippine conditions, the milling season starts in the middle of November and ends in May. The usual duration of operations were expressed in grinding days per month. A total of 135 grinding days were estimated for the 7-month period.

Sugar milling cost estimates (P14 per ton) were synthesized from financial statements of sugar mills and after consultations with the Philippine Sugar Institute (PHILSUGIN) technical staff. The milling

¹²The total costs for rice milling per metric ton were: P53.40 for kiskisan; and P31.40 for cono. Their respective recovery rates by weight were: 58 percent kiskisan and 64 percent for cono. These data were based on preliminary results of (4).

¹³The total corn milling costs (obj) as plugged in the model were: P60 per metric ton for kiskisan and P36 per metric ton for cono. Their recovery rates by weight were: 72 percent for cono and 60 percent for kiskisan. See (64), a preliminary report.

¹⁴See (74), pp. 1-4.

recovery rate as used in the model was 93 kilos of sugar per metric ton of cane.¹⁵

The integration of the farm-sugar cane mill interdependence was accomplished in the model through the imposition of milling (grinding) constraints and inclusion of production activities that transformed tons of sugarcane into sugar.

Copra Processing

In the model, there were two general ways of transforming mature coconut meat into copra. One was directly drying the split coconut shell under the sun and the other was smoking or drying the coconut meat in half shells called "pugon" (small huts with shallow excavations).

The total cost of copra making started from husking, splitting, drying the coconut meat, and transporting the dried meat (copra forms) from the farm gate to the buyers. It took ₱36.00¹⁶ processing cost to convert 1,000 nuts into 200 kilograms of copra (15).

V. DEMAND-CONSTRAINTS

Demand Structure

Commodity demand functions were included within the structure of MAAGAP and hence market equilibrium prices were determined endogenously by both demand and supply conditions. The incorporation of demand functions (instead of exogenous product prices) provided a more realistic

¹⁵Ibid., p. 5.

¹⁶Preliminary results of (20).

description of the aggregate market conditions faced by farmers (36). The method reduced the tendency of programming models to seek solutions with extreme crop specialization. In MAAGAP, demand and product prices were related endogenously through segmented demand curves using constant elasticities.

It was a basic assumption that all purchasers would pay the same price and that all suppliers will receive this price. Under perfectly competitive framework, producers act as price takers and equate their marginal costs to the prices of products.

Given base period prices, quantities, and elasticities, a program (63, 89) was devised that could automatically calculate the 12 demand segments incorporated in the model. The function was of logarithmic form:

$$Q = AP^{-\alpha}$$

where

- Q = base quantity,
- A = intercept,
- P = base price, and
- α = elasticity.

For purposes of exposition, the calculation of the demand segments for rice is discussed. Aside from base period quantities, prices and elasticities that differed among the seven commodities, computations of the 12 segments were basically the same: the prices of the first and twelfth segments were computed such that they were 200 percent and

50 percent of the historical base price, respectively. The rationale for this was that historical trends indicated that real prices didn't increase more than twice and decrease less than 50 percent of the average price in the same year.

The demand equation for rice as estimated in the ADAM regression analysis was:

$$Q = 3.499 P^{-.528}$$

Given therefore, $Q_0 = 3,596$ m.t./year; $P_0 = .94/\text{kg.}$; and $\alpha = -.528$ the computer program estimated midpoint prices (P_{wi}) and prices at the end of the segments (P_{ri}) with their corresponding quantity demanded and objective functions. A graphical representation of the demand segments for rice was shown in Figure 5, Chapter III, page 39. Generally, the demand segments of the other six commodities resembled that of rice and due to space limitation are not all shown graphically. All seven commodities had inelastic demand functions¹⁷ ranging from a high of $-.90$ (corn grits) to a low elasticity of $-.24$ (sugar). Pork, rice, eggs, and poultry meat had close elasticities ranging from $-.47$ to $-.60$; while sugar had $-.24$.

The corresponding prices, quantities and objective functions incorporated in MAAGAP 1972 Base can be seen in Appendix B, Tables B-1 to B-7. Take note, however, at this point that several adjustments were made to arrive at the quantities, prices and objective functions of corn grits, copra, poultry meat, and eggs.

¹⁷Refer to Table 10, page 55.

For corn grits elasticity, the ADAM regression estimate based on the NFAC consumption survey was too high (-1.4), because of data error. What was reported in the cross section data was the consumption of corn and corn products plus green corn. Foote's estimate, on the other hand, for all corn was not comparable. The computed elasticity, which was the inverse of corn products price flexibility (-.916) was -1.10. Somehow, -.90 was used instead in the model because the program used for demand segments calculation was not designed to handle elasticities greater than one.

Copra demand segments on the other hand were based originally from the domestic demand function for coconut oil. The elasticity was estimated by Nyberg (68) as -.093, while the base periods and quantities were generated from the Coconut Statistics, 1972. The computed oil segments were then divided by .63, since copra contains 63 percent oil.

Finally, poultry meat and eggs were also adjusted. Earlier results of the MAAGAP model using demand levels obtained from the ADAM regression runs from NFAC consumption surveys proved too high. The result from Haverly Systems Run No. 81 showed that using base quantities of 192.9 m.t. for eggs and 167.8 m.t. of poultry meat, would require that there would be about 36 million commercial broilers and 25 million commercial layers. This would require about 1.5 million metric tons of commercial feeds which was 10 times that produced in 1972. Demand levels were then adjusted accordingly to correspond with the amount of feed actually

produced. This resulted in a new base level demand of 79.8 million tons of eggs (238 million dozen) and 42.4 million tons of poultry.¹⁸

Product Prices

Domestic prices of the base period were based on market prices at the national level. To minimize fluctuation, average prices for the three year period 1969/70-1971/72 data from the Agricultural Marketing Services Division of the BAEcon and Central Bank sources were used.

Export prices for most commodities except coconuts were taken as given since it was assumed that the Philippines was a price taker. Import prices, on the other hand, were related to Manila wholesale prices. In some cases where the restrictions of imports resulted in domestic prices being higher than world prices, prices had been adjusted to account for this and the difference taken as a cost to consumers. Import quotas where applicable were also included. For a breakdown of the base prices used in the MAAGAP Model refer to Table 12. The table also includes actual production levels using 1969-72 base.

VI. RESOURCE RESTRICTIONS AND AVAILABILITIES

Labor

Man labor. The total available supply of labor incorporated in the model was the total self-employed and unpaid family workers as estimated by the Bureau of the Census and Statistics (BCS) in 1972 (23) minus

¹⁸ For specific results on this, see Haverly System Run #81 MAAGAP Model, July 11, 1971, ADAM Internal File.

Table 12. Historical Data Base for the MAAGAP Model, Philippines, 1969 to 1972 (Crop Year Basis)

Description	Production Levels	Average Market Prices 1970/72
	---1,000 m.t.---	--Pesos per ton--
Intermediate Products		
Rice bran	—	183 ^h
Corn bran	—	540 ⁱ
Rice brokers	—	723 ⁱ
Final Products		
Rice Sales	3,509	—
Domestic	3,280 ^d	900
Imports	229 ^a	924 ^g
Corn grit sales	852 ^e	700
Copra	1,644.4 ^a	—
Export	683.7 ^a	930 ^b
Domestic	960.7 ^a	835 ^b
Sugar	1,933.3 ^a	—
Export	1,278 ^c	901 ^c
Domestic	655 ^c	935 ^c refined and 666 ordinary at 97°
Pork	385 ^e	574
Poultry	42.4 ^j	500
Eggs	79.9 ^j	708 ^k
Others		
Fertilizer (total)	513 ^f	550 ^f
Corn grain imports	65 ^a	370 ^g

^aCentral Bank, Statistical Bulletin, 1972.

^bCoconut Statistics, 1972.

^cStatistical Series on Sugar, 1974, p. 112, for Sugar Export Buyers price; domestic prices for Manilla delivered refined and ordinary 97°.

^dThree years average, Oct.-Sept. crop year production using .62 milling rate.

^eNFAC consumption survey.

^fFertilizer Industry Authority (FIA), 1972 Urea only.

Table 12 (continued)

^gRice FOB Bangkok 5 percent Broken, Corn US# @ FOB Gulf Port FATUS, Foreign Agricultural Trade of the U.S. April 1975, p. 45, Exchange Rate, \$1:₱6.60.

^hCentral Bank, Price Division.

ⁱNational Census Statistical Industry Division.

^jInitial estimates from consumption survey analysis proved to be too high for feed supplies and were reduced.

^kEquivalent to ₱24.78/100 pieces.

5 percent to take care of forestry and logging. The total available labor force for agriculture was 5.5 million workers or 1,650 million man days (300 days/worker). Total available labor supply for each bimonthly period, was 275 million available man days.

Animal labor. The Statistics Division of BAEcon reported a total carabao inventory of 4.7 million heads in 1972 (17). After adjustments for age and sex, 61 percent of this total (2.87 million) was available for working animals. Using 300 days as an estimate of effective working days, 143.4 million available animal days were available in each two month period.

Tractor services. Two types of tractor services were used in the model. One was the hand and the other, the four-wheel tractor. Time series data on annual sales of tractors (2) from 1958 to 1974 were used in arriving at the total available tractor services in the model. Assuming a 12-year longevity for four-wheel tractor and 7 years for hand tractor (8), the following formula of declining balance was used:

$$K_t = K_{t-1} - K_{t-1}(r) + S_t$$

where

- K_t = number of tractors in year t ;
- K_{t-1} = number of tractors in year $t - 1$;
- r = rate of depreciation; and
- S_t = number of tractor sales in year t .

On the average, it was assumed that both hand and four-wheel tractor had a depreciation rate of 18 percent and an effective working day of 150 days¹⁹ a year. Based on these assumptions, the total available bimonthly tractor services for hand and four-wheel tractors, respectively, were 219 and 161.5 thousand tractor days.

Land

The seasonal land constraints were based on absolute area of cultivable land classified into 5 categories: two-crop irrigated lowland (J); one crop irrigated lowland (I); rainfed (R); first class upland with 3-8 percent slope (U); and second class upland with more than 8 percent slope (V). The land classification scheme was a collaborative effort among the personnel of ADAM/BAEcon and the Bureau of Soils. Table 13 summarizes the total absolute areas of arable land in the Philippines as incorporated in the model. Total land area was 6.7 million hectares. Twice irrigated and once irrigated lowland were estimated at 478.9 and 425.3 thousand hectares, respectively. Rainfed was 1.8 million hectares; first class upland, 2.4 million; and second class upland, 1.6 million (Table 13).

Capital

Two general sources of capital were assumed in the model. The institutionalized sources (banks) supplied credit at 12 percent interest

¹⁹Most tractor studies indicate that tractors are normally used for less than 400 hrs./yr., or a range from 300-1,000 hrs./yr. See (5), pp. 15-18.

Table 13. Land Area of the Philippines by Capability Class (1,000 Hectares)^a

	Total Cultivated Area	Lowland		Rainfed	Upland	
		Total	Irrigated		1st Class	2nd Class
			Once		Twice	
Philippines	6,748.8	902.2	425.3	1,801.4	2,444.5	1,598.7
Ilocos	424.8	111.7	87.7	264.7	48.4	—
Cagayan Valley	416.9	110.9	19.3	157.1	79.1	69.8
Central Luzon ^b	618.0	215	128.7	362.0	41.0	—
Southern Tagalog	752	93.3	21.4	78.4	262.7	317.6
Bicol ^d	817.2	95.7	50.8	96.4	138.8	486.4
Western Visayas ^c	729.2	63.1	43.3	444.1	102.0	120.0
Central Visayas	351.3	36.3	3.9	53.8	207.9	69.5
Eastern Visayas ^d	491.5	24.8	3.8	91.0	375.7	—
Western Mindanao ^d	397.9	26.2	7.8	70.5	244.7	56.5
Northern Mindanao ^d	749.8	57.8	20.0	74.3	463.0	154.7
Southern Mindanao	1,000.2	85.6	38.6	109.1	481.3	324.2

^aThe basic source of data: BAEcon Statistics Division. Figures were for 1972 and reported number of farms, cultivated area and absolute Palay Area. Further breakdown as to category was made according to the draft of an ADAM working paper by Berdin, Sardido, Balagot and Kunkel "Land According to Capability Classification in the Philippines." Lowland is land capability classes A, Be and Bw. First class upland is class Be and Ce. The remaining upland class was placed in class De. There appears to be considerable lowland (2,705.6 hectares) not cultivated which would principally come from class Bw (wet lands). Some upland lands are available mostly out of class De (over 15 percent slope) but these require careful cultivation.

^bCentral Luzon figures have been adjusted because they are reported as low due to the occurrence of floods.

^cTotal cultivated area as reported by BAEcon appears to be on the low side; upland area adjusted upward based on area devoted to annual crops. Class Be and Ce land reduced by 50 percent to provide figures for uplands.

^dTwice irrigated area revised downward to correspond with total irrigated cropped area as reported by BAEcon.

rate, while the noninstitutional sources (nonfinancial institutions) supplemented the credit availability at interest rates of 50 percent. The right hand side of the model on institutional sources of capital was divided into 3 types of constraints: credit requirements for crops; for livestock, and processing. A total of 1,718 million pesos was put in the model as credit available for the four crops; ₱40.9 million for livestock; and ₱422 million for milling.

Sugar Capacity Constraints

The PHILSUGIN reported for CY 1971-72 a sugar mill potential capacity of 27,993,370 metric tons for the Philippines.²⁰ Cross checking the actual tonnage of sugarcane milled during the same year (19,491,041 metric tons) resulted in a capacity utilization rate of 70 percent. This could be explained by the drought that confronted the mill districts of Western Visayas in the same year, significantly limiting farm output. Hence, a better index of sugar mills operation would be the average of cane milled for crop years 1969/70 and 1970/71 which were normal years. This gave a milled output of 22,362,500 metric tons.

On the other hand, preliminary estimates of the PHILSUGIN Development staff indicated that given the conditions of sugar mills, the modal available milling capacity was 21,584,620 metric tons. For conservative reasons, the latter figure was used as the right hand side capacity constraint for sugar in the MAAGAP Model.

²⁰ It is of course assumed that mills operate for 24 hours and 150 days a year only (73).

The given constraint was allocated to the various land classes through the use of weights reflective of soil capabilities.²¹ The weights and respective capacities were distributed as follows:

<u>Land Type</u>	<u>Weights (Percent)</u>	<u>Capacity (1,000 m.t.)</u>
Irrigated (I)	6.0	1,587
Rainfed (R)	63.9	13,501
1st Class Upland (U)	14.7	3,173
2nd Class Upland (V)	15.4	3,324
Total	<u>100.0</u>	<u>21,585</u>

The Crop Area Constraints

The crop area constraints for the four crops were used in the model as stabilizing measure. Their upper limits in thousand hectares were: palay, 3,147.8; corn, 2,414; sugar, 360; and coconuts, 2,020. These were based on average crop area estimated by the Statistics Division of BAEcon during the base year 1969/70 to 1971/72.

The Livestock Inventory Constraints

For both hogs and poultry, the inventory referred to the number of animal units at the farm level. It was used as a constraint to limit backyard production which was the subsistence sector of the livestock industry. The backyard production was the cheapest way of producing meat, but there were limits and the limits were the inventory at the

²¹As defined in (6).

farm level. In the model, the total hog inventory at the farm level was 7,587 thousand²² while that of chickens was 50 million birds.

²²Two percent of the total hog inventory was deducted to account for commercial piggery. See (17), pp. 73-77.

CHAPTER V

RESULTS

I. INTRODUCTION

A discussion of the base periods used by the MAAGAP model is presented in this section. As mentioned earlier in Chapter II, the analysis took the form of specifying a normalized base period derived from historical data. The actual 1972 normalized base was a composite of three crop years, 1969/70-1971/72. This actual 1972 base was then used as a benchmark in validating¹ the 1972 MAAGAP model results.

Two base periods, the 1972 and 1974 bases, however, were utilized as benchmarks in analyzing the different policy alternatives. The rationale for this was simply that alternative policies on fertilizer pricing and rice import subsidy were better presented within a 1974 context and would depict more realism due to the drastic economic changes that transpired from the years 1972 to 1974. For the alternative policies on mechanization, the tracing of the general marginal value product of fertilizer, and the effects of floods and other natural calamities, the 1972 base was sufficient as a comparative benchmark.

¹The validation is simply a "test of validity" within the period of fit.

The MAAGAP 1972 Base

To gauge the accuracy of the MAAGAP model in approximating actual conditions, a comparison of the model's 1972 base results with that of the actual data during the same period is presented. Comparison of yield per hectare, value, production and market prices, between MAAGAP model estimates and actual data are shown in Tables 14-17.

MAAGAP model underestimated yield of corn by 6.6 percent. It overestimated palay yield by 3.5 percent while sugarcane and coconut yields were overestimated less than 2 percent (Table 14).

The MAAGAP model generally underestimated the value of crops in comparison to the actual 1972 data. Sugarcane, coconuts and corn values of production were underestimated by 30.4 percent, 24.2 percent, and 5.8 percent respectively. Palay on the other hand was overestimated by almost 20 percent (Table 15).

The comparison of production estimates from the MAAGAP model with 1972 actual data is shown in Table 16. Since actual data on the by-products of rice and corn milling at the national level were not available, no comparisons with 1972 base were possible. Except for sugarcane, the MAAGAP model generally estimated the primary production in the same direction as yield.

Estimates of the production of final products, using the MAAGAP model ranged from an overestimation of 163.8 percent (domestic sugar production) to an underestimation of 61.4 percent (poultry meat). Sugar exports, pork and eggs were underestimated by 10 to 53 percent; production estimates on domestic and export copra were overestimated by

Table 14. Comparison of the MAAGAP Model Results with Actual Data on Yield per Hectare, by Crop, Philippines, 1969/70-1971/72

Description	Units	Yield			
		Actual	MAAGAP 1972 Base	Difference	Percent
		1969/72 Base ^a			
Crops:					
Palay	metric tons	1.709	1.769	0.060	3.51
Corn	metric tons	0.83	.775	(0.055)	(6.63)
Sugarcane	metric tons	50.81	51.618	0.808	1.59
Coconuts	nuts	3,960	4,000	40.00	1.01

^aSource is BAEcon average of three years normalized for 1972.

Table 15. Comparison of the MAAGAP Model Results with Actual Data on Value by Crops, Philippines, 1969/70-1971/72

		Value			
Description	Units	Actual	MAAGAP	Difference	Percent
		1969/72	1972 Base		
		Base ^a			
Crops:					
Palay	million pesos	2,561.5	3,073	511.50	19.97
Corn	million pesos	763.5	719	(44.50)	(5.83)
Sugarcane	million pesos	1,927.4	1,342	(585.40)	(30.37)
Coconuts	million pesos	1,282.3	972	(310.30)	(24.20)

^aSource is BAEcon average of three years normalized for 1972.

Table 16. Comparison of the MAAGAP Model Results with Actual Data on Production by Commodity, Philippines, 1969/70-1971/72

Description	Units	Production		
		Actual 1969/72	MAAGAP	Percent
		Base ^a	1972 Base	Difference
Crops:				
Palay	1,000 m.t.	5,379.4	5,568	188.60
Corn	1,000 m.t.	2,008.6	1,871	(137.60)
Sugarcane	1,000 m.t.	21,397 ^b	18,582	(2,815.00)
Coconuts	million nuts	7,995	8,080	85.00
				3.51 (6.85) (13.16) 1.06
Intermediate products:				
Rice bran	1,000 m.t.	—	1,051.565	—
Corn bran	1,000 m.t.	—	386.323	—
Rice brokens	1,000 m.t.	—	18.059	—
				—
Final products:				
Rice sales	1,000 m.t.	3,509	3,652	143.00
Domestic	1,000 m.t.	3,280 ^c	3,327	47.00
Imports	1,000 m.t.	229 ^d	325	96.00
Corn grits sales	1,000 m.t.	825 ^e	1,249	397.00
Copra	1,000 m.t.	1,644.4 ^d	2,936.7	1,292.30
Exports	1,000 m.t.	683.7 ^d	1,320.7	637.00
Domestic (sales)	1,000 m.t.	960.7 ^d	1,616	655.30
Sugar	1,000 m.t.	1,933.3 ^d	2,876.5	943.20
Exports	1,000 m.t.	1,278 ^f	1,148.5	(129.50)
Domestic	1,000 m.t.	655 ^f	1,728	1,073.00
Pork	1,000 m.t.	385 ^e	319	(66.00)
Poultry	1,000 m.t.	101.1 ^e	39	(62.10)
Eggs	1,000 m.t.	192.9 ^e	90	(102.90)
				(53.34)

Table 16 (continued)

Description	Units	Production		
		Actual 1969/72 Base ^a	1972 Base MAAGAP	Difference Percent
Others:				
Fertilizer (total)	1,000 m.t.	513 ^g	531.86 ^h	18.86
Corn grain imports	1,000 m.t.	65 ^d	—	(65.00)
				3.68
				—

^a Source except where noted is BAEcon average of three years normalized for 1972.

^b Statistical Series on Sugarcane, Quezon City, Philsugin, Vol. IV, No. 1, January 1974.

^c Three years average, October-September crop year production using 62 percent milling recovery rate.

^d Central Bank, Statistical Bulletin, 1972.

^e NFAC consumption surveys.

^f Statistical Series on Sugar, p. 112, for Sugar Export Buyers price; domestic prices for Manila delivered refined and ordinary 97°.

^g Fertilizer Industry Authority (FIA), 1972, Urea only.

^h Total for fertilizer by types.

Table 17. Comparison of the MAAGAP Model Results with Actual Data on Market Prices by Commodity, Philippines, 1969/70-1971/72

Description	Unit	Actual 1969/72 Base ^a	Market Prices		
			MAAGAP 1972 Base	Difference	Percent
Crops:					
Palay	Pesos/ton	490	551.95	61.95	12.64
Corn	Pesos/ton	380	384.41	4.41	1.16
Sugarcane	Pesos/ton	—	72.19	72.19	—
Coconuts	Pesos/nut	0.12 ^b	0.12	—	—
Intermediate products:					
Rice bran	Pesos/ton	183	946.48	763.48	417.20
Corn bran	Pesos/ton	540	1,009.30	469.30	86.91
Rice brokens	Pesos/ton	723	384.41	(338.59)	(46.83)
Final products:					
Rice sales	Pesos/ton	1,824	1,631.41	(192.59)	(10.56)
Domestic	Pesos/ton	900	851.41	(48.59)	(5.40)
Imports	Pesos/ton	924 ^c	780.00	(144.00)	(15.58)
Corn grits	Pesos/ton	700	481.94	(218.06)	(31.15)
Copra	Pesos/ton	1,765 ^d	1,700.00	(65.00)	(3.68)
Export	Pesos/ton	930 ^d	850.00	(80.00)	(8.60)
Domestic (sales)	Pesos/ton	835 ^d	850.00	15.00	1.80
Sugar	Pesos/ton	1,836	1,968.00	132.00	7.19
Export	Pesos/ton	901 ^e	984.00	83.00	9.21
Domestic (refined)	Pesos/ton	935 ^e	984.00	49.00	5.24
Pork	Pesos/ton	5,740	5,555.79	(184.21)	(3.21)
Poultry	Pesos/ton	5,000	5,293.41	293.41	5.87
Eggs	Pesos/ton	7,080	5,488.53	(1,591.47)	(22.48)

Table 17 (continued)

Description	Unit	Market Prices		
		Actual 1969/72 Base ^a	1972 Base MAAGAP	Difference Percent
Others:				
Fertilizer (total)	Pesos/ton	550 ^f	1,500 ^g	950 173
Corn grain imports	Pesos/ton	369.60 ^c	—	369.60 —

^aSource except where noted is BAEcon average of three years normalized for 1972.

^bPrice per unit of nuts used for copra.

^cRice FOB Bangkok 5 percent broken, corn US#2 FOB Gulf Port FATUS, Foreign Agricultural Trade of the U.S., April 1975, p. 45, at the exchange rate of \$1.00:₱6.60.

^dCoconut Statistics, 1972.

^eStatistical Series on Sugar, p. 112, for Sugar Export Buyers Price; domestic prices for Manila delivered refined and ordinary 97°.

^fFertilizer Industry Authority (FIA), 1974, urea only.

^gPrice for nitrogen only.

68 to 93 percent; corn grits sales and rice imports were overestimated about 40 percent while domestic rice production and total fertilizer usage were MAAGAP's closest estimates (1.4 to 3.7 percent respectively, Table 16).

The comparison between MAAGAP results and the actual data base on market prices is shown in Table 17. The largest discrepancy was in the intermediate product prices between MAAGAP estimates and 1972 actual data. This could be explained by the close relationship between the livestock industry and crop production. The MAAGAP model provided for feed mix alternatives (with rice and corn milling by-products as major components) which were directly fed to the livestock production activities. Whereas the actual 1972 prices were ordinary market prices, the shadow prices generated by MAAGAP model were really the opportunity cost of rice and corn bran/brokens when they were used as commercial feeds. Hence the discrepancy was great, from 47 to 417 percent.

The MAAGAP price estimates on other items were relatively accurate. Eggs and corn grits prices were understated the most—22 to 32 percent; poultry, sugar products, copra and rice prices estimated by MAAGAP were within 5-10 percent bracket of actual base prices (Table 17).

Overall, in the estimation of prices and production levels, the MAAGAP model was relatively consistent in depicting the behavior of aggregate prices and quantities produced. Except for eggs and pork products, which were estimated short in both production and prices, an overestimation of quantities produced (e.g., rice, corn, copra, sugar), demonstrated an underestimation of their market prices, and vice versa.

Shifting the 1972 Base to 1974

Computationally, two major economic adjustors were used in shifting the 1972 base to 1974. One was the 2.23 Wholesale Price Index (WPI) deflator which was used to deflate current 1974 prices of inputs and products to manifest price changes in 1972 real terms. The other was the 78 percent mineral fuel price index inflator which was used to adjust the cost of processing activities due to the increased prices in mineral fuel.

Partly, the 1974 base also reflected the two pricing systems for fertilizer between the food crop and export crop subsectors. Crop area constraints, land capability classes, livestock inventory, sugar capacity constraints, tractor services, labor availabilities and demand segments were adjusted to reflect the 1974 conditions.

The shift from 1972 base to 1974 captures partially the effects of inflation due to the inclusion of the mineral fuel wholesale price inflator of 78 percent. However, because the other elements of the MAAGAP model were likewise adjusted, it was hard to determine the specific effects of the inflationary spiral. Hence the MAAGAP 1974 new base adjusted to 1972 price level as the base was a composite result of the major price changes that occurred between the periods 1972 and 1974.

A summary of the percent changes in the major components of the model as a result of the shift from the 1972 to 1974 base is shown in

Table C-1, Appendix C. All shadow prices² were higher in 1974 than in 1972 (except corn grits which manifested no percent change) at the primary, intermediate and final product levels. Total fertilizer price increased the most and was 267 percent of the 1972 base; the 1974 shadow price of nuts was 142 percent of the 1972 base; copra export and domestic prices were 94 percent higher; palay, domestic rice and the livestock product prices were about 30 percent higher; rice import price was up 86 percent; while the prices of the remaining commodities (corn, sugar and by-products of corn and rice milling) were up less than 12 percent.

On the activity levels, only rice products, poultry, eggs and total fertilizer usage showed declines as a result of the shift from 1972 to 1974 base. Production of rice brokens was nearly 31 percent lower. The amount of primary production and hectareage planted to farm crops all increased. Sugarcane showed the most substantial percent increase with 30 percent in hectareage and 14 percent increase in primary production. The primary reason for the expansion in production of sugarcane was the addition of available land and increase in sugar processing capacity constraints in the 1974 resource base (Table C-1, Appendix C).

²The MAAGAP model assumes a perfectly competitive market and hence interprets shadow prices as approximations of market prices of both inputs and products. Since MAAGAP is a production-processing-distribution model and equilibrium prices and quantities are determined endogenously for the sector, shadow prices of inputs, primary products, intermediate and final products are estimated simultaneously with determination of activity mix.

The shift from 1972 to 1974 base resulted in increases in production of 14 percent for sugar, 9 percent for copra, 7 percent for pork and 1 percent for corn grits (Table C-1, Appendix C).

An interesting feature in the MAAGAP was the approximation of net social benefit as measured by the competitive objective function which was the sum of the consumer's and producer's surplus. Net social benefit generally increased by 14 percent; consumer's surplus by 7 percent; while the producer's surplus increased by 50 percent (Table C-1).

While the measurements only indicate general directional approximations, they have considerable meaning. The adjustment in the availability of resources to higher levels in 1974 was responsible in the uptrend in net social benefit which resulted in net gains for both the consuming sectors and producing sectors. The producer's surplus (theoretically, the returns to the owners of the fixed factors of production) exhibited the higher percentage share.

II. ALTERNATIVE POLICIES IN FERTILIZER PRICING

In the middle part of 1973, the Philippine government adopted a system of dual pricing for fertilizer: one for export commodities and the other for food crops. As of August 1974, the export subsector was buying fertilizer at the nonsupport price of ₱170.00 per bag of urea.

Through the use of subsidies, the price to producers for the same quantity of urea was ₱70.00 per bag in the food subsector.³

In adopting the two pricing systems for fertilizer, the primary policy objective of the government was to reduce the cost of producing food crops at the primary production levels by subsidizing fertilizer cost, one of the most expensive factors of food production. This would be expected to stimulate the use of fertilizer, expand production of food crops and result in lower and more stable food prices in the Philippine economy.

The two-tier system of fertilizer prices resembles an economic construct called price discrimination whose administrative feasibility is contingent on two basic assumptions: one, that the markets under consideration are separate and independent from each other, and two, that the elasticities of demand between them also differ.

If one of the assumptions does not hold, price discrimination breaks down and the policy becomes administratively infeasible to enforce. Symptoms of such infeasibility are manifested by the occurrence of rampant blackmarketing activities.⁴

³The Fertilizer Industry Authority (FIA), however, as of November 25, 1974, increased the price of urea to an average of ₱112.00 per bag in the food subsector.

⁴Evidently, there is enough reason to believe that the Philippine conditions exhibit these symptoms. Newspaper articles reported several military investigations and arrests due to the alleged diversion of fertilizer allotted to the food crop subsectors to the sugar producers during the crop year 1973-1974 when the supply of fertilizer was low.

Historically, developing countries who have adopted the policy of fertilizer subsidy in one way or another used it only as a temporary measure which would eventually be withdrawn.⁵

Since the major portion of this section deals with the economics of fertilizer pricing, a relevant point to introduce at this juncture would be to look into the relative responsiveness of fertilizer usage to changes in its price.

The Demand for Fertilizer

The adoption of fertilizer subsidy policy implies that the usage level of fertilizer input has a structural response relationship with its own price and that its usage has a direct effect on total output.

Rodriguez (78) estimated that the short-run nitrogen fertilizer price elasticity in the Philippines ranged from $-.13$ to $-.59$. An elasticity range of $-.13$ to $-.59$ means that a 10 percent increase in the real price of nitrogen fertilizer decreases nitrogen total consumption from 1.3 to 5.9 percent.

A general demand curve⁶ for fertilizer by varying its 1972 base prices for fertilizer used by all crops by intervals from 75 percent of base to a high of 300 percent above the base are shown

⁵ Among the developing countries subsidizing their fertilizer prices are Sri Lanka, Pakistan, Indonesia, Bangladesh, several African and Latin American countries. For a thorough survey on the nature of fertilizer pricing of these countries see (27).

⁶ Actually this is the marginal value product (MVP) curve for fertilizer which can under perfectly competitive conditions be interpreted as a demand curve. For specific changes in components of MAAGAP model as the MVP curve for fertilizer was derived, refer to Table C-2, Appendix C.

in Figure 7. The horizontal axis represents the amount of urea used by all crops in the model while the vertical axis is the price per kilogram. At the price of ₱.41 per kilogram, the crops (export and food) used 175,000 metric tons of urea and as the price was increased to ₱2.09 per kilogram, the consumption of urea decreased to 83,000 metric tons.

Taking at least three points along the parametric variation, the average price elasticity for nitrogen ranges from $-.19$ to $-.23$ for all crops. Although it was somewhat lower than the estimates of Rodriguez, the findings supported the notion that the price elasticity of demand for fertilizer in the Philippines is quite inelastic.

Effects of Relaxing the Subsidy to Food Crops⁷

Table C-3, Appendix C, summarizes the impact of varying the price of fertilizer in the food crop subsector. Only the components of the model sensitive in the variations are presented in the table. The upward parametric variation in fertilizer price ranged from an average low of ₱0.597 per kilogram to a high of ₱1.273 per kilogram (in real terms).⁸ Expressed in the 1974 current prices, the cost of fertilizer in the food crop subsector was changed on the average from ₱66.00 to ₱142.00 per 50 kilogram bag.⁹

⁷The food crops in MAAGAP were rice and corn while the export crops were sugar and copra.

⁸The 1974 base price of fertilizer in the food crop subsector was subsidized on the average by 53 percent for all types of fertilizer, while the export crop subsector was unsubsidized.

⁹This price range was a composite average of the three types of fertilizer used in the model. The price of urea was changed, for instance, from ₱72.50 per bag (base price) to ₱177.30 per 50 kilogram bag.

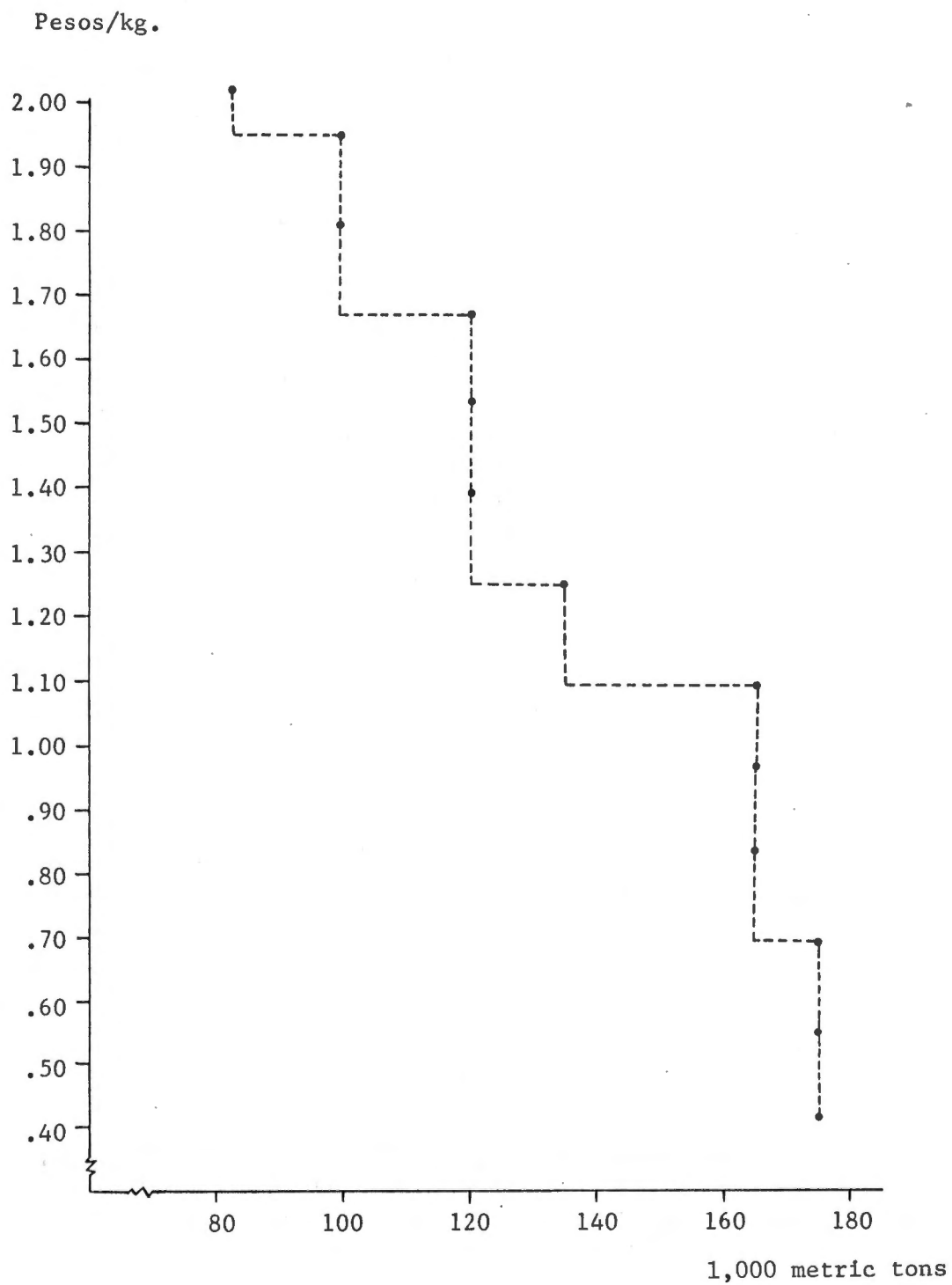


Figure 7. MAAGAP demand curve for fertilizer (urea).

The procedure was to approximate a uniform pricing scheme for fertilizer in both the export and food crop subsectors at 1974 price levels. Increasing the prices of fertilizer used by the food crops at different percent levels from the 1974 base until they are equal to the fertilizer prices used by the export crops, was synonymous to relaxing the fertilizer subsidy in the food crop subsector.

Relative to the 1974 base, 10 segments of upward price variations were programmed, each averaging an 11 percent change in price. The changes in the solutions were then recorded and compared to the 1974 base.

Generally, the solutions were insensitive relative to the 1974 base. There were only minor changes in shadow prices of the commodities from primary production to their final form relative to the 1974 base. The shadow prices of land inputs with the exception of once irrigated land second season (I_2) and tractor services however, changed considerably. Shadow prices for crop area constraints, decreased ranging from 1.7 percent to 57 percent as fertilizer price was increased. Shadow prices for sugar capacity constraints and crop area constraints for coconuts increased by as much as 2.5 percent as compared to the 1974 base (Table C-3, Appendix C).

Sugar capacity constraints on the other hand which were underutilized in the 1974 base were completely utilized as fertilizer price for food crops was raised to higher levels.

On the activity levels the parametric variation of fertilizer price in the food subsector to the highest level decreased the

production of palay by .24 percent from the 1974 base of 5,718 metric tons. Eggs and copra production which are both nonfertilizer users on the other hand increased by 1.2 percent and 0.57 percent, respectively.

Capital usage in food crop production also declined by .50 percent,¹⁰ and the consumption of urea fertilizer by the food crop subsector likewise decreased by almost 7 percent.¹¹

The fertilizer subsidy cost allotted to food crops in the MAAGAP model could be computed by multiplying the total amount of fertilizer used in the food crop subsector with the difference of the fertilizer market price and the subsidized price. The bigger the fertilizer price difference between the two subsectors, the higher would be the level of subsidy. However, as the price gap of fertilizer between the two subsectors diminishes, so would the cost of the fertilizer subsidy. The direct relationship between the fertilizer price gap of the two subsectors and the cost of fertilizer subsidy can be illustrated in Figure 8. The price of urea was plotted on the vertical axis to represent the price changes for all types of fertilizer. At the current 1974 urea price of ₱1.45 per kilogram which was approximately 59 percent subsidized, the total cost of subsidy for fertilizer in the

¹⁰ Since capital usage and fertilizer usage moved in the same direction as the price of fertilizer was increased, capital and fertilizer (urea) were complementary factors in the production of food crops. The cross price elasticity of capital usage with respect to the price of fertilizer was estimated by MAAGAP to be $-.004$.

¹¹ This implies a price elasticity for urea of $-.06$ in the food crop subsector.

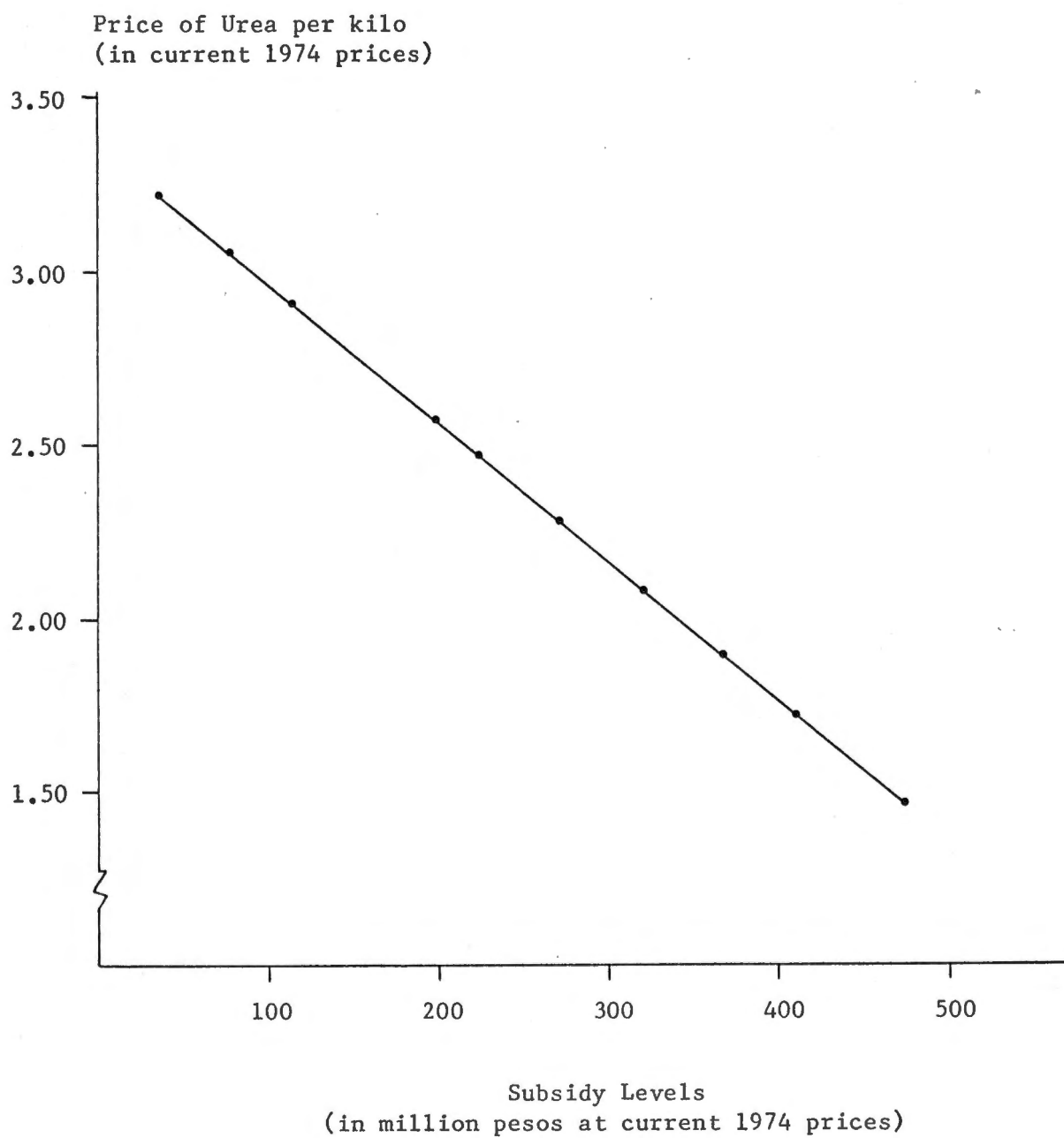


Figure 8. Fertilizer subsidy levels in the food crop subsector at different prices of urea.

food subsector in 1974 could be estimated at ₦460 million. This represents a combined total of 307,600 metric tons of fertilizer used by the food crop subsectors in MAAGAP in 1974.

The welfare effects of increasing the price of fertilizer in the food sector was also worth noting. Results showed that net social benefit and consumer's surplus would decrease slightly by as much as .01 and .07 percent, respectively, from the 1974 base; while producer's surplus would increase slightly with the highest fertilizer price in the food crop subsector (no subsidy) (Table C-3, Appendix C).

Uniform Fertilizer Pricing and Subsidy for Both
Subsectors, with 4 Percent Tax and without
Tax to the Export Crop Subsector

Three interrelated policy issues imbedded into two types of fertilizer pricing alternatives are analyzed in this section. The first two, uniform fertilizer pricing and uniform subsidy, for both food and export crop subsectors are possible alternatives to avoid the blackmarketing problem of fertilizer sold in the food crop subsector but diverted into the export crop subsector. The third, taxing the export crop subsector at the rate of 4 percent, has some relevance to income distribution between the two subsectors. A 4 percent export tax would have the effect of redistributing subsectoral income by shouldering part of the government fertilizer subsidy cost spent in the agricultural sector.

The cost of fertilizer used by both food crops and exports was varied from 100 percent subsidy to zero subsidy at uniform fertilizer

pricing for both subsectors. Computer runs were made for situations with and without a 4 percent export tax. The results are summarized in Table C-4, Appendix C. The 1974 base was used as a benchmark in the analysis.¹²

Data show that for subsidy levels in both export and food crop subsectors of 72 percent and above a general decrease in domestic prices of primary and finished products would result. The range of decreases in product prices would be from .20 to 9 percent. The lower commodity prices would result, regardless of whether or not a 4 percent tax was imposed on the export subsector. However, at lower levels of fertilizer subsidy (68 to 9 percent) and with export tax, only the prices of copra and sugar would be lowered and by an amount approximating the level of export tax. At zero level of fertilizer subsidy, with or without export tax, the prices of rice, corn grain and livestock products would increase slightly as compared to situations with fertilizer subsidies (Table C-4).

The shadow prices of the different classes of land (except first class upland second season (U_2)) were higher than the 1974 base for high levels of fertilizer subsidy (60-100 percent) but were lower than the 1974 base for low levels of fertilizer subsidy (0-56 percent). As the fertilizer subsidy was increased more of it was used and the

¹²Fertilizer prices used in the 1974 base were of nonuniform pricing for the two subsectors. The fertilizer used by the food crop subsector was subsidized on the average by 53 percent while that of the export crop subsector was not subsidized.

marginal productivity of land increased; hence land value at the margin was higher.

As was expected, the prices of fertilizer nutrients decreased as fertilizer subsidy was increased and the usage level of fertilizer in the food crop subsector increased tremendously from the 72 to 100 percent subsidy level. Increase in usage ranged from less than 1 percent (complete) to 41 percent (ammophos). With no fertilizer subsidy, the usage of urea in the food crop subsector was 7 percent lower.

The usage level of fertilizer in the export subsector showed a different pattern. At the 80 to 100 percent uniform subsidy, the taxed export subsector manifested a consistent high decline (75-78 percent) in urea consumption as compared to the 1974 base. From the 96 to 100 percent levels of subsidy on the other hand, the untaxed export subsector showed an increase of 207 percent in urea usage compared to the base. At high subsidy levels (80-100 percent) the decrease in the usage of potassium (as compared to 1974 base) was in the 1 percent range, but as the subsidy levels declined (72 percent to zero subsidy), the decrease in usage from the 1974 base for the export crop subsector (taxed and untaxed) varied from 60 to 153 percent. Complete and ammophos fertilizers used in the export crop subsector on the other hand showed small changes from the 1974 base as the fertilizer prices for both subsectors were parameterized uniformly at different levels of subsidy (Table C-4, Appendix C).

The production of food crops increased from base levels by a range of 0.3 percent (rice) to 11 percent (corn grits) at 72 to 100 percent subsidy, for both situations with and without export tax. Egg production decreased by 1.2 percent. The imposition of a 4 percent tax on the export crop subsector reduced the export levels of copra and sugar by 0.7 percent and 1.5 percent, respectively, as compared to the base situation. This was constant regardless of the level of fertilizer subsidy (Table C-4, Appendix C).

Both subsectors showed general increases in use of short-term capital at high subsidy levels. At lower subsidy levels, however, the food crop subsector (taxed and untaxed) showed decreases in capital usage of less than 1 percent while the use of capital for export crop increased by slightly over 1 percent. The use of capital for livestock and milling activities did not change with the variation in fertilizer subsidy levels at uniform prices (Table C-4).

Employment likewise increased slightly in the 72 to 100 percent levels of uniform fertilizer subsidy. The range of increase was from 0.1 to 0.3 percent. At lower levels of fertilizer subsidy (60 percent to zero subsidy levels, taxed and untaxed), however, employment dropped slightly (Table C-4).

Hand tractor services did not change from the base level as a result of the parametric variation of the fertilizer subsidy. Four-wheel tractor usage declined from the 1974 base as the fertilizer subsidy levels for both subsectors were decreased uniformly from 100

percent to zero subsidy level (taxed and untaxed). Animal labor likewise decreased with a reduction in the subsidy (Table C-4, Appendix C).

Uniform fertilizer pricing and uniform subsidy levels resulted in a general increase in net social benefit and increases in both consumer's and producer's surplus (with the 56 percent to zero subsidy level, untaxed exports, consumer's surplus declined very slightly from the base). The objective function reached the levels of .8 (untaxed) and .5 (taxed) percent increases from the 100 percent subsidy levels and reaching low positive increases of .7 and .4 percent taxed and untaxed, respectively, as the fertilizer subsidy was at zero level.

Consumer's surplus declined slightly with subsidy levels of 0-56 percent and no export tax. For all subsidy levels with export tax and for situations with above 56 percent subsidy and no export tax, consumer surplus was slightly higher than for the base situation—but less than 1 percent higher in all cases. Producer's surplus was somewhat higher than the base situation at all subsidy levels with and without export tax. The increase was as high as 3.8 percent and tended to be greater as subsidy level was reduced. Higher subsidy, therefore, implies higher consumer's surplus while lower subsidy implies higher producer's surplus (Table C-4).

To summarize, a 4 percent tax imposed to the prices of export crops had only minor effects on results obtained, except for lower levels of exports and lower net social benefits. In general, the same effect as the tax could be achieved by uniform subsidization of the prices of fertilizer for both food and export crop subsectors.

III. VARIATIONS IN THE EFFICIENCY OF THE IRRIGATION SYSTEMS

In 1972, a total land irrigated area of 904.2 thousand hectares was estimated in the Philippines. Of this hectarage, 478 thousand hectares were twice irrigated lands (J) and 425.3 thousand hectares, once irrigated (I).

The above gives a ratio of twice irrigated to once irrigated hectarage of 53 : 47 percent. The MAAGAP model was used to examine the effects on agricultural production, price, and income, if the existing irrigation systems were improved and made more efficient such that the ratio of twice to once irrigated land would be increased to ratios of 63:37 and 75:25.

The MAAGAP model results indicated that the production of palay and corn would be the major crops directly affected if the ratio of twice irrigated lands were increased with the production of palay increasing and the production of corn decreasing.

At the primary production levels, palay production increased 2.4 percent and 5.0 percent, respectively, from the 1972 base when the ratio of twice to once irrigated lands was increased to 63:37 and 75:25 ratios. At these ratios, however, corn grain production decreased by 3.2 percent and 5.2 percent respectively as compared to the base. Similar changes were evident in the production of these commodities at the finished product level in the form of rice and corn grits.

These activity level changes, however, were too small to effect an alteration in the shadow price levels of rice and corn or of other commodities. The livestock product prices as well as sugar and copra prices were virtually unaffected (Table C-5, Appendix C).

On the input side, the shadow prices of land, hand tractor and four-wheel tractor services manifested slight decreases ranging from .3 percent to less than 3 percent. The shadow prices of nitrogen, phosphorous and potassium on the other hand rose 3 percent above the 1972 base.

The MAAGAP results did not show any changes in import-export levels through variation in proportion of twice irrigated land. Total fertilizer usage by type, manifested general decreases from the 1972 base. The range was 0.3 percent (urea) to 6 percent (ammophos). The reason for this was the high requirement of fertilizer for palay as compared to corn. Only palay crop used more of nitrogen (.21 to 1.0 percent), phosphorous (3 to 7 percent), and potassium (1.5 to 3.43 percent) compared to the 1972 base as the irrigation system became more efficient.

The MAAGAP results also indicated that as the irrigation system becomes efficient, employment would tend to increase slightly. Total man-labor increased about 1 percent from the 519 million man-days required in the 1972 base. The usage levels of four-wheel tractor and animal labor on the other hand decreased; up to 14 percent for four-wheel tractors and up to 2 percent for animal labor. There was no change in the usage of hand tractor from the 1972 base.

With respect to welfare measures, varying the ratio of twice to once irrigated lands would result into a slight increase of net social benefit (.1 to .3 percent), slightly a higher consumer's surplus, but a decrease of producer's surplus (6 to 7 percent) (Table C-5, Appendix C).

The above results can be summarized as follows: improving the efficiency of the existing irrigation systems by changing the ratios of twice to once irrigated land, would result in higher production of rice, increase in man-labor employment, higher capital usage for crops, an increase in the fertilizer usage for the palay crop, a higher net social benefit for the agricultural sector and an increase in consumer's surplus. The negative offsetting effects, however, would be a lower producer's surplus, a decrease in corn production and a lower usage of animal and four-wheel tractor services.

IV. VARIATIONS IN THE PRICE CEILINGS FOR RICE

The substantial reduced yield levels of rice in crop year 1972-1973 due to the heavy flooding in Central Luzon and simultaneous drought condition in Visayas and Mindanao brought forth an increased Philippine rice import requirements for the succeeding crop year 1973-1974.

The BAEcon's January 1 production forecast for crop year 1973-1974 was for a total output of 125.7 million sacks of palay which was 25 percent above the previous year. Projected total rice imports for 1973-1974 were 100,000 metric tons (60).

The total yearly¹³ available supply of milled rice for the Philippines from 1956 to 1972 is summarized in Table 18. Total imports during 1971-1972 were in the vicinity of 600 thousand metric tons compared to 300 thousand metric tons for 1972-1973.

The acute shortage and the subsequent relaxation of price controls in July 1973 were followed by an abrupt rise in prices. Increased supplies tempered the behavior of prices in the months of November through December 1973. However, prices rose gradually thereafter throughout January 1974 and price ceilings were reinstated in the same month to stabilize rice prices.

The imposed rice price ceiling of ₱843 per metric ton was less than the January 1974 current Thai world prices of approximately ₱2,600-₱4,875 per metric ton excluding transportation and distribution costs.

The imposition of a price ceiling as a price stabilizing measure was a policy of tremendous concern for the Philippine agricultural sector. The MAAGAP model was used to assess three different levels of price ceilings for rice and estimated their impacts on crop production, import subsidy cost, employment, general usage levels of inputs and sectoral welfare.

¹³ Data for production have been adjusted from a July-June to October-September crop year basis in order to cover for the lean period for which consumption needs have to be met from the previous crop year. See (60).

Table 18. Total Available Supply of Rice in the Philippines, Crop Year 1956 to 1972 (1,000 Metric Tons)^a

Year	Total Available Supply	Production ^b	Imports	Exports ^c
1955-1956	2,134	2,066	68	d
1956-1957	2,109	2,100	9	d
1957-1958	2,249	2,044	205	d
1958-1959	2,381	2,324	57	d
1959-1960	2,362	2,354	10	2
1960-1961	2,454	2,345	109	d
1961-1962	2,536	2,466	70	d
1962-1963	2,621	2,493	128	d
1963-1964	2,776	2,429	347	d
1964-1965	3,044	2,520	524	d
1965-1966	2,691	2,567	124	d
1966-1967	2,911	2,605	306	d
1967-1968	2,812	2,854	12	54
1968-1969	2,763	2,804	d	41
1969-1970	3,289	3,290	—	1
1970-1971	3,467	3,344	123	d
1971-1972	3,772	3,207	565	d
1972-1973	3,172	2,880 ^e	292 ^f	—
1973-1974	3,588	3,484 ^e	104 ^f	—

^aCrop year—October–September.

^bProduction data from 1956 to 1973 were adjusted from July–June to October–September crop year.

^cData on exports are on calendar year. They were allocated to that year that accounted for the smallest imports.

^dLess than 100 metric tons.

^eJanuary 1 forecast. Forecast for crop year 1973–1974.

^fProjected imports through July 1 only.

Source: Production—Crop Statistics, Bureau of Agricultural Economics; Imports—Department of Economic Research, Central Bank, National Grains Authority; Exports—The Statistical Reporter.

Table C-6, Appendix C, summarizes the results as the price ceilings for rice were varied from the 1974 base prices of ₱1,147 per metric ton to ₱843, ₱1,143 and ₱1,293 per metric ton, respectively.¹⁴

Increasing the rice price ceiling led to a decrease in the shadow prices of palay and corn and their by-products ranging from .1 percent to 27 percent from the 1974 base. Shadow prices for land also decreased with twice irrigated second season land (J_2) exhibiting the highest decline of 45 percent. The shadow price of November-December four-wheel tractor services declined from the base situation by 37 percent at price ceilings ₱843 per metric ton but was essentially the same for price ceilings of ₱1,143 and ₱1,293. The shadow prices of May-June hand tractor services also decreased 32 percent from the base, the lowest level of price ceiling, but was unchanged at the two higher price ceilings. The shadow prices of fertilizer nutrients, however, were unaffected (Table C-6).

At the first segment (₱843/m.t.) of rice price ceiling variation, the food crop fertilizer usage level declined by 2.1 percent (urea) compared to the 1974 model results. The use of nitrogen on palay declined 1.3 percent and phosphorous .2 percent.

Total employment (man-labor), however, increased by about .1 from the base levels at the ₱843 per metric ton price ceiling but was unchanged from the base for higher levels of import price ceilings.

¹⁴ This is equivalent to 1974 current price levels of ₱2.67 per kilo (base), ₱1.90, ₱2.55 and ₱2.88 per kilo respectively.

The use of tractor services were unaffected by variations in price ceilings (Table C-6, Appendix C).

As the rice price of ₱1,147 per metric ton was lowered to ₱843 per metric ton, the production of rice decreased by 1.5 percent compared to the 1974 base. The production of corn grits, however, increased by 1.6 percent. The production of the other commodities on the other hand did not change from their 1974 levels.

From the import-export section of the model we can compute import subsidy cost to the government if the different price ceilings were imposed. The rice import subsidy cost is equal to the difference between the cost of importing with the price ceiling (domestically imposed) multiplied by the level of imports.¹⁵

To maintain a low rice price ceiling of ₱843 per metric ton, a total of 0.9371 thousand metric tons of rice must be imported. At the maximum average January 1974 world price of Thai rice of ₱4,875 per ton,¹⁶ this implies a net import rice subsidy cost to the government of approximately ₱2.8 million. On the other hand, if the price ceiling would be set at ₱1,143 per metric ton (₱2.55 per kilogram, current 1974 levels) only .2863 thousand metric tons of rice import would be necessary decreasing substantially the net subsidy cost to ₱0.66 million.

¹⁵ For simplicity, interest rate was not included in the calculation.

¹⁶ Assuming an exchange rate of \$1 : ₱7.50 and excluding transport and distribution costs.

Finally, the sectoral welfare direction of the policy is also worth observing. Compared to the 1974 base at the ceiling price of ₱843 per metric ton, net social benefits for agriculture would increase by .3 percent; consumer's surplus would increase by 3.2 percent; while producer's surplus would decline by 1.4 percent. At ₱1,143 per metric ton rice price ceiling, social benefit would increase slightly, consumer's surplus would be virtually unchanged while producer's surplus would increase slightly. However, if the ceilings were raised higher to ₱1,293 per metric ton, net welfare would be unchanged from the 1974 levels; consumer's surplus would decrease .9 percent while producer's surplus would gain by 3.4 percent from the 1974 base (Table C-6, Appendix C).

To recapitulate, an imposition of a rice price ceiling below its equilibrium market price would depress domestic production of rice, increase import requirements to supplement the shortage from domestic source but consequently would raise import subsidy cost. Producer's surplus would decline while consumer's surplus would increase. On the other hand, if the price ceiling is higher than the equilibrium price, import subsidy costs would be eliminated, producer's surplus would rise but consumer's share would be lower.

V. VARIATIONS IN THE LEVELS OF MECHANIZATION

The use of agricultural machinery, particularly tractors, on Philippine farms grew considerably in the 1960's. They were originally concentrated in the sugar growing areas; but during the latter part of

the 1960's there was a shift to tractor mechanization in rice technology due partly to government adoption of a credit program to encourage mechanization and the development of cage wheels which allowed tractors to operate in wet paddies (14).

In the recent past, the Philippine government sought policies and programs favorable toward farm mechanization so long as employment levels would not be affected adversely. To date, however, there have been no studies to evaluate the effects of the different levels of farm mechanization to agricultural output, employment, income and prices at the national level.

The MAAGAP model was used to determine the likely sectoral economic effects if the stock of tractor services was varied at different levels from the 1972 level of tractor stocks.

Varying Simultaneously the Use of Hand and Four-Wheel Tractors

The procedure used here was to vary the availability of all types of tractor services (hand and four-wheel tractor) from 0 to 500 percent of their 1972 bases. The 1972 stock of hand tractor services was 219 thousand tractor days, while that of four-wheel tractor, 161.5 thousand tractor days. Both stocks of tractor services were then simultaneously parameterized from zero levels of their 1972 base to 500 percent (seven segments). For instance, at segment one ($\theta = 0$), no supply of both hand and four wheel tractor services were made available to the model. At segment two ($\theta = 30$), only 30 percent of their 1972 base levels were supplied, i.e., 30 percent of the 1972

hand tractor stock of 219 thousand tractor days or 65.7 thousand tractor days and 30 percent of the 1972 four-wheel stock of services (48.4 thousand tractor days) were made available in the model. At the seventh segment ($\theta = 500$), 500 percent of their 1972 base stock of tractor services (1,095 thousand tractor days for hand and 807.5 thousand tractor days for four-wheel tractor) were made available.

Results from varying simultaneously the stock of four-wheel and hand tractor services indicated that the crucial periods (peak periods) in the utilization of tractor services were the months of May-June and November-December. During these peak months, estimates of shadow prices (1972 base) for hand tractor service per day were ₦63.30 in November-December period and ₦94.0 in May-June period. Four-wheel tractor service (also 1972 base) on the other hand were restrictive in more periods and had a higher shadow price ranging from ₦312.0 (May-June) to ₦325.90 (November-December).

As the stocks of available tractor services (in thousand tractor days) were simultaneously varied for both hand and four-wheel tractors ranging from zero to 500 percent from the 1972 base,¹⁷ marginal value

¹⁷ The 1972 base contained 219 thousand and 161.5 thousand tractor days for hand and four-wheel tractors, respectively. These stocks of available tractor services were distributed on a bimonthly period throughout the year. To convert these tractor days into actual tractor units, multiply them by .04, the ratio of the six bimonthly periods with the effective working day per year of one tractor unit. For a complete discussion on how the 1972 stocks of tractors were generated refer to Chapter IV.

product (MVP) curves were derived for both types of tractors for the periods May-June and November-December.¹⁸

The MVP curves of hand tractor for May-June and November-December are shown in Figure 9. If no tractors of any type were used at all, the shadow price for hand tractor for May-June would be ₦115.20 per day, and ₦81.0 for the November-December period. As hand tractor services, however, would be increased from the base levels of 219,000 tractor days (8,760 units of hand tractor) to 500 percent, the shadow price was steady at ₦93.4 for May-June and ₦63 for November-December (Figure 9).

The demand curves for four-wheel tractor services had a somewhat different pattern. At zero level of mechanization the four-wheel tractor shadow price for May-June was high at ₦1,970 per day and ₦432 for November-December. Then at 8,398 units of four-wheel tractor to 32,300 units, the shadow price for May-June was constant at ₦321.00. On the other hand, the demand curve for November-December tractor service was horizontal at ₦321 per day from the 10,336 to 32,300 units of four-wheel tractors (Figure 10).

The sectoral effects of varying the availability of both hand and four-wheel tractor services are summarized in Table C-7, Appendix C.

¹⁸This is not the usual way of deriving an MVP curve of a resource because in this case both hand and four-wheel tractor services were varied simultaneously. Furthermore, since tractors are a flow resource, shadow prices in particular periods have little meaning. In tracing out these curves, the objective in mind was to demonstrate that although a resource may not be totally exhausted for the year as a whole, it could be constraining in some peak periods.

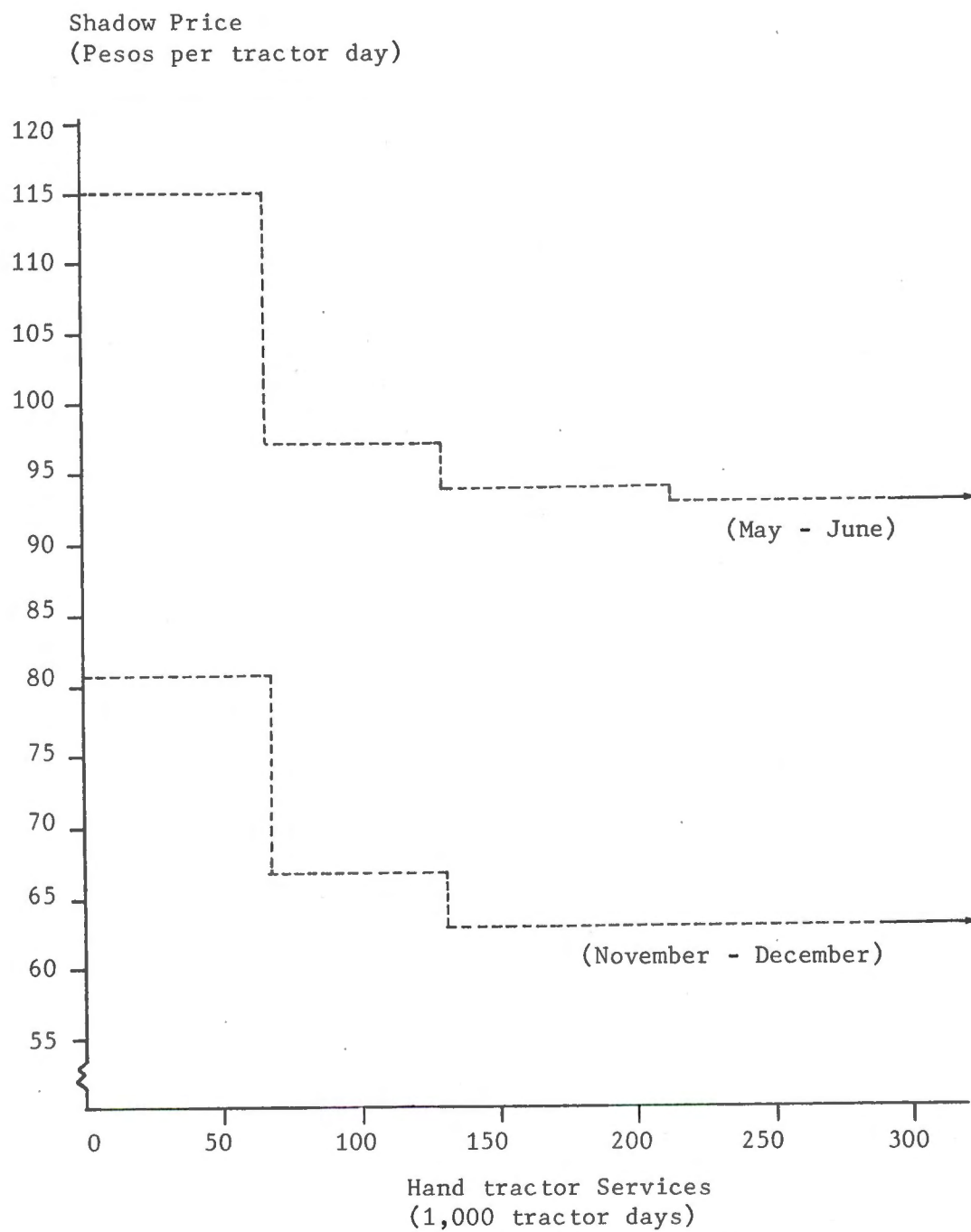


Figure 9. MAAGAP MVP curves for hand tractors.

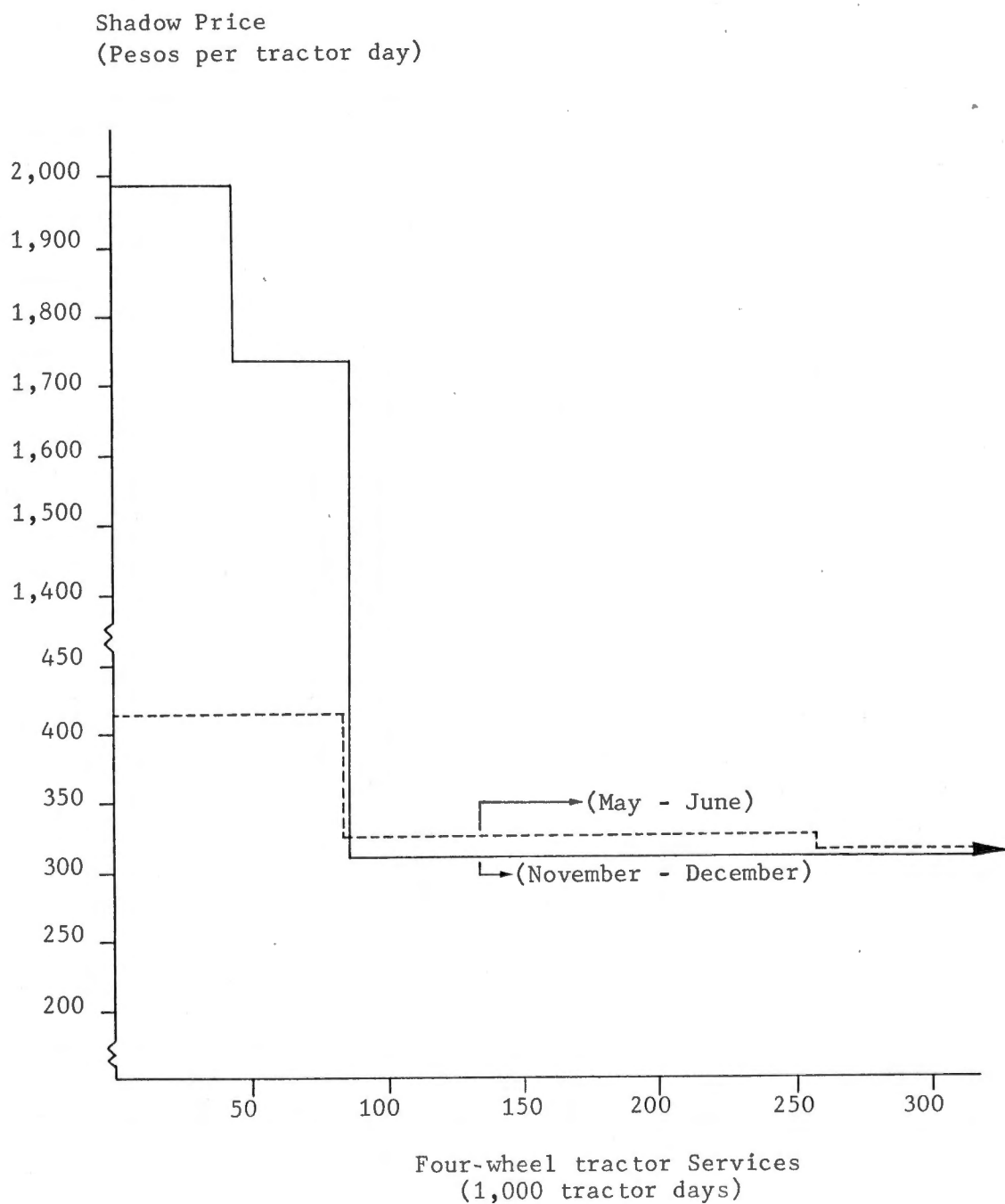


Figure 10. MAAGAP MVP curves for four-wheel tractors.

If the supply of tractor services were reduced from 40 percent to 100 percent from their 1972 levels, the consequences would be increased in the shadow prices of palay from 0.6 to 1.5 percent, decrease in corn grain prices from 4.6 to 7.5 percent; decrease in hog prices from 3 to 8 percent and a decrease in chicken prices of 1.3 percent.

The final product prices would also be affected in a similar manner. Rice price would increase by 1.5 percent from the base level; corn grits would decline about 7 or 8 percent; a general decline, not exceeding 3 percent levels among finished livestock prices would result; the prices of the export crops (sugar and copra) would remain unchanged (Table C-7, Appendix C).

As the tractor services were varied from 40 percent to 100 percent less than their 1972 base levels, the shadow prices for land likewise increased. Once irrigated land first season (I_1) had the highest increase in shadow price ranging from a low of 10 percent to a high of 32 percent. First season rainfed (R_1) land increased from 9 to 31 percent; twice irrigated lands first and second season (J_1 and J_2) were both in the range of 5-25 percent increase; first class upland first season (U_1) increased 6 percent; while first class upland second season (U_2) showed a decline in its shadow price from 7 to 10 percent (Table C-7).

During the months May-June and November-December, at lower stock of tractor services, the shadow prices of hand tractor services increased from 3.5 to 28 percent above the 1972 base. On the other hand four-wheel tractor shadow prices also spiraled from a low of

9 percent to a high of 531 percent, when a higher constraint of the availability of tractor services was imposed (Table C-7, Appendix C).

The reverse pattern was observed as the constraint on tractor services was relaxed. This resulted in lower shadow prices of tractor services during the peak periods. The percent decreases, however, were relatively small—less than 2 percent.

The effects of varying the stock of tractor services on the levels of usage and shadow prices of fertilizer nutrients were somewhat different. At zero tractor stock and up to a decrease from 40 to 70 percent of the 1972 base level, the shadow prices of fertilizer nutrients were lower than for the base situation. Shadow prices for fertilizer increased up to 3 percent as the constraint on tractor services was relaxed to as high as 500 percent above the 1972 base.

The effect of variation in availability of tractor services on fertilizer use varied by type of fertilizer. Urea and complete fertilizer declined in use levels from .3 percent (complete) to 54 percent (urea) when tractor services were cut from 100 to 40 percent of the 1972 base while ammophos increased from a range of 45 to 65 percent. At levels of tractor service availability above the 1972 base, urea tended to increase slightly. Increasing availability of tractor services above the 1972 base had no effect on complete fertilizer use but resulted in a decline of up to nearly 15 percent in use of ammophos.

It is also interesting to note the pattern of fertilizer nutrients usage among the different crops. As tractor services were decreased

below their 1972 base levels, use of nitrogen, phosphorous, and potassium on palay and sugar cane generally declined. On the other hand, the amount of fertilizer used on corn increased as tractor services were reduced and declined as tractor services were expanded above the 1972 base level (Table C-7; Appendix C).

Results of the tractor service parametric variation also showed that generally tractor and man-labor were competing factors to a very limited degree. As tractor services were decreased from 40 to 100 percent below the 1972 base, employment increased within the range of 0.7 to 1.2 percent; but as tractor services were increased from 130 to 200 percent of the 1972 levels, employment declined from 0.1 to .7 percent. Within these segments observed the average elasticity of substitution of tractor for man-labor was calculated to be in the range of $-.0.002$ to $-.0.018$.¹⁹ This pattern of substitutability was demonstrated aptly by the changes in the levels of man-labor usage in palay and corn during peak periods, May-June and November-December. As tractor services were reduced, labor tended to be substituted for tractor services for palay and corn production. For sugarcane, however, with a 70 to 100 decrease in tractor services from the base, man-labor utilized in the months of May-June and July-August decreased 10 to 20 percent. In the other time periods, reducing available tractor services resulted in increases of man-labor utilized for sugarcane production from 1 to less than 5 percent (Table C-7).

¹⁹ Simple percentage change in man-labor divided by percentage change in tractor services.

As the tractor services were varied from 0 to 500 percent from the base, tractor services tended to be substituted for animal labor. The elasticity of substitution of tractor for animal labor ranged from a low of -0.001 to a high of -.04. This pattern was mostly manifested for palay production during the months of May-June and November-December.

In terms of palay production hand tractor usage was vital in the peak periods of May-June and November-December. During these two periods, palay production utilized all the available bimonthly hand tractor services. Palay hand tractor usage levels in these periods showed a decline as tractor services were decreased and proportionate percent increases as the constraint on tractor services were relaxed (Table C-7, Appendix C).

Four-wheel tractor services on the other hand were mostly utilized by sugar from the periods May-June and July-August and palay during the period November-December.

The impact of these simultaneous variations in hand and four-wheel tractor services on agricultural output was a lower production of rice and sugar at low levels of tractor services and a higher production of rice as tractor service availability was increased above the 1972 base. The decline in rice and sugar production when tractor services were decreased from 40 to 100 percent below the 1972 base ranged from 1.2 percent to 4.2 percent, and 9 to 12.5 percent, respectively. Likewise, at these levels of tractor service variation below the base, sugar export declined from 12 to 29 percent. Corn production, a nontractor

user, increased from base levels about 5 percent as tractor services were reduced to zero and decreased by 1.6 percent as the variations reached 500 percent of the 1972 base. The increase in corn grain production triggered an increase of 58 percent in the production of commercial hogs, as the stock of both hand and four-wheel tractor services was decreased to 60 percent of their 1972 base levels.

The welfare direction of varying the quantity of hand and four-wheel tractor services can be summarized as follows: net social benefit would decrease slightly (.2 to .4 percent), while producer's surplus would increase 1.7 to 4.4 percent from the 1972 base, if tractor services were reduced by 70 to 100 percent below the 1972 base. As tractor services were increased to 500 percent above the 1972 base, net social benefits and consumer's surplus increased slightly while producer's surplus declined (Table C-7, Appendix C).

In summary we could say that the simultaneous increase in the availability of hand and four-wheel tractor services would result in greater production of rice and sugar both for domestic use and export. Increasing availability of tractor services would have an inverse effect on the production of corn. That is, as tractor availability is expanded, corn production would decline triggering lower production of commercial hogs which would eventually increase the prices of livestock products.

Results of the variation also demonstrated the relative substitutability of man-labor (employment) and animal labor for tractor services, while fertilizer tended to exhibit a complementary

relationship with tractor usage in the production of rice. Likewise, lower tractor services would imply a decline in net social benefit and consumer's surplus, while producer's surplus would increase. Higher tractor services (above the 1972 base) on the other hand would tend to increase net social benefit and consumer's surplus but decrease producer's surplus.

Varying the Availability of Hand Tractor Services

The procedure undertaken here was to vary the 1972 stock of hand tractor services (219 thousand tractor days) from a low of zero to 800 percent (10 segments) of the 1972 base while holding the stock of four-wheel tractor services constant at its 1972 base level. The aim was to evaluate whether hand tractor services had a substantial impact on agricultural prices, employment and income.

As hand tractor service availability was reduced from the 1972 base level (80 to 0 percent of 1972 base), palay production declined from .3 percent to 1.46 percent while production of corn grain increased from 1.0 percent to almost 5 percent above the base levels. Commercial hog production likewise increased by as much as 50 percent. As the stock of hand tractors, however, was increased from 115 to 800 percent greater than the 1972 base, palay production increased from .2 percent to 1.6 percent, while corn grain production decreased from .7 to 1.6 percent. Sugarcane production, coconut and backyard hogs and layer activities were unaffected (Table C-8, Appendix C).

The combined increases in the production of corn and commercial hogs lowered the shadow price of corn by as much as 3.4 percent and the shadow price of hogs by as much as 7.5 percent. Palay price was .7 percent lower than the base at 0 level of hand tractor services. The relative decrease in the price of palay could be explained by the competitive relationship between rice and corn. Given their demand levels, a relative decrease in the production of palay due to lower availability of hand tractor services resulted in substitutions of corn production for palay. This would increase in commercial livestock production, which would tend to lower the general price levels of almost all the commodities except sugar and coconut.

The shadow prices of hand tractor services for the periods May-June and November-December increased as hand tractor services were reduced and consequently declined as the hand tractor services were increased above the 1972 base. The percent increases, however, were relatively low and ranged from .6 to less than 2.5 percent.

The levels of usage of hand tractor services declined proportionately with the reduction in availability during the periods May-June and November-December. That is, for every 90 percent reduction in hand tractor services, there was a corresponding decrease in the levels of usage. A 15 to 90 percent increase in hand tractor service availability also resulted in a proportionate increase in the levels of usage of hand tractor during these peak periods. As the constraint was relaxed to a level equal to 800 percent of the 1972 base levels, hand tractor service used in the March-April period was only 526.9 percent higher

than the 1972 base while the level of usage during the sixth period (December-January) declined by 20.1 percent (Table C-8, Appendix C).

Four-wheel tractor usage on the other hand was constant relative to the 1972 levels as the availability of hand tractor was reduced below the 1972 level but declined from 14 to 52 percent as the hand tractor services were increased above the 1972 base. The implication was that it was uneconomical to substitute totally four-wheel tractor for hand tractor but at higher levels of hand tractor availability hand tractor can be substituted for four-wheel tractor (Table C-8, Appendix C).

Employment (man-labor) increased from .1 to 5 percent as hand tractor restraint was reduced sequentially from 80 percent to 0 percent of 1972 level. From 15 to 90 percent higher than the base employment declined from .1 to .2 percent, but increased again from .5 to 1.2 percent for the 475 and 800 percent of the base level. It was difficult to assess the labor displacement from the adoption of more hand tractor services without looking more closely at the pattern of tractor usage among the different crops.

For instance, in palay production during the first labor period (January-February) man-labor could be substituted at low levels of hand tractor availability below 1972 base but man labor was a complementary factor as the hand tractor services were increased to 475 and 800 percent of the base period. In the fourth labor period (July-August) manlabor and hand tractor usage were more complementary to each other. In peak periods (May-June, November-December), however,

man labor and hand tractor were more likely to be substituted for each other. Lesser hand tractor services would result in more employment of labor and vice versa. During peak periods the elasticity of substitution was estimated to be in the range of $-.0047$ to $-.014$.

Hand tractor and man labor were competing factors in the production of corn during the November-December period and the elasticity of substitution of tractor for labor was estimated to be about $-.06$. There was a very minimal effect, however, of hand tractor services on man labor employment in sugar and coconut production (Table C-8, Appendix C).

Animal labor on the other hand tended to show a competitive relationship with the use of hand tractor services only in the production of palay. During the May-June period, animal services increased from .4 to .5 percent as the stock of hand tractor was reduced from the 1972 base to the 40 percent levels. At levels of hand tractor services above the 1972 base, animal labor declined from .1 to a high of 4.8 percent. The same pattern was generally demonstrated by the model during the period of November-December with the use of animal labor relative to the variation in the levels of hand tractor services (Table C-8).

Finally, variations in the stock of hand tractor services from 0 to 800 percent of the 1972 base resulted in a decrease in the producer's surplus by 1.1 to 3.8 percent. Net social benefit was slightly lower than the base when hand tractor services were constrained to levels below the 1972 base and slightly higher (.09 percent) at

levels of hand tractor stock above the 1972 base. The consumer's surplus was above the 1972 level for all levels of hand tractor variation.

To recapitulate, at low (0 to 80 percent of the 1972 base) levels of hand tractor services palay production would decline relative to the 1972 base but would be offset more than proportionately by the substitution of corn, stimulating the production of livestock at commercial levels with a resultant general decline in prices. The result of lower prices would be a lower producer's surplus, but a positive gain to consumer's surplus although net social benefit would slightly fluctuate.

Increasing hand tractor services on the other hand would lead to higher production of palay but a probable displacement of man and animal labor in the production of palay and corn.

Varying the Availability of Four-Wheel Tractor Services

As in the case of hand tractor services, the stock of four-wheel tractor services was also varied to measure its impact on agricultural prices, employment, output and income. The parametric variation ranged from 0 to 167 percent of the 1972 base (161.5 thousand tractor days) while holding the 1972 base stock of hand tractor services constant.

The major crops affected by the variation of the availability of four-wheel tractor services were sugar, palay and corn. Results from the MAAGAP model indicated that as the supply of four-wheel tractors

was reduced from 37 to 100 percent lower than the 1972 base, sugarcane production decreased from 6 to 19 percent from the 1972 base and palay production declined from 1.0 to 3.0 percent; but corn grain increased up to 5 percent and commercial hogs increased by as much as 58 percent. Sugar export would likewise decline from 10.2 percent to 39.5 percent.

The substantial increases in corn (as a substitute for palay) and the expansion of hog production resulted in lowering of all commodity prices (except rice at the first two segments). Corn grits had the largest decline (6.9 percent) while poultry had the lowest decline (1.2 percent) compared to the 1972 base (Table C-9, Appendix C).

As in the case of hand tractor parametric variation, all the land capability classes except first class upland second season (U_2) showed higher shadow prices ranging from .9 percent (J_1) to 31.3 percent (R_1) when four-wheel tractor services were reduced from 0 to 63 percent of the 1972 base.

As would be expected the shadow prices of four-wheel tractor services during peak periods (May-June and November-December) also increased at low levels of four-wheel tractor availability. For May-June the percent increases in the four-wheel tractor shadow prices were as high as 53 percent at zero level of tractor and 36.6 percent for the November-December period as compared to the 1972 base level.

The prices of fertilizer nutrients also decreased ranging from 6 percent to 19 percent at low levels of four-wheel tractor service availability. Their shadow prices, however, rose 3 percent above 1972 base as four-wheel tractor services was increased to 167 percent of the 1972 base (Table C-9).

Urea and complete fertilizer showed complementary relationship with four-wheel tractor usage by declining as much as 51 percent from 1972 base (urea) when the level of four-wheel tractor availability was reduced to 0. When four-wheel tractor availability was increased to 67 percent greater than the 1972 base, urea usage increased slightly (1.1 percent) but the use of other fertilizer was unaffected.

As four-wheel tractor was reduced below the 1972 base, employment increased slightly from .5 to .6 percent. As tractor services constraint was relaxed to 67 percent greater than the 1972 base, employment dropped by about .3 percent. Within these segments, elasticity of substitution of four-wheel tractor for man-labor was estimated to be roughly $-.01$. The levels, however, would vary among crops and between periods of the year. For instance, the elasticity of substitution of four-wheel tractor for man labor in palay production period one was estimated to be $-.11$, while that of corn in period six would be about $-.03$.

Four-wheel tractor services were mostly used for palay production in the November-December period. The palay usage level of four-wheel tractor declined proportionately as the availability was reduced and increased 15.5 percent as the stock of four-wheel tractor services was raised to 67 percent greater than the 1972 base. For sugar production, however, use of four-wheel tractor services in periods three and four decreased from 34 to 84 percent as the stock of tractor services was reduced to less than the base.

Results also indicate the degree of substitution between animal labor and four-wheel tractor services. The competitive factor relationship was most demonstrated for palay production in the November-December labor period with elasticity of substitution four wheel tractor for animal labor ranging from -0.05 to -0.24.

Finally, the welfare implication of varying the availability of four-wheel tractor services while holding hand tractor services constant would be an increase in consumer's surplus (from .38 to .55 percent from the 1972 base), a general decrease in net social benefit, and a decrease in the producer's surplus (except when four-wheel tractor services were at zero) ranging from 1.7 to 5.0 percent.

In summary, results showed that four-wheel tractor services are vital to the production of sugar and palay but not for corn. Reducing four-wheel tractor services would reduce sugar (domestic and export) and rice production, but corn would be substituted for palay, and would create a spinoff in commercial livestock production generally causing a lower price level for agricultural products. Producer's surplus would be less than before (1972) while the slight gains due to price decreases would go to the consuming sector. Further, as in the case of hand tractor variation, land and fertilizer (especially urea) inputs were complementary factors, while animal and man labor services were competing inputs to four-wheel tractor services.

VI. THE EFFECTS OF FLOODS AND OTHER NATURAL CALAMITIES

Historically, floods, typhoons, drought and other natural calamities have occurred quite frequently in the Philippines and little serious effort has been made to measure their extent of damage and/or their possible effect on agricultural prices.

The economic dislocations posed by the floods, drought and disasters of crop year 1972-1973, however, restructured the thinking of many that natural calamities like those of 1972-1973 could create a major economic impact on the Philippine economy.

The MAAGAP model was used to assess the likely macroeconomic effects on agricultural prices if another flood like that of 1972 would ever occur again.

The crop losses in 1972 as estimated by the BAEcon Statistics Division are summarized in Table 19. These losses were from the combined effects of floods, rat infestations, drought and plant disease like Tungro for rice during the crop year 1972-1973. The estimates indicate that palay had the highest crop damage of 18 percent from the three-year normalized base followed by 9 percent for corn, 2.2 percent for coconuts, and only .1 percent for sugar.

These estimated crop losses were then incorporated in the MAAGAP model as negative commodity balances in the right hand side of the model to simulate the abnormal crop year of 1972-1973.

The results from incorporating the combined effects of floods and other natural occurrences in the MAAGAP model are shown in Table C-10,

Table 19. Estimated Crop Losses Due to Combined Effects of Floods and Other Natural Calamities on Production, Philippines, 1972

Crop	Production (in 1,000 m.t.)		
	1969/70-1971/72 Normalized Base ^a	Estimated Damage	Estimated Damage in Percent
Palay	5,379.4	964.7 ^b	18.0
Corn grain	2,008.6	177.5 ^b	9.0
Sugarcane	21,397.0	21.5 ^a	0.1
Coconut ^c	7,995.0	172.3 ^a	2.2

^aAs estimated by BAEcon's Statistics Division.

^bThe assumption made here is that the difference in production between the normalized base years and the 1973 Crop Year is due to the combined effects of the floods in 1972 as well as drought, pests and rats. See BAEcon's Crop, Livestock and Natural Resources Statistics, 1973, pp. 10-14.

^cIn Million nuts.

Appendix C. Palay and corn showed the highest increases in prices from the 1972 base. Palay price was 37.5 percent higher while corn price was 19.2 percent higher at the primary production levels. The shadow prices of the by-products of rice and corn milling also increased by a range of 19 to 37 percent compared to base level prices.

In their final forms, the prices estimated by the model for rice, corn grit and pork showed increases of 35 percent, 12 percent, and 6.4 percent respectively above the 1972 base. The prices of poultry and eggs, however, declined from the 1972 base—poultry by 3.5 percent and eggs by 4.9 percent.

The processing activities also manifested general decreases from the 1972 base as a result of the floods. Palay processing (cono) declined 77 percent while corn (kiskisan) milling also declined 14 percent. Likewise, the finished products, rice, corn grits and sugar also declined from their 1972 base levels by 19 percent, 14 percent and 0.6 percent respectively (Table C-10, Appendix C).

Finally, net social benefits of the agricultural sector would decrease 1.8 percent; consumer's surplus would be lower by 3.2 percent, while the producer's surplus would increase 6.1 percent from the 1972 base (Table C-10).

The economic explanation of higher producer's surplus and lower consumer's surplus resulting from a flood is simply that floods reduce output, consequently raising the price levels of commodities. Since all of the products examined in the MAAGAP model have inelastic demand, a higher price level would have a net effect of making the producers better off and the consumers worse off, compared to a no-flood situation.

In summary, the net effects of a flood or natural disaster would be higher agricultural prices and decreases in net social benefits. Consumer's surplus would be lower while the producer's surplus would be higher as a result of the more than proportionate rise in product prices.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The objective of this study was to estimate the economic effects of selected policy alternatives on prices, output, employment and income in the agricultural sector of the Philippines. The evaluated policies were: fertilizer subsidy; efficiency of irrigation systems; rice price ceilings; mechanization; and natural calamities. A brief summary of the results, conclusions, economic trade offs among the selected policies and suggestions for further research undertakings based on these results are presented in this chapter.

I. SUMMARY

Alternative Fertilizer Pricing Policy

Results from the study showed that removing the fertilizer subsidy to the food crop subsector would lead into a lower production of rice, lower employment, a decline in both hand and four wheel tractor usage, a decline in capital usage and a lower marginal productivity of land because of lower fertilizer consumption in the food crop subsector. Consumer's surplus would likewise be lower while producers would gain as the fertilizer subsidy to food crop subsector would be removed. The economic explanation was simply that as the quantity of food crops (rice and corn) decreased due to lower usage of fertilizer, prices would tend to increase and since the elasticity of demand for rice and

corn are relatively inelastic, producers would benefit from the increase in price.

A uniform fertilizer pricing and subsidy for both subsectors of high levels (100 to 72 percent subsidy) would result into a tremendous decrease in domestic prices compared to their 1974 base levels (which was 53 percent subsidized only for the food crop subsector); increase in the marginal productivity of lands because of higher usage of fertilizer; higher employment of man labor; and increase in capital usage as compared to the 1974 base. Higher uniform subsidy levels for both food and export crops, however, would tend to reduce the use of four-wheel tractor services and animal labor compared to the 1974 base.

At low levels of uniform pricing and subsidy levels (56 percent to zero levels) for both the export and food crops, domestic production (especially rice) would decline, marginal productivity of lands would likewise decline because of relatively lower usage of fertilizer. Prices of commodities would then tend to rise. Employment, four wheel tractor usage and animal services would also decline.

The imposition of a 4 percent tax to the export subsector will adversely affect the levels of export. The decline in the levels of copra and sugar export would be around .7 percent and 1.5 percent, respectively, regardless of the level of uniform subsidy.

A uniform pricing and subsidy scheme whether a tax is imposed or not, would generally result in higher net benefits for both producers and consumers, with the proportion of shares differing between the two conditions conditions (general lower benefits when tax is imposed).

Variations in the Efficiency of Irrigation Systems

Increasing the efficiency of the existing irrigation systems without necessarily altering the ratio of total irrigated areas from nonirrigated lands, but only changing the ratios of twice to once irrigated lands would result in the higher production of rice, increase in employment, higher usage of capital on crops, increase in fertilizer usage (especially on palay), a higher net social benefit for the agricultural sector with the consumers' benefiting from relatively lower prices. The negative offsetting effects, however, would be a lower producer's surplus and a decline in corn production as well as the use of animal and four wheel tractor services.

Variations in the Price Ceilings for Rice

Results showed that lower price ceilings for rice would result in lower rice production levels. To maintain a rice price ceiling of approximately ₱843 per metric ton (₱1.90 at current 1974 prices), MAAGAP estimated that a total of .9371 thousand metric tons of rice must be imported, incurring an import subsidy cost of approximately ₱2.8 million. On the other hand, if the rice price ceiling were raised to ₱1,143 per metric ton, only .2863 thousand metric tons of rice import would be necessary decreasing substantially the net subsidy cost to ₱.66 million.

Low price ceilings would tend to depress domestic production, increase import requirements to supplement the shortage from domestic

source, and consequently raising import subsidy. Producer's surplus would increase while consumer's share would be lower. Higher price ceilings on the other hand would eliminate import subsidy costs, with producers benefiting while consumers would be hurting.

Variations in the Levels of Mechanization

The simultaneous increase in the availability of both hand and four wheel tractor services from 0 to 200 percent of 1972 levels would result in increases in the production of rice, domestic and export sugar and decreases in the production of corn and commercial hogs. Expansion of hog production would in turn lead to decreases in the prices of livestock products.

Results of the variations also demonstrated the relative substitutability of both man labor (employment) and animal labor for tractor services, while fertilizer showed a complementary relationship to tractor usage in the production of rice and sugar.

Likewise, lower tractor services (lower than 1972 base) would imply a decline in net social benefit and consumer's surplus while producer's surplus would increase. Higher tractor services on the other hand (higher than 1972 base) would tend to increase net social benefit with consumer's surplus generally higher while producer's benefits would be lower.

Variations in the availability of hand tractors with four-wheel tractors held constant at 1972 levels showed that palay production would decline at levels below 1972 base but would be offset more than proportionately by the substitution of corn grain production for

palay. This would in turn lead to increases in production of commercial livestock causing a general decline in prices. The lower price levels would result to a lower producer's surplus but a positive increase to consumer's surplus.

Increasing hand tractor services above 1972 levels on the other hand would lead to higher production of palay but a probable displacement of man and animal labor in the production of palay and corn.

Results would also indicate that four-wheel tractor services were very vital to the production of sugar and palay but not for corn. Reducing the availability of four-wheel tractor services below 1972 levels would reduce the production of domestic and export sugar and rice production, but corn would be substituted for palay, causing an increase in commercial livestock production and generally would decrease price levels for agricultural products. Producer's surplus would be lower than before (1972) while the slight gains due to price decreases would go to the consuming sector. It was further shown by the four-wheel tractor parametric variation that fertilizer (especially urea) was a complementary input to four wheel tractor usage, while animal and man labor services were competing inputs to four wheel tractor usage.

Effects of Floods and Other Natural Calamities

The net effects of floods and/or natural calamities would be higher agricultural prices and lower net social benefits. Consumer's

surplus would be lower, while producer's surplus would be higher because of the price increases.

II. CONCLUSIONS

From the results of the study the following general sectoral conclusions can be deduced.

1. Crop and livestock sectors are highly interdependent. A higher crop production (especially corn) would be very conducive to a higher commercial livestock production consequently leading to lower general price levels among products in the agricultural sector.

2. In the food subsector, programming results showed that rice and corn were highly competing production enterprises. At low levels of technology (e.g., lower fertilizer usage, and lower usage of hand and four-wheel tractor services) corn production would economically prevail over the production of rice. At high levels of technology, however (e.g., relaxing the constraints on hand and four-wheel tractor services, higher usage of fertilizer due to higher subsidy levels, and more efficient irrigation systems), corn production would be sharply displaced by rice. The higher production of corn (rather than rice), would have a significant impact on the commercial production of hogs and poultry.

3. The programming results also demonstrated that the rice price ceiling which would minimize import requirements was within the vicinity of ₱1,147 to ₱1,43 per metric ton. A rice price ceiling of ₱843 per metric ton would tend to depress domestic production and

Conversely, as the availability of fertilizer was relaxed (higher subsidy and lower prices) the level of fertilizer use increased and the marginal productivity of lands, employment and capital used by the food crop subsector likewise increased. From this behavior, we can conclude that employment (man labor) and capital used by food crops are complementary factors of production with fertilizer usage.

- b. The input relationship between fertilizer and four-wheel tractor, animal labor and hand tractor was inconclusive from the point of view of complementarity and substitutability of factors. Hand tractor services on the other hand manifested no change from the 1974 base as the price of fertilizer was uniformly varied and subsidized.

6. Lowering the levels of four-wheel tractor availability had the most effect on the production of sugar. Reducing the 1972 stock of four-wheel tractor availability from 1972 levels down to 0 would substantially reduce domestic sugar production as much as 23 percent at 0 level of four-wheel tractors. This would result in reduction of sugar export by as much as 39 percent. Increasing the levels of tractor availability above the 1972 base level resulted in a small but insignificant increase in rice production but had no effect on sugar production or sugar export. The above behavior implies that the current 1972 stock level of four-wheel tractor services would appear

to be near the proper levels for the current input mix of Philippine agriculture.

7. Within the seven segments of parametric variation of the availability of four-wheel tractor services, results would indicate that man labor, animal labor and capital were competing factors with four-wheel tractor usage, while fertilizer's input relationship to the latter was inconclusive.

8. Restricting the availability of hand tractor services on the other hand was most crucial to rice production. The results demonstrated that as the availability was restricted, a decline in rice production occurred. Corn production, however, would be substituted for rice. Rice production would respond positively to increases in hand tractor availability, with the usage levels of other factors held constant.

9. As the stock of hand tractors was increased to 800 percent of the 1972 levels the use of hand tractor services in peak periods for palay production expanded by 527 percent. At these high levels of hand tractor availability, the total usage level of four-wheel tractors declined by 52 percent, implying that it was economically feasible for hand tractors to be substituted for four-wheel tractors, but not vice versa. Further, as the availability of hand tractor services was relaxed, relative to other input usage, results indicated that it was inconclusive whether higher hand tractor availability would displace labor. At some range (115 to 190 percent from the base) there was some evidence of displacement (.13 to .24 percent) but at 475 to

800 percent range, employment was complementing higher hand tractor services. It was also inclusive whether fertilizer was a competing or a complementary factor to hand tractor. Results demonstrated that animal services and short term capital were competing factors to hand tractor usage.

10. Results from the MAAGAP model also demonstrated that improvement of present irrigation systems would have a positive impact on rice production, short term capital usage and employment but would decrease the use of animal power, four wheel tractors and fertilizers.

11. The impact of natural disasters as exemplified by the 1972 Philippine floods was primarily on the prices of intermediate and final products and on the values in use of the scarce resources.

12. Finally, from the point of view of net social benefit, the results from the Model would indicate that higher uniform fertilizer subsidy for both food and export crops, lower price ceilings for rice, higher availability of tractor services and more efficient irrigation systems were favorable to consumers. On the other hand, low or no fertilizer subsidy at all, tighter availability of tractor services, higher rice price ceilings and natural calamities were generally favorable to the producers.

III. ECONOMIC TRADE OFFS AMONG POLICY ALTERNATIVES

Different policy alternatives have different policy goals and objectives such that their likely economic impacts, if implemented, become either complementary or contradictory to one another.

The general results and likely economic effects of the different policies evaluated individually by the MAAGAP model, as summarized in the preceding sections of this chapter, indicate that there was no one policy mix that would provide a perfect economic alternative to all the relevant macroeconomic variables embodied in the MAAGAP model. Conflicting macroeconomic directions among the policies examined were an inevitable reality.

A synthesis of the impact of the different policy alternatives demonstrating diverse economic directions relative to possible target variables are summarized in Tables 20, 21, and 22. Tables 20 and 21 show the percentage changes relative to the 1972 and 1974 no-policy-change bases, while Table 22 provides a convenient way of summarizing the qualitative effects of the various policy instruments.

It was evident that from the summarized programming results that there were well defined trade offs among the policy alternatives relative to the target variables. For example, producer's surplus and consumer's surplus are almost always in conflict. In the two exceptions (higher uniform fertilizer subsidy and rice price ceiling of ₱1,143 per metric ton) both may be increased at the expense of a decline in animal labor services, tractor services and export levels (Table 21).

Employment as a target variable was positively responsive to low levels of mechanization, more efficient irrigation systems, and higher levels of fertilizer subsidy. Low levels of fertilizer subsidy (especially no subsidy at all for both food and export crop subsector) are substantially militating against employment (Table 22).

Table 20. Impact of Policy Changes on MAAGAP Selected Variables (Percentage Change from the 1972 Base)

Variables	Units	MAAGAP 1972 Base	Variations in the Levels of Mechanization (all Tractor Types)					63/37 ^a Ratio	75/25 ^a Ratio	Effects of Floods
			Percent Levels from the Base							
			0	30	60	200				
Objective Function	Million									
Consumer's Share	"	41,270	(.43)	(.21)	(.02)	(.01)	.12	.25	(1.8)	(1.8)
Producer's Share	"	35,299	(.80)	(1.0)	.58	.28	1.22	1.22	(3.2)	(3.2)
Value of Crops	"	5,971	1.74	4.43	(3.60)	(1.60)	(6.85)	(5.74)	6.1	6.1
Value of Livestock	"	6,509	(.94)	(2.25)	(1.15)	.12	.85	1.89	3.68	3.68
Employment	"	2,474	(1.45)	(1.45)	(2.4)	--	--	--	5.88	5.88
Fertilizer	Man days	518.98	1.20	1.14	.71	--	.27	.98	(.3)	(.3)
Short term Credit	m.t.	531.86	(19.2)	(8.96)	5.73	(2.5)	(.12)	1.54	1.3	1.3
Chemicals	Pesos	3,396.0	(.14)	.47	1.14	(.24)	.17	.63	(2.4)	(2.4)
Tractor Use	"	78.55	(13.6)	(4.87)	(1.59)	(.38)	(1.28)	(2.09)	0.9	0.9
Animal Labor	Tractor days	750.30	0	(195.5)	(47.73)	51.69	(2.0)	(14.0)	--	--
Export	Animal days	104.26	3.62	2.80	.80	0.77	(1.0)	(2.0)	--	--
Import	m.t.	2.47	(15.14)	(6.93)	.09	--	--	--	(.46)	(.46)
Price Index ^b	"	0.325	--	--	--	--	--	--	--	--
		100.0	98.0	98.0	98.9	100.0	100.1	100.1	113.56	113.56

^aPercentage ratio from total irrigated area of twice to once irrigated lands.^bWeighted for each commodity by dividing the production of each commodity with the total value of production.

Table 21. Impact of Policy Changes on MAGAP Selected Variables (Percentage Change from the 1974 Base)

Variables	Units	MAGAP		Rice Price Ceilings		100% Subsidy		88% Subsidy		68% Subsidy		24% Subsidy		No Subsidy	
		1974 Base		P84.7/m.t.		P1,143/m.t.		Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed
Objective Function	Million	46,985.0		-30	-19	--	-80	-48	-47	-74	-46	-73	-42	-72	-40
Consumer's surplus	"	37,907.0		3.21	.03	(.89)	1.67	.53	.49	.17	.13	(.01)	.15	(.01)	.09
Producer's surplus	"	9,988.0		(1.36)	-.84	(3.79)	(3.57)	(5.78)	(5.93)	(3.78)	(6.0)	(3.79)	1.13	3.79	1.68
Value of crops	"	9,843.6		(17.0)	(3.94)	--	(2.98)	(3.72)	(3.72)	(2.25)	--	--	(6.0)	3.89	(6.12)
Value of Livestock	"	3,357.0		(1.26)	(1.02)	--	-.32	-.32	(3.72)	(2.25)	--	--	--	.016	(8.28)
Employment	Man days	586.35		(.49)	-.02	--	28.76	28.76	13.30	.44	--	.01	--	(8.28)	(8.28)
Fertilizer	m.t.	445.3		(.60)	--	--	2.18	2.18	1.62	.29	--	.28	.28	1.17	1.17
Credit	Million	3,689.0		(6.1)	(5.07)	--	2.79	2.79	1.62	.29	--	.28	.28	.01	.01
Chemicals	"	82.6		--	--	--	2.57	(2.57)	.10	(5.4)	(5.4)	(5.26)	(5.26)	(5.46)	(5.46)
Tractor Use	1,000	39.60		--	(.02)	5.07	2.57	(2.57)	(.30)	(.19)	(.19)	(.19)	(.19)	(13.9)	(13.9)
Animal Labor	1,000	119.30		-.53	(.02)	(.02)	(.04)	(.04)	(.04)	(.04)	(.04)	(.02)	(.02)	.09	.09
Export	m.t.	2,761		--	--	--	--	(.98)	(.98)	--	--	--	--	--	--
Import	m.t.	--		-.9371 ^a	--	--	--	--	--	--	--	--	--	--	--
Price Index		135.0	123.2	134.9	135.1	135.1	134.0	131.4	131.4	135.1	133.0	135.1	133.0	135.1	133.1

^a Not percentage change from the 1974 base but actual quantity in thousand metric tons.^b With 1972 = 100, weighted for each commodity by dividing the production of each commodity with the total value of production.

Table 22. Qualitative Impact of Selected Policy Alternatives in MAGAP

	Fertiliser Subsidy				Rice Price Ceilings (1974 Prices)				Mechanization			More Efficient Irrigation System	Natural Disasters Calamities		
	Uniform Fertiliser Pricing for Both Food and Export Crops at 100% Subsidy		Uniform Fertiliser Pricing for Both Sub-sectors with a 4% Tax on Exports, No Subsidy		F1.90 per Kilogram		F2.55 per Kilogram		F2.88 per Kilogram		Zero Tractor Availability			Medium Tractor Availability	High Tractor Availability
	+	++	+	++	-	+	+	+	++	++					
Target	+	++	+	+	-	+	-	+	+	++	+	+	+	++	++
Producers' surplus	+	-	+	+	+	+	-	+	-	--	-	+	+	--	++
Consumers' Surplus	+	--	-	+	+	n.a.	n.a.	n.a.	+	n.a.	+	-	+	+	n.a.
Employment	++	n.a.	--	n.a.	n.a.	n.a.	--	n.a.	n.a.	n.a.	-	+	n.a.	n.a.	-
Exports	n.a.	n.a.	n.a.	--	-	-	n.a.	+	n.a.	+	n.a.	n.a.	n.a.	n.a.	n.a.
Imports	++	-	-	-	n.a.	n.a.	-	+	n.a.	+	-	+	+	++	--
Production	--	+	++	--	-	-	n.a.	++	n.a.	++	n.a.	n.a.	-	-	n.a.
Government Budget															

Key:

++ Strongly favorable

+ Favorable

-- Strongly Unfavorable

- Unfavorable

n.a. Not Applicable

The complementarity and substitutability relationships among inputs vary from one policy alternative to another. For instance, chemicals and short term credit may substantially decline together at zero levels of all tractor usage but as irrigation systems become more efficient, short term capital becomes a complementary factor input to improved irrigation system while chemical input usage was a percent decline in Table 20. Tractor usage and animal labor services were both competitive factors with fertilizer at high levels of subsidy but at zero fertilizer subsidy, animal labor became a substitute while tractor service usage was a complement (Table 20). Furthermore, in the parametric variation of the availability of power services, land was evidently a complementary input to tractor services. As the availability of irrigated land (through more efficient irrigation systems) however was relaxed, tractor services manifested a substitutable relationship with irrigated land.

Taxing the export crop subsector by 4 percent although beneficial to both consumers and producers would decrease export levels, animal and tractor usages as well as chemicals. Similarly, imposing a ₦1.90 per kilogram rice price ceiling although beneficial to consumers, would likewise decrease producer's surplus and would encourage higher rice import, augmenting the subsidy cost on rice import (Table 21).

Table 22 likewise demonstrates a quality assessment of the different policy alternatives in terms of the types of impacts. No two policies are alike in terms of their impacts on producers, consumers, employment, trade, and government budget. There are always

trade offs. The most common trade off is between the welfare levels of producers and consumers. However, a 100 percent level of fertilizer subsidy for both subsector benefits both producers and consumers but at the expense of government budget. A 4 percent tax imposition to export crops to partly shoulder the input subsidy cost for fertilizer, would be beneficial too to both consumers and producers, strongly favorable to government budget but to the high expense of exports, production and employment. Another trade off is between producer's surplus and government cost at one hand, and consumer's surplus, employment and production on the other, as irrigation systems become more efficient.

The section of this study has so far provided economic information relating to the economic trade offs among the target variables relative to the selected policy alternatives examined. At this juncture, people involved in Philippine public policy decisions and selections are the relevant group who must be able to put relative importance or weights to each of the policy alternatives:

An optimal policy mix that satisfies the criteria of administrative, political and economic feasibilities in light of the Philippine agricultural conditions can only be prescribed or selected in view of these weights and trade offs.

The policy alternatives being evaluated by this study are very limited and the results shown are not sufficient to be able to unravel all the facets of the Philippine agricultural sector. The study, however, in being able to trace out the likely economic trade offs, and in its attempt to measure the impacts of the selected policies under

consideration to Philippine agricultural output, prices, employment and income, has already accomplished its major objectives as laid down in the earlier sections. A planning model like that of MAAGAP, can go no further than providing general sectoral economic directions relative to existing policy alternatives. Developing and implementing an innovative set of new policy instruments is the responsibility of policy makers.

IV. IMPLICATIONS FOR FURTHER RESEARCH

Model building inevitably is contingent to the limitations of data availability and reliability. Due to the pioneering nature of the study and the limitations of data used, it is safe to assume that some of the results provided by MAAGAP are not totally accurate. There is, therefore, a need to continuously update and expand the data base of the Model such that it will become more and more realistically reflective of Philippine agricultural conditions.

It is therefore suggested:

1. That MAAGAP should encompass not only 88 percent of crop hectarage of Philippine agriculture but 100 percent of the crop production activities in the said sector.
2. That the economic activities for livestock from backyard to commercial levels be updated.
3. That it be linked to other nonagricultural sectors of Philippine economy.

Relative to policy analysis, the MAAGAP once expanded can further evaluate the following:

1. Impact of the MASAGANA 99 program relative to technology adoption and credit nonrepayment problems.
2. The impact of a minimum foreign trade net balance for Philippine agriculture.
3. The impact of minimum food consumption requirements.
4. The impact of decreasing prices of export crops.

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APPENDIXES

APPENDIX A

Table A-1. Per Hectare Input-Output Requirements of Pelay, by Different Types of Observed Technology, Philippines, 1969 to 1972

Technology	Labor Tables by Periods (in mm/machine days)						Fertilizer by Nutrients (in kilogram)			Chemicals (in pesos)		Yield (metric tons)	Short-Term Capital (in pesos)	Objective Function (in pesos)
	1	2	3	4	5	6	N	P	K	Insecticides	Medicines			
1. J ₁ H—Two crop—irrigated lowland type, using hand tractor 1st season Man Labor Animal Labor Hand Tractor			25.8 3.9 3.4	15.8 3.9 3.4	16.75		54.2	15.0	7.0	15	5	2.50	208.50	208.50
2. J ₁ Y—Two crop—irrigated lowland type, using wheel tractor 1st season Man Labor Animal Labor Wheel Tractor			20.0 4.9 0.7	15.8 4.9 0.7	17.35		52.0	15.0	7.0	15	5	2.46	212.10	212.10
3. J ₁ M—Two crop—irrigated lowland type, using nonmechanized type of tech. 1st season Man Labor Animal Labor			31.4 13.9	15.6 13.9	14.60		12.67	11.0	7.0	4	2	2.07	195.60	195.60
4. J ₂ H—Two crop—irrigated lowland type, using hand tractor 2nd season Man Labor Animal Labor Hand Tractor		15.8 18.16	3.9			25.8 3.4	36.13	15.0	7.0	15	5	2.49	213.30	213.30
5. J ₂ M—Two crop—irrigated lowland type, using nonmechanized type of tech. 2nd season Man Labor Animal Labor		57.0 13.27				28.6 10.5	20.0	15.0	7.0	4	2	1.98	187.62	187.62
6. J ₂ Y—Two crop—irrigated lowland type, using wheel tractor 2nd season Man Labor Animal Labor Wheel Tractor		23.0 18.16				28.7 6.8 0.7	52.0	15.0	7.0	15	5	2.58	216.96	216.96
7. I ₁ H—One crop—irrigated lowland, using hand tractor Man Labor Animal Labor Hand Tractor			25.8 3.9 3.4	15.8 3.9 3.4	15.14		24.09	15.0	7.0	15	5	2.26	198.84	198.84
8. I ₁ M—One crop—irrigated lowland type of land, nonmechanized type of technology Man Labor Animal Labor			31.9 13.9	15.6 13.9	10.52		14.0	14.0	7.0	6	2	1.57	171.12	171.12
9. I ₁ Y—One crop—irrigated lowland type of land, using traditional type Man Labor Animal Labor			33.2 17.5	20.3 17.5	10.39		15.4	11.0	5.0	2	1	1.55	170.34	170.34
10. R ₁ Y—Nonirrigated lowland type, using wheel tractor Man Labor Animal Labor Wheel Tractor			28.1 14.7 0.7	15.2 14.7 0.7	12.06		20.0	13.0	5.0	15	5	1.80	180.32	180.32
11. R ₁ M—Nonirrigated lowland type, using nonmechanized type of technology Man Labor Animal Labor			33.2 17.5	20.3 17.5	10.38		15.4	11.0	5.0	2	1	1.55	170.28	170.28
12. U ₁ M—First class upland type, using nonmechanized type of technology Man Labor Animal Labor			36.7 21.5	35.9 21.5	5.96		12.7			3		0.98	99.76	99.76
13. V ₁ M—Second class upland type nonmechanized type of technology Man Labor Animal Labor			36.7 21.5	35.9 21.5	5.56		12.4			3		0.91	97.36	97.36

Table A-2. Far Hectare Input-Output Requirements of Corn, by Different Types of Observed Technology, Philippines, 1969 to 1972

Technology	Labor Tables by Periods (in man/machine days)						Fertilizer by Nutrients (in kilogram)			Chemicals (in pesos)		Yield (metric tons)	Short-Term Capital (in pesos)	Objective Function (in pesos)
	1	2	3	4	5	6	N	P	K	Insecticides	Weedicides			
1. J ₂ Y—Two crop—irrigated lowland type, using wheel tractor 2nd season Man Labor Wheel Tractor Animal Labor	23.86				16.90 5.20 .70		70	20		10		1.79	113.87	113.87
2. J ₂ Y—Two crop—irrigated lowland type, using traditional type of technology 2nd season Man Labor Animal Labor	11.46				25.90 15.20		30			4		0.86	68.78	68.78
3. J ₂ Y—One crop—irrigated lowland type, using wheel tractor 2nd season Man Labor Animal Labor					16.90 20.80 5.20 0.70		70	20		10		1.56	95.47	95.47
4. J ₂ Y—One crop—irrigated lowland type, using nonmechanized type of technology 2nd season Man Labor Animal Labor					26.90 21.28 15.20		70	20		10		1.60	127.65	127.65
5. J ₂ Y—One crop—irrigated lowland type, using traditional type of technology Man Labor Animal Labor					25.90 13.16 15.20		20			4		1.40	158.16	158.16
6. P ₁ Y—Nonirrigated lowland type, using nonmechanized type of technology 1st season Man Labor Animal Labor	15.18 7.91	6.33 .93	11.00		1.16 .84		5	2.2	2.2			1.17	148.21	148.21
7. P ₂ Y—Nonirrigated lowland type, using nonmechanized type of technology 2nd season Man Labor Animal Labor			9.05 4.19	8.38 1.74	6.11 1.08		1					.65	84.12	84.12
8. P ₁ Y—Nonirrigated lowland type, using tractor 1st season Man Labor Animal Labor	5.88 .84	12.78 .07			14.45 6.09		9.3	2.4	1.8	8		1.36	114.76	114.76
9. P ₂ Y—Nonirrigated lowland type, using wheel tractor 2nd season Man Labor Animal Labor			28.14 9.47	10.07 .03 .59	10.72		9	1	.4			1.14	107.37	107.37
10. V ₁ Y—Second class upland type, using nonmechanized type of technology 1st season Man Labor Animal Labor			16.24 15.05	6.33 2.38	6.02		1.4	1.4	1.4			.64	69.63	69.63
11. V ₂ Y—Second class upland type, using nonmechanized type of technology 2nd season Man Labor Animal Labor		5.26			22.77 12.24		1					.56	55.56	55.56
12. U ₁ Y—First class upland type, using nonmechanized type of technology 1st season Man Labor Animal Labor			25.85 8.57	13.57 3.65	7.61 1.71		7	8.6				.81	81.23	81.23
13. U ₂ Y—First class upland type, using nonmechanized type of technology 2nd season Man Labor Animal Labor			25.85 8.57	13.57 3.65	6.77 1.71		1					.72	76.19	76.19

Table A-3. Per Hectare Input-Output Requirements of Sugar, by Different Types of Observed Technology, Philippines, 1969 to 1972

Technology	Labor Tables by Periods (in man/machine days)						Fertilizer by Nutrients (in kilograms)			Chemicals (in pesos) Insecticides Weedicides	Yield (metric tons)	Short-Term Capital (in pesos)	Objective Function (in pesos)
	1	2	3	4	5	6	N	P	K				
1. I.Y—One crop—irrigated lowland type, using wheel tractor Man Labor Animal Labor Wheel Tractor	28.70	21.30	21.30			74.40 6.00 6.00	120	60	60	250	80.00	652.00	652.00
2. I.M—One crop—irrigated lowland type, using nonmechanized type of technology Man Labor Animal Labor	1.67	0.80											
3. R.Y—Nonirrigated lowland type, using wheel tractor Man Labor Animal Labor Wheel Tractor	30.00 13.00	25.20 3.00	25.20 3.00			66.96 3.00	90	60	60	150	72.00	573.00	573.00
4. R.M—Nonirrigated lowland type, using nonmechanized type of technology Man Labor Animal Labor	48.36 5.00	27.50 1.51	20.00 .80				120	60	60	208	52.00	533.00	533.00
5. U.Y—First class upland type, using wheel tractor Man Labor Animal Labor Wheel Tractor	44.64 3.00	25.00 13.00	26.00 12.00				90	30	60	125	48.00	505.00	505.00
6. V.Y—Second class upland type, using wheel tractor Man Labor Animal Labor Wheel Tractor	46.50 1.33	28.30 .70	22.50 22.50				90	60	60	170	50.00	353.00	353.00
	50.21	28.30	22.50	22.50							54.00	353.00	353.00
		1.53	.81										

Table A-4. Per Hectare Input-Output Requirements of Coconut, by Different Types of Observed Technology, Philippines, 1969 to 1972

Technology	Labor Tables by Periods (in man/machine days)						Fertilizer by Nutrients (in kilograms)			Chemicals (in pesos) Insecticides Weedicides	Yield (metric tons)	Short-Term Capital (in pesos)	Objective Function (in pesos)
	1	2	3	4	5	6	N	P	K				
1. I.N—One crop—irrigated lowland type, using nonmechanized type of technology Man Labor Animal Labor	6.30	4.70	6.30	4.70	6.30	4.70 1.00					3,800.00	170.00	170.00
2. R.M—Nonirrigated lowland type, using nonmechanized type of technology Man Labor Animal Labor	6.30	5.60	6.30	5.60	6.60	5.60 1.00					4,200.00	192.00	192.00
3. U.M—First class upland type, using nonmechanized type of technology Man Labor Animal Labor	6.30	6.00	6.30	6.00	6.30	6.00 1.00					4,000.00	215.00	215.00
4. V.M—Second class upland type, using nonmechanized type of technology Man Labor Animal Labor	6.30	5.10	6.30	5.10	6.30	5.10 1.00					3,510.00	235.00	235.00

Table A-5. Input-Output Coefficients of Hog Production by Type of Operation, Philippines, 1972

Technology	Units	Labor Input (million man days)						Veterinary Medicine (P1,000)	Feed Requirements (1,000 m.t.)	Short-Term Capital (P1,000)	Objective Function (P1,000)	Pork Production (1,000 m.t. dressed weight)	Weaners (1,000 heads)
		1	2	3	4	5	6						
1. Small backyard hog	3,000 heads	.00750	.00750	.00750	.00750	.00750	.00750	—	.49	40.0	40.0	.110	—
2. Commercial hog production	10,000 heads	.00150	.00150	.00150	.00150	.00150	.00150	36.0	3.00	612.0	1,276.0	.486	2.16
3. Semicommercial hogs	27,000 heads	.01913	.01913	.01913	.01913	.01913	.01913	185.0	2.21	780.0	3,123.0	.820	6.00

Table A-6. Input-Output Coefficients of Poultry Production by Type of Operation, Philippines, 1972

Technology	Units	Labor Input (million man days)						Veterinary Medicine (P1,000)	Feed Requirements (1,000 m.t.)	Short-Term Capital (P1,000)	Objective Function (P1,000)	Broilers (1,000 m.t. dressed weight)	Eggs (1,000 m.t.)
		1	2	3	4	5	6						
1. Small backyard layer	16,000 birds	.001	.001	.001	.001	.001	.001	—	.015	—	—	.007	.018
2. Commercial layer	10,000 birds	.0015	.0015	.0015	.0015	.0015	.0015	6.8	.428	79.23	189.7	.0063	.062
3. Commercial broilers	10,000 birds	.000075	.000075	.000075	.000075	.000075	.000075	5.2	.144	43.85	113.2	.03458	—

APPENDIX B

Table B-1. National Demand Segments for Rice (NDMDRC), MAAGAP, 1972 Base

Description	Units	Segments											
		1	2	3	4	5	6	7	8	9	10	11	12
Quantity of rice	1,000 m.t.	2493.80	2763.00	3032.10	3301.20	3570.30	3839.50	4108.60	4377.70	4646.90	4916.00	5185.10	5454.20
OBJ COM	million ₱	16683.20	17122.80	17488.10	17796.80	18061.20	18290.40	18491.00	18668.20	18825.90	18967.20	19094.60	20125.80
OBJ MONO	million ₱	4488.90	4096.00	3769.40	3493.50	3257.10	3052.20	2872.90	2714.40	2573.50	2447.19	2333.32	—
Mid Point Price (PWRC)	₱/kg.	6.69	1.63	1.35	1.15	0.98	0.85	0.75	0.66	0.59	0.52	0.47	0.43
Segment Price (PRRC)	₱/kg.	1.79	1.48	1.24	1.05	0.91	0.79	0.69	0.62	0.55	0.49	0.45	—

Given: $Q_0 = 3596.0$ metric tons
 $P_0 = .94$ per kilogram
 $\alpha = -.528$

Table B-2. National Demand Segments for Corn (NDMDCT), MAAGAP, 1972 Base

Description	Units	Segments											
		1	2	3	4	5	6	7	8	9	10	11	12
Quantity of corn grits	1,000 m.t.	456.95	570.37	683.79	797.22	910.64	1024.07	1137.40	1250.90	1364.30	1477.70	1591.19	4347.35
OBJ COM	million ₱	1381.89	1522.00	1634.00	1727.10	1806.60	1875.66	1936.70	1991.40	2040.80	2085.80	2127.21	2609.54
OBJ MONO	million ₱	639.75	624.16	611.71	601.36	592.54	584.86	578.08	572.00	566.51	561.51	556.91	—
Mid Point Price (PWCT)	₱/kg.	3.02	1.22	0.98	0.81	0.69	0.60	0.53	0.48	0.43	0.39	0.36	0.17
Segment Price (PRCT)	₱/kg.	1.40	1.09	0.89	0.75	0.65	0.57	0.50	0.45	0.41	0.37	0.35	—

Given: $Q_0 = 852.7$ metric tons
 $P_0 = .70$ per kilogram
 $\alpha = -.90$

Table B-3. National Demand Segments for Sugar (NDMSG), MAAGAP, 1972 Base

Description	Units	Segments											
		1	2	3	4	5	6	7	8	9	10	11	12
Quantity of sugar	1,000 m.t.	523.28	542.06	560.84	579.62	598.40	617.18	635.96	654.73	673.51	692.29	711.07	729.85
OBJ COMP	million ₱	3683.40	3708.80	3730.82	3749.90	3766.60	3781.30	3794.20	3805.60	3815.80	3824.80	3832.80	3840.10
OBJ NONG	million ₱	761.90	681.42	611.75	551.16	498.23	451.79	410.88	374.71	342.61	314.04	288.52	265.66
Midpoint Price (PMSC)	₱/kg.	26.14	1.35	1.17	1.01	0.88	0.78	0.68	0.60	0.53	0.48	0.42	0.38
Segment Price (PRSC)	₱/kg.	1.45	1.25	1.09	0.95	0.83	0.73	0.64	0.57	0.50	0.45	0.40	0.36

Given: $Q_0 = 618$ metric tons
 $P_0 = .728$ per kilogram
 $\alpha_0 = -.24$

Table B-4. National Demand Segments for Copra (NDMDCA), MAAGAP, 1972 Base

Description	Units	Segments											
		1	2	3	4	5	6	7	8	9	10	11	12
Quantity of copra	1,000 m.t.	272.76	276.51	280.26	284.02	287.77	291.52	295.28	299.03	302.78	306.54	310.29	314.04
OBJ COMP	million ₱	4104.00	4112.00	4119.00	4125.00	4130.00	4135.00	4139.00	4142.00	4145.00	4148.00	4150.00	4152.00
OBJ NONG	million ₱	628.33	549.92	482.16	423.49	372.60	328.36	289.85	256.25	226.90	201.21	178.69	158.92
Midpoint Price (PMCA)	₱/kg.	6114.70	3.29	2.84	1.45	2.15	1.85	1.61	1.41	1.23	1.07	0.94	0.83
Segment Price (PRCA)	₱/kg.	3.54	3.05	2.64	2.29	1.99	1.73	1.51	1.31	1.15	1.01	0.88	0.77

Given: $Q_0 = 189.1$ metric tons
 $P_0 = 1.77$ per kilogram
 $\alpha_0 = -.093$

Table B-5. National Demand Segments for Pork (NDMPK), MAAGAP, 1972 Base

Description	Units	Segments											
		1	2	3	4	5	6	7	8	9	10	11	12
Quantity of pork	1,000 m.t.	218.75	243.37	268.99	294.11	319.23	344.35	369.47	394.59	419.71	444.83	469.95	907.67
OBJ COMP	million ₱	8823.40	9084.70	9301.30	9484.10	9640.60	9776.30	9895.10	10000.20	10093.80	10177.70	10253.50	10881.60
OBJ MGO	million ₱	2511.30	2298.90	2122.80	1974.20	1846.90	1736.60	1640.00	1554.60	1478.60	1410.30	1348.70	—
Midpoint Price (PMPK)	₱/kg.	40.33	10.37	8.60	7.26	6.22	5.39	4.72	4.17	3.72	3.34	3.01	1.43
Segment Price (PRPK)	₱/kg.	11.48	9.43	7.89	6.71	5.79	5.04	4.44	3.94	3.52	3.17	2.87	—

Given: $Q = 320.62$ metric tons
 $P_0 = 5.74$ per kilogram
 $\alpha = -.5516$

Table B-6. National Demand Segments for Poultry Meat (NDMPB), MAAGAP, 1972 Base

Description	Units	Segments											
		1	2	3	4	5	6	7	8	9	10	11	12
Quantity of poultry meat	1,000 m.t.	28.00	30.70	33.30	36.00	38.60	41.30	43.90	46.60	49.20	51.90	54.50	97.60
OBJ COMP	million ₱	1188.00	1212.50	1232.30	1249.40	1264.00	1276.70	1287.80	1297.50	1306.20	1314.00	1320.90	1374.80
OBJ MGO	million ₱	280.33	254.20	232.20	215.90	198.00	184.30	172.30	161.70	152.30	143.90	136.30	—
Midpoint Price (PMPR)	₱/kg.	42.37	9.08	7.58	6.42	5.51	4.77	4.18	3.68	3.27	2.92	2.63	1.24
Segment Price (PRBR)	₱/kg.	9.99	8.28	6.97	5.94	5.12	4.46	3.92	3.47	3.09	2.77	2.50	—

Given: $Q = 42.4$ metric tons
 $P_0 = 5.0$ per kilogram
 $\alpha = -.4819$

Table B-7. National Demand Segments for Eggs (NUMDEG), MAAQAP, 1972 Base

Description	Units	Segments										
		1	2	3	4	5	6	7	8	9	10	11
Quantity of eggs	1,000 m.t.	56.50	62.10	67.70	73.40	79.00	84.70	90.40	96.00	101.60	107.30	112.90
QBJ COMP	million ₱	3198.40	3271.10	3331.70	3382.90	3426.90	3464.90	3498.30	3527.70	3553.80	3577.20	3598.20
QBJ WONO	million ₱	799.60	726.90	666.30	615.10	571.10	533.10	499.70	470.40	444.20	420.80	399.80
Midpoint Price (PMEG)	₱/kg.	56.64	12.84	10.70	9.06	7.76	6.73	5.89	5.20	4.62	4.13	3.72
Segment Price (PREG)	₱/kg.	14.16	11.70	9.83	8.37	7.22	6.29	5.53	4.89	4.37	3.92	3.54

Given $Q_0 = 79.9$ metric tons
 $P_0^U = 7.0$ per kilogram
 $Q_0^U = -.4819$

APPENDIX C

Table C-1. MAAGAP Model Solutions in Real Terms (1972=100) after Changing the Base to 1974

Description	Units	MAAGAP Solutions			Percent Change
		1972 Base	1974 Base	Difference	
I. Shadow Price					
Crops:					
Palay	Pesos/ton	551.95	744.32	192.37	34.85
Corn	Pesos/ton	384.41	403.37	18.96	4.93
Sugarcane	Pesos/ton	72.19	74.91	2.72	3.77
Coconuts	Pesos/nut	0.12	0.29	0.17	141.67
Intermediate products:					
Rice bran	Pesos/ton	946.48	1,056.97	110.49	11.67
Corn bran	Pesos/ton	1,009.30	1,056.97	47.67	4.72
Rice brokens	Pesos/ton	384.41	403.37	18.96	4.93
Final products:					
Rice sales	Pesos/ton	1,631.41	2,600.16	968.75	59.38
Domestic	Pesos/ton	851.41	1,147.16	295.75	34.74
Imports	Pesos/ton	780.00	1,453.00	673.00	86.28
Corn grits sales	Pesos/ton	481.94	481.94	--	--
Copra	Pesos/ton	1,700.00	3,301.40	1,601.40	94.20
Export	Pesos/ton	850.00	1,650.70	800.70	94.20
Domestic (sales)	Pesos/ton	850.00	1,650.70	800.70	94.20
Sugar	Pesos/ton	1,968.00	2,084.00	116.00	5.89
Export	Pesos/ton	984.00	1,042.00	58.00	5.89
Domestic	Pesos/ton	984.00	1,042.00	58.00	5.89
Pork	Pesos/ton	5,555.79	7,248.20	1,692.41	30.46
Poultry	Pesos/ton	5,293.41	7,218.79	1,925.38	36.37
Eggs	Pesos/ton	5,488.53	7,144.61	1,656.08	30.17

Table C-1 (continued)

Description	Units	MAAGAP Solutions			Percent Change
		1972 Base	1974 Base	Difference	
Others:					
Fertilizer (total)	Pesos/ton	4,640 ^a	17,030.00 ^a	12,390.00	267.03
Food	Pesos/ton	--	5,710.00	5,710.00	--
Export	Pesos/ton	--	11,320.00	11,320.00	--
Corn grain imports	Pesos/ton	--	--	--	--
II. Levels					
Area:					
Palay	1,000 has.	3,147.4	3,500.0	352.60	11.20
Corn	1,000 has.	2,414.0	2,770.0	356.00	14.75
Sugarcane	1,000 has.	360.0	466.7	107.70	29.64
Coconuts	1,000 has.	2,020.0	2,206.0	186.00	9.21
Crops:					
Palay	1,000 m.t.	5,568	5,718	150.00	2.69
Corn	1,000 m.t.	1,871	1,967	96.00	5.13
Sugarcane	1,000 m.t.	18,582	21,139	2,557.00	13.76
Coconuts	million nuts	8,080	8,824	744.00	9.21
Intermediate products:					
Rice bran	1,000 m.t.	1,051.565	1,164.813	113.248	10.77
Corn bran	1,000 m.t.	386.323	390.664	4.341	1.12
Rice brokens	1,000 m.t.	18.059	12.521	(5.538)	(30.67)
Final products:					
Rice sales	1,000 m.t.	3,652	3,411	(241.00)	(6.60)
Domestic	1,000 m.t.	3,327	3,411	84.00	(2.52)
Imports	1,000 m.t.	325	--	(325.00)	--

Table C-1 (continued)

Description	Units	MAAGAP Solutions				Percent Change
		1972 Base	1974 Base	Difference		
Corn grits sales	1,000 m.t.	1,249	1,263	14.00		1.12
Copra	1,000 m.t.	2,936.7	3,201.9	265.20		9.03
Export	1,000 m.t.	1,320.7	1,436.9	116.20		8.80
Domestic (sales)	1,000 m.t.	1,616	1,765	149.00		9.22
Sugar	1,000 m.t.	2,876.5	3,270.1	393.60		13.68
Export	1,000 m.t.	1,148.5	1,304.1	155.60		13.55
Domestic	1,000 m.t.	1,728	1,966	238.00		13.77
Pork	1,000 m.t.	319	341	22.00		6.90
Poultry	1,000 m.t.	39	37	(2.00)		(5.13)
Eggs	1,000 m.t.	90	86	(4.00)		(4.44)
Others:						
Fertilizer (total)	1,000 m.t.	531.86 ^b	445.50 ^b	(86.36)		(16.24)
Food	1,000 m.t.	--	307.57	307.57		--
Export	1,000 m.t.	--	137.93	137.93		--
Corn grain imports	1,000 m.t.	--	--	--		--
Social benefit:						
Objective function	million pesos	41,270	46,895	5,625		13.6
CS	million pesos	35,299	37,907	2,608		7.4
PS	million pesos	5,971	8,988	3,017		50.5

^a Total for fertilizer by nutrients (pesos/kg.) converted to pesos/ton.^b Total for fertilizer by types.

Table C-2. NAAGAP Model Results after Varying Simultaneously the Input Cost of Fertilizer for Both Export and Food Crop Subsectors from the 1972 Base^a

Description	Units	NAAGAP 1972 Base	MAAGAP Solutions at Different Levels of Theta ^b											
			Percent Increase or (Decrease) from the 1972 Base											
			0	2	3	4	5	6	7	8	9	10	11	
I. Shadow Prices														
A. Primary Products														
Palay	Pesos/m.t.	551.9	(.53)	--	--	--	--	--	.75	3.4	6.0	8.7	11.1	11.2
Corn grain	Pesos/m.t.	384.4	(6.4)	--	--	--	--	--	.11	0.5	.89	1.2	1.6	1.8
Sugarcane	Pesos/m.t. (cane)	72.2	--	--	--	--	--	--	--	--	--	--	--	--
Coconuts	Pesos/nut	0.12	--	--	--	--	--	--	--	--	--	--	--	--
Hogs	Pesos/head	73.50	(2.8)	--	--	--	--	--	(.21)	(1.2)	(2.0)	(3.0)	(3.7)	(4.2)
Chicken	Pesos/head	8.00	(1.2)	--	--	--	--	--	--	--	--	--	--	--
B. Intermediate Products														
Rice brokens	Pesos/m.t.	384.4	(6.4)	--	--	--	--	--	.11	0.5	.89	1.3	1.6	1.8
Rice bran (cono)	Pesos/m.t.	384.4	(6.4)	--	--	--	--	--	.11	0.5	.89	1.3	1.6	1.8
Rice bran (kiskisan)	Pesos/m.t.	562.1	(2.3)	--	--	--	--	--	.34	1.6	2.8	4.0	5.1	5.6
Corn bran (kiskisan)	Pesos/m.t.	562.1	(2.3)	--	--	--	--	--	.34	1.6	2.8	4.0	5.1	5.6
Corn bran (cono)	Pesos/m.t.	447.2	(4.3)	--	--	--	--	--	.29	1.3	3.4	3.4	4.3	4.8
C. Finished Products														
Rice	Pesos/m.t.	851.4	--	--	--	--	--	--	.74	3.4	6.0	8.6	11.0	12.1
Corn grits	Pesos/m.t.	481.9	(6.3)	--	--	--	--	--	--	--	--	--	--	--
Sugar	Pesos/m.t.	984.0	--	--	--	--	--	--	--	--	--	--	--	--
Copra	Pesos/m.t.	850.0	--	--	--	--	--	--	--	--	--	--	--	--
Poultry (dressed wt.)	Pesos/m.t.	5,293.4	(1.2)	--	--	--	--	--	.02	.09	.16	.23	0.3	.33
Pork (dressed wt.)	Pesos/m.t.	5,555.8	(2.3)	--	--	--	--	--	.04	.17	.30	.43	.55	.61
Eggs	Pesos/m.t.	5,488.5	(1.7)	--	--	--	--	--	.03	.14	.24	.35	.45	.49

Table C-2 (continued)

Description	Units	MAAGAP 1972 Base	MAAGAP Solutions at Different Levels of Theta ^b											
			Percent Increase or (Decrease) from the 1972 Base											
			0	2	3	4	5	6	7	8	9	10	11	
D. Inputs														
1. Hand tractor services														
	Pesos/day	--	--	--	--	--	--	--	--	--	--	--	--	--
	Pesos/day	--	--	--	--	--	--	--	--	--	--	--	--	--
	Pesos/day	94.0	(.64)	1.49	1.38	--	--	2.87	(3.5)	(1.9)	(.32)	(1.3)	(2.9)	(2.3)
	Pesos/day	--	--	--	--	--	--	--	--	--	--	--	--	--
	Pesos/day	--	--	--	--	--	--	--	--	--	--	--	--	--
	Pesos/day	63.30	1.90	1.90	1.11	(2.05)	(5.2)	(8.2)	(10.4)	(9.8)	--	--	(8.1)	(8.2)
2. Four wheel tractor services														
	Pesos/day	--	--	--	--	--	--	--	--	--	--	--	--	--
	Pesos/day	312.2	6.0	(11.8)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)
	Pesos/day	312.2	6.0	(11.8)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)
	Pesos/day	312.2	6.0	(11.8)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)
	Pesos/day	312.2	6.0	(11.8)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)	(17.1)
	Pesos/day	325.9	1.56	.98	2.53	(3.52)	(13.4)	(18.1)	(20.6)	(20.6)	(20.6)	(20.6)	(20.6)	(20.6)
3. Fertilizer nutrients														
	Pesos/kg.	1.50	(14.0)	8.0	22.7	44.0	64.7	85.3	106.0	126.7	147.3	168.0	188.7	209.3
	Phosphorous	2.00	(13.5)	7.0	21.0	41.5	61.5	81.5	101.5	121.5	141.5	161.5	181.5	201.5
	Potassium	1.14	(11.4)	7.0	20.2	39.5	58.8	72.2	96.5	114.9	134.2	153.5	171.9	191.2

Table C-2 (continued)

Description	Units	NAAGAP 1972 Base	NAAGAP Solutions at Different Levels of Theta ^b											
			Percent Increase or (Decrease) from the 1972 Base											
			0	1	2	3	4	5	6	7	8	9	10	11
III. Activity Levels														
A. Primary Production														
Palay	1,000 m.t.	5,568	(.84)	--	--	--	--	(.09)	(.56)	(2.17)	(2.21)	(2.08)	(2.68)	(2.68)
Corn grain	1,000 m.t.	1,871	3.26	--	--	--	--	(1.55)	(1.55)	(1.60)	(1.82)	(1.76)	(2.35)	(2.35)
Sugarcane	1,000 m.t.	18,582	--	--	--	--	--	(.55)	(1.55)	(.55)	(2.69)	(3.70)	(6.89)	(6.89)
Coconuts	million nuts	8,080	--	--	--	--	--	--	--	--	--	--	--	--
B. Processing														
Palay (cono)	1,000 m.t.	1,805.9	(2.49)	--	--	--	--	(1.75)	(1.75)	(2.07)	(3.78)	(9.61)	(8.85)	(22.62)
Palay (kispisan)	1,000 m.t.	3,708.4	(.05)	--	--	--	--	.88	.88	.99	1.41	1.00	8.74	8.74
Corn (cono)	1,000 m.t.	--	--	--	--	--	--	--	--	--	--	--	--	--
Corn (kiskisan)	1,000 m.t.	1,753.6	.12	--	--	--	--	(1.88)	(1.88)	(1.92)	(2.18)	(3.11)	(2.2)	(4.69)
Sugar milling	1,000 m.t.	--	--	--	--	--	--	--	--	--	--	--	--	--
Copra making	million nuts	18,582.4	--	--	--	--	--	(.55)	(.55)	(.55)	(2.70)	(3.7)	(3.7)	(6.89)
C. Finished Products														
Rice	million m.t.	3,327	(.90)	--	--	--	--	--	--	--	--	--	--	--
Corn grits	million m.t.	1,249	.16	--	--	--	--	(1.60)	(1.60)	(1.92)	(2.16)	(3.04)	(2.16)	(2.46)
Sugar	million m.t.	1,728	--	--	--	--	--	(.58)	(.58)	(.52)	(2.66)	(3.7)	(3.7)	(6.89)
Copra	million m.t.	1,616	--	--	--	--	--	--	--	--	--	--	--	--
D. Import-Export														
Corn grain import	1,000 m.t.	--	--	--	--	--	--	--	--	--	--	--	--	--
Copra export	1,000 m.t.	1.32	--	--	--	--	--	--	--	--	--	--	--	--
Sugar export	1,000 m.t.	1.15	--	--	--	--	--	(.87)	(.87)	(.87)	(4.35)	(6.09)	(6.09)	(10.43)
Rice import	1,000 m.t.	.32	--	--	--	--	--	(3.13)	(.87)	(.87)	(.87)	(.87)	(.87)	(.87)

Table C-2 (continued)

Description	Units	MAAGAP 1972 Base	MAAGAP Solutions at Different Levels of Theta ^b											
			0	2	3	4	5	6	7	8	9	10	11	12
			-----Percent Increase or Decrease from the 1972 Base-----											
7. Four wheel tractor	1,000 tractor days	312.3	(4.3)	--	.20	--	--	--	(37.0)	(39.6)	(50.9)	(56.2)	(49.9)	(15.9)
8. Animal labor	million mandays	104.3	.42	--	--	--	(11.8)	(11.8)	2.04	(12.2)	(4.8)	(52.4)	(12.0)	(12.5)
F. Social Benefit														
ORJ	million pesos	41,270	.17	.17	.15	.15	.15	.09	.05	.02	--	.07	(.68)	(.14)
CS	million pesos	35,299	.54	.32	.28	.28	.25	.28	.22	.22	(.25)	(.99)	(.70)	(.81)
PS	million pesos	5,971	(2.0)	(.71)	(.62)	(.62)	(.43)	(1.04)	(.97)	(1.14)	(1.50)	2.89	3.61	3..

^aThe 1972 base prices of fertilizer for both the food and export crop subsectors were: P.55/kg. for urea; P.52/kg. for ammonios; and P.53/kg. for complete.

^bEach level of theta represents a 25 percent change in the price of fertilizer from the 1972 base. The parametric program started with theta = 0, which was 25 percent lower than the prices of fertilizer in the 1972 base. Thus, theta = 1 was the same as the 1972 base prices for all the three types of fertilizer; theta = 2, 25 percent higher than the 1972 base; . . . theta = 12, means that the fertilizer prices were varied 300 percent higher than the 1972 base.

Table C-3 (continued)

MAAGAP Solutions at Different Levels of Theta ^b												
Description	Unit	1974 Base										
		1	2	3	4	5	6	7	8	9	10	
-----Percent Increase or (Decrease) from the 1974 Base-----												
5. Sugar capacity constraints												
Irrigated land Pesos/ha.		43.8	---	---	---	.46	.68	.68	.91	.91	1.1	1.4
Rainfed "	"	37.9	.26	.26	.53	.79	1.06	1.3	1.6	1.8	2.1	2.4
First class upland	"	18.9	---	---	---	---	.53	.53	.53	.53	.53	.53
Second class upland	"	17.4	---	---	---	---	---	---	---	---	.57	.57
6. Fertilizer nutrients												
Nitrogen Pesos/kg.		1.9	1.5	21.1	31.7	42.2	52.8	63.3	73.9	83.9	94.5	105.0
Phosphorous "	"	2.27	2.6	5.3	7.5	10.1	12.8	15.4	17.6	20.3	22.9	25.6
Potassium "	"	1.45	13.1	1.6	40.0	53.1	66.2	79.3	92.4	105.5	118.6	131.7
II. Activity Levels												
1. Primary production												
Palay	1,000 m.t.	5,718	---	---	---	---	---	---	(.09)	(.09)	(.24)	(.24)
2. Processing												
Palay (cono)	1,000 m.t.	1,252.08	---	---	---	---	---	---	(.42)	(.42)	(1.24)	(1.24)
" (kiskisan)	"	4,465.58	---	---	---	---	---	---	.01	.01	.04	.04
Corn "	"	1,773.3	---	---	---	---	---	---	(.04)	(.04)	(.10)	(.10)
3. Finished products												
Copra	million m.t.	1.76	---	---	---	---	---	---	.57	.57	---	---
Eggs	"	.087	---	---	---	---	---	---	1.15	1.15	---	---
4. Capital												
Food crops	million pesos	888.3	---	---	---	.45	.45	.45	.27	.27	(.50)	(.50)

Table C-3 (continued)

MAAGAP												
Description	Unit	1974 Base	MAAGAP Solutions at Different Levels of Theta ^b									
			1	2	3	4	5	6	7	8	9	10
			-----Percent Increase or (Decrease) from the 1974 Base-----									
5. Fertilizer (food crops)												
(By type)												
Urea (45-0-0)	1,000 m.t.	86.4	---	---	---	---	---	(2.5)	(2.5)	(6.9)	(6.9)	(6.9)
Ammophos (16-20-0)	"	87.6	---	---	---	---	---	---	---	---	---	---
Complete (14-14-14)	"	133.6	---	---	---	---	---	---	---	---	---	---
(By Nutrients)												
Nitrogen	1,000 m.t.	88.08	---	---	---	---	---	(1.1)	(1.1)	(3.0)	(3.0)	(3.0)
Phosphorous	"	53.2	---	---	---	---	---	---	---	---	---	---
Potassium	"	46.7	---	---	---	---	---	---	---	---	---	---
6. Net social benefit												
OBJ	mil. pesos	46,895	---	---	---	---	---	---	---	(.01)	(.01)	(.01)
CS	"	37,907	---	---	---	.21	.21	.21	.02	.02	(.07)	(.07)
PS	"	8,988	---	---	---	(.90)	(.90)	(.90)	(.10)	(.10)	.25	.25

^aThe 1974 base prices of fertilizer in real terms for the food crop subsector were: urea, ₱0.65/kg; ammophos, ₱0.56/kg; and complete, ₱0.58/kg. In the same manner, the prices in the export crop subsector were ₱1.59/kg; ₱1.01/kg.; and ₱1.22/kg., respectively, for urea, ammophos and complete fertilizer. The procedure taken here was to vary the fertilizer prices in the food crop subsector, upward from the 1974 base, until they are equal with the fertilizer prices in the export crop subsector.

^bTheta here refers to the percent change in the prices of fertilizer in the food crop subsector as they were increased from the 1974 base. Theta = 1 means that food subsector price of urea was increased from the 1974 base by 14 percent; ammophos, 8 percent; and complete, 11 percent. Theta = 2 means that the price of urea was increased from the 1974 base by 28 percent; ammophos, 16 percent; and complete, 22 percent. At the tenth segment (Theta = 10) the price of urea was raised to 140 percent from the base; ammophos, 80 percent; and complete, 110 percent; to approximate the fertilizer prices of the export subsector.

Table C-4. Changes in the MAAGAP Model Solutions in Real Terms (1972=100) after Uniformly Subsidizing the Input Cost of Fertilizer for both Food and Export Crop Subsectors, by Different Levels of Subsidy, with 4 Percent Tax and without Tax to the Product Prices of the Export Crops

Description	Units	1974 MAAGAP Base	MAAGAP Solutions at Different Levels of Subsidy with Tax and without Tax																			
			100% Subsidy		96% Subsidy		92% Subsidy		88-80% Subsidy		76-72% Subsidy		68-60% Subsidy		56-28% Subsidy		24-16% Subsidy		12-9% Subsidy		No Subsidy	
			Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed
Percent Increase or (Decrease) from the 1974 Base																						
I. Shadow prices																						
A. Primary products -																						
Palay	pesos per m.t.	744.32	(.60)	(.60)	(.60)	(.60)	(.60)	(.60)	(.60)	(.20)	(.20)	--	--	--	--	--	--	--	--	--	.24	.24
Corn grain	pesos per m.t.	403.37	(9.24)	(9.24)	(9.24)	(9.24)	(9.24)	(9.24)	(9.24)	(3.15)	(3.15)	--	--	--	--	--	--	--	--	--	.05	.05
Sugarcane	pesos per m.t. (cane)	74.91	--	(5.18)	--	(5.18)	--	(5.18)	--	(5.18)	--	(5.11)	--	(5.18)	--	(5.18)	--	(5.18)	--	(4.26)	--	(5.18)
Coconut	pesos per nut	.29	--	(3.45)	--	(3.45)	--	(3.45)	--	(3.45)	--	(3.45)	--	(3.45)	--	(3.45)	--	(3.45)	--	(3.45)	--	(3.45)
Hogs	pesos per head	131.40	(3.96)	(3.96)	(3.96)	(3.96)	(3.96)	(3.96)	(3.96)	(1.36)	(1.07)	--	2.29	--	--	--	--	--	--	--	(.08)	(.08)
Chicken	pesos per head	11.00	(1.82)	(1.82)	(1.82)	(1.82)	(1.82)	(1.82)	(1.82)	(.91)	.91	--	--	--	--	--	--	--	--	--	--	--
B. Finished products -																						
Rice	pesos per m.t.	1,147.16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.24	.24
Corn grits	pesos per m.t.	481.94	(9.61)	(9.71)	(9.61)	(9.71)	(9.61)	(9.71)	(9.61)	(9.71)	(3.27)	(3.87)	--	--	--	--	--	--	--	--	--	(4.0)
Sugar	pesos per m.t.	1,042.00	--	(4.0)	--	(4.0)	--	(4.00)	--	(4.00)	--	(4.0)	--	(4.0)	--	(4.0)	--	(4.0)	--	(4.0)	--	(4.0)
Copra	pesos per m.t.	1,650.70	--	(4.0)	--	(4.0)	--	(4.00)	--	(4.00)	--	(4.0)	--	(4.0)	--	(4.0)	--	(4.0)	--	(4.0)	--	(4.0)
Poultry meat (dressed weight)	pesos per m.t.	7,218.79	(1.29)	(2.78)	(1.29)	(2.78)	(1.29)	(2.78)	(1.29)	(2.78)	(.44)	(.68)	--	--	--	--	--	--	--	--	.01	.01
Pork (dressed weight)	pesos per m.t.	7,248.20	(3.17)	(1.69)	(3.17)	(1.69)	(3.17)	(1.69)	(3.17)	(1.69)	(1.08)	(.84)	--	--	--	--	--	--	--	--	.02	.02
Eggs	pesos per m.t.	7,144.61	(2.03)	(2.03)	(2.03)	(2.03)	(2.03)	(2.03)	(2.03)	(.69)	(.69)	--	--	--	--	--	--	--	--	--	.01	.01
C. Inputs -																						
1. Land																						
J ₁	pesos per hectare	735.50	3.22	3.22	2.81	2.81	2.41	2.41	2.0	2.00	1.10	1.10	.48	.49	(2.00)	(2.00)	(4.49)	(4.49)	(6.55)	(6.50)	(8.0)	(7.41)
J ₂	pesos per hectare	644.60	6.97	6.97	6.17	6.17	5.38	5.38	4.61	4.61	2.24	2.25	6.95	.90	(3.55)	(3.63)	(7.99)	(7.99)	(11.67)	(11.67)	(15.3)	(13.30)
I ₂	pesos per hectare	377.70	8.87	8.87	7.86	7.86	6.88	6.88	5.88	5.88	2.93	2.94	1.64	1.16	(4.66)	(4.66)	(10.51)	(10.51)	(15.39)	15.38	(21.44)	(17.66)
I ₁	pesos per hectare	180.20	11.71	11.71	6.22	6.22	1.00	1.00	(2.61)	2.61	(4.55)	(4.55)	.11	(.11)	.39	.39	.94	.94	1.33	1.33	1.66	(9.49)
R ₁	pesos per hectare	363.10	8.07	8.07	7.16	7.16	6.22	6.22	(5.32)	5.32	2.47	2.70	1.07	1.07	(4.38)	(4.38)	(9.86)	(9.86)	(14.44)	(14.43)	(19.87)	(16.58)
R ₂	pesos per hectare	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
U ₂	pesos per hectare	56.40	3.37	3.37	2.48	1.77	1.77	1.77	.089	.89	1.24	1.24	.88	.87	(3.55)	(3.55)	(7.80)	(7.80)	(8.34)	(8.33)	(10.80)	(9.75)
U ₁	pesos per hectare	39.50	(14.94)	(14.94)	(14.98)	(14.94)	(14.94)	(14.95)	(14.94)	(14.94)	(5.06)	(5.33)	--	--	--	--	--	--	--	--	--	--
V ₂	pesos per hectare	8.20	20.73	20.73	14.63	14.63	9.76	9.76	3.66	3.66	4.87	4.88	6.09	6.10	(28.12)	(21.95)	(100.0)	(50.0)	(273.0)	(13.73)	(531)	(84.15)
V ₁	pesos per hectare	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2. Hand tractor service (May-June)	pesos per day	130.40	(89.11)	8.90	(89.57)	(4.29)	(90.11)	1.07	2.61	2.61	1.23	1.23	.31	.46	(1.92)	(1.92)	(4.29)	(4.29)	(6.11)	(6.13)	(7.3)	(6.83)
3. Four-wheel tractor (November-December)	pesos per day	459.80	--	18.27	--	16.35	--	14.44	12.53	12.53	5.44	3.83	1.96	1.91	(7.66)	(7.66)	(17.22)	(17.22)	(22.01)	(23.14)	(33.5)	(25.10)
4. Fertilizer nutrients																						
a. Food crops -																						
Nitrogen	pesos per kg.	1.99	(72.36)	(72.86)	(65.33)	(65.33)	(57.79)	(57.79)	(50.75)	(50.18)	(21.61)	(21.61)	(7.50)	(7.04)	29.15	29.15	65.33	65.33	94.47	94.47	109.05	109.05
Phosphorous	pesos per kg.	2.27	(72.69)	(72.69)	(65.20)	(65.20)	(58.15)	(58.71)	(50.66)	(50.66)	(22.03)	(21.59)	(7.49)	(7.49)	29.07	29.07	65.20	65.20	94.27	94.27	108.81	108.81
Potassium	pesos per kg.	1.45	(74.41)	(72.41)	(64.83)	(64.83)	(57.93)	(57.93)	(50.34)	(50.34)	(21.38)	(21.38)	6.90	(6.90)	29.06	29.66	65.52	65.52	94.48	94.48	108.97	108.97
b. Export crops -																						
Nitrogen	pesos per kilo	4.88	(72.54)	(72.54)	(69.47)	(69.47)	(57.79)	(66.60)	(50.75)	(63.73)	(51.84)	(51.84)	(45.90)	(45.90)	(39.34)	(39.14)	(35.04)	(35.04)	(31.56)	(31.56)	(42.69)	(42.69)
Phosphorous	pesos per kilo	3.07	(72.64)	(72.64)	(67.10)	(67.10)	(58.15)	(64.80)	(50.66)	(63.52)	(60.26)	(59.87)	(58.63)	(58.63)	(41.07)	(41.37)	(20.20)	(20.20)	(3.26)	(30.84)	4.89	4.89
Potassium	pesos per kilo	3.37	(72.40)	(72.40)	(65.28)	(65.28)	(57.93)	(57.86)	(50.34)	(50.74)	(21.66)	(21.26)	(7.42)	7.42	28.78	28.78	64.99	64.99	94.06	94.07	108.61	108.61
5. Sugar capacity constraint																						
One-crop irrigated land	pesos per hectare	43.80	12.79	3.88	12.10	3.20	11.42	2.74	10.96	2.05	8.22	(.58)	6.66	(2.28)	3.20	(5.71)	(.23)	(9.13)	(2.97)	(11.87)	(4.53)	(13.24)
Rainfed land	pesos per hectare	37.90	17.68	7.39	16.36	6.07	15.30	3.95	14.25	3.96	10.03	(.26)	7.92	(2.37)	3.17	7.12	(1.58)	(11.87)	(5.55)	(15.83)	(7.98)	(17.68)
First class upland	pesos per hectare	18.90	53.97	33.33	49.74	29.10	46.56	29.93	43.39	25.93	31.22	10.58	25.40	4.76	12.17	(8.47)	(1.06)	(21.69)	(12.17)	(32.28)	(21.15)	(38.10)
Second class upland	pesos per hectare	17.40	69.49	39.66	56.90	34.48	52.87	30.46	49.43	27.01	37.36	14.94	31.61	9.20	16.67	(5.17)	2.30	(19.54)	(8.63)	(31.03)	(16.78)	(36.78)

Table C-4 (continued)

Description	Units	1974 MAAGAP Base	MAAGAP Solutions at Different Levels of Subsidy with Tax and without Tax																			
			100% Subsidy		96% Subsidy		92% Subsidy		88-80% Subsidy		76-72% Subsidy		68-60% Subsidy		56-28% Subsidy		24-16% Subsidy		12-9% Subsidy		No Subsidy	
			Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed
Percent Increase or (Decrease) from the 1974 Base																						
II. Activity levels																						
A. Primary products -																						
Palay	1,000 m.t.	5,718	.14	.14	.14	.14	.12	.12	.12	.12	.05	.02	.02	.02	--	--	.09	--	(.25)	--	(.40)	--
Corn grain	1,000 m.t.	1,967	8.64	8.64	8.64	8.64	6.86	6.86	6.86	6.86	3.91	3.91	.05	.05	--	--	--	--	--	--	--	--
Sugarcane (cane)	1,000 m.t.	21,139	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Coconuts (nuts)	million nuts	8,821	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.03	--
B. Finished products -																						
Rice	million m.t.	3.41	.59	.29	.59	.29	.59	.29	.59	.29	.29	--	--	--	--	--	--	--	--	--	(.41)	--
Corn grits	million m.t.	1.26	11.11	11.11	11.11	11.11	8.73	8.73	8.73	8.73	5.56	5.56	--	--	--	--	--	--	--	--	--	--
Sugar	million m.t.	1.97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Copra	million m.t.	1.76	--	--	--	--	--	--	--	--	--	--	--	.57	.57	--	--	--	--	--	--	--
Pork (dressed weight)	million m.t.	.34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Poultry (dressed weight)	million m.t.	.037	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Eggs	million m.t.	.087	(1.15)	--	(1.15)	--	(1.15)	(1.15)	(1.15)	(1.15)	(1.15)	(1.15)	(1.15)	--	(1.15)	--	--	--	--	(1.15)	(1.15)	(1.15)
C. Import - export -																						
Corn grain import	1,000 m.t.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Copra export	1,000 m.t.	1.44	--	(.69)	--	(.69)	--	(.69)	--	(.69)	--	(.69)	--	(.69)	--	(.69)	--	(.69)	--	(.69)	--	(.69)
Sugar export	1,000 m.t.	1.30	--	(1.54)	--	(1.54)	--	(1.54)	--	(1.54)	--	(1.54)	--	(1.54)	--	(1.54)	--	(1.54)	--	(1.54)	--	(1.54)
Rice import	1,000 m.t.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
D. Short-term capital -																						
Crops -																						
Food crop	million pesos	888.34	7.58	7.58	7.58	7.58	5.53	5.52	5.52	5.52	3.04	3.03	.03	.49	.01	.01	(.17)	.01	(.03)	(.48)	(.58)	(.54)
Export crop	million pesos	904.48	1.87	1.87	1.81	1.81	2.57	2.57	1.23	1.26	1.17	1.17	(.84)	1.17	1.07	1.07	2.91	1.07	1.07	1.07	1.07	1.07
Livestock	million pesos	86.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Milling	million pesos	1,500.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
E. Fertilizer by types -																						
1. Food crops																						
Urea (45-0-0)	1,000 m.t.	86.40	42.66	15.56	42.66	15.87	15.43	15.43	15.43	15.43	7.02	7.0	(.03)	(.43)	(.01)	.01	(2.53)	(.01)	(6.89)	(6.89)	(7.92)	(7.34)
Ammophos (16-20-0)	1,000 m.t.	87.62	50.48	50.48	50.48	50.48	50.35	50.35	50.35	50.35	32.98	28.64	.06	.06	.02	.02	.02	.02	.02	.02	(.06)	.06
Complete (14-14-14)	1,000 m.t.	133.55	.13	.13	.13	.13	.09	.09	.07	.07	.07	.07	.07	.07	.02	.02	.02	.02	.02	.02	.02	.02
2. Export crops																						
Urea (45-0-0)	1,000 m.t.	6.50	207.23	(5.0)	201.08	(63.83)	(65.08)	(65.08)	(77.38)	(77.38)	(84)	(84)	(84)	(84)	--	--	--	--	--	--	--	--
Ammophos (16-21-0)	1,000 m.t.	84.70	(2.32)	(2.32)	(2.28)	(2.28)	--	(1.47)	--	1.47	--	--	--	--	--	--	--	--	--	--	--	--
Complete	1,000 m.t.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	1,000 m.t.	46.67	(1.14)	(1.41)	(1.37)	(1.37)	(60.53)	(1.37)	(60.53)	(1.37)	(60.53)	(60.53)	(60.53)	(60.53)	(60.53)	(60.53)	(60.53)	(60.53)	(60.54)	(60.54)	(153.4)	(60.53)
F. Fertilizer by nutrients -																						
Nitrogen	1,000 m.t.	88.08	33.42	.95	33.23	.95	20.48	.95	15.99	.95	8.59	(21.79)	.74	.95	.48	.48	.64	.48	(2.55)	(2.55)	(2.85)	(2.55)
Palay	1,000 m.t.	67.90	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	1.46	.12	.01	.01	--	--	(1.44)	--	(3.94)	(3.95)	(4.4)	(4.21)
Corn	1,000 m.t.	3.70	560.81	--	560.81	--	273.78	--	273.78	--	155.41	--	--	--	--	--	--	--	--	--	--	--
Sugar	1,000 m.t.	16.48	34.89	34.81	33.86	33.80	30.16	30.16	6.12	6.12	5.04	6.12	5.04	5.04	2.55	2.55	2.55	2.55	(2.54)	(2.55)	2.55	2.55
Phosphorous	1,000 m.t.	53.17	15.95	15.95	15.97	15.97	15.99	16.01	16.40	16.40	8.46	(34.74)	(.17)	(.17)	(.08)	(.08)	(.08)	(.08)	(.08)	(.08)	(.11)	(.11)
Palay	1,000 m.t.	34.68	.09	.09	.09	.09	.06	.09	.06	.09	.06	.06	.06	.06	.03	.03	.03	.03	.02	.03	.03	.03
Corn	1,000 m.t.	1.54	574.03	--	574.03	--	572.73	--	572.73	--	325.32	--	--	--	--	--	--	--	--	--	--	--
Sugar	1,000 m.t.	16.95	(2.30)	(2.30)	(2.24)	(2.30)	(2.01)	(2.30)	(.71)	(2.05)	(.65)	(1.0)	.65	.65	(.29)	(.29)	(.29)	(.29)	(.30)	(.29)	(.29)	(.29)
Potassium	1,000 m.t.	46.70	(.79)	(.79)	(.77)	(.79)	(.69)	(.79)	(.24)	.69	(.21)	(.24)	(.21)	(.21)	(.11)	(.11)	(.11)	(.11)	(.11)	(.11)	(.11)	(.11)
Palay	1,000 m.t.	17.16	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06	.06	--	--	--	--	--	--	--	--
Corn	1,000 m.t.	1.54	.65	.65	.65	.65	.65	(.65)	(.65)	(.65)	(.65)	(.65)	(.65)	(.65)	--	--	--	--	--	--	--	--
Sugar	1,000 m.t.	28.0	(1.39)	(1.39)	(1.36)	(1.36)	(1.21)	(1.21)	(.43)	(.43)	(.39)	(.43)	.39	.39	(.18)	(.18)	(.18)	(.18)	(.18)	(.18)	(.18)	(.18)
G. Man labor (total)	million man-days	586.52	.30	.12	.30	.12	.23	.12	.28	.12	.14	.14	(.03)	(.03)	(.19)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)

Table C-4 (continued)

Description	Units	1974 MAAGAP Base	MAAGAP Solutions at Different Levels of Subsidy with Tax and without Tax																						
			100% Subsidy		96% Subsidy		92% Subsidy		88-80% Subsidy		76-72% Subsidy		68-60% Subsidy		56-28% Subsidy		24-16% Subsidy		12-9% Subsidy		No Subsidy				
			Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed	Untaxed	Taxed			
H. Hand tractor (total)	1,000 tractor days	221.40	--	--	--	--	--	--	--	Percent Increase or (Decrease) from the 1974 Base										--	--	--	--	(27.05)	--
I. Four-wheel tractor (total)	1,000 tractor days	171.17	(5.75)	(5.75)	(5.58)	(5.58)	(5.58)	(5.58)	(.68)	(.68)	(.44)	(.44)	(.44)	(.43)	(.43)	(.43)	(.43)	(.43)	(.44)	(.43)	(.44)	(.43)			
J. Animal labor (total)	million animal days	119.33	(.03)	(.03)	(.03)	(.04)	(.03)	(.04)	(.03)	(.04)	(.03)	(.04)	(.04)	(.03)	--	--	(.01)	(.01)	--	(.01)	.09	(.01)			
K. Net social benefit -																									
OBJ	million pesos	46,895	.80	.48	.80	.48	.79	.47	.78	.47	.77	.45	.74	.46	.74	.42	.73	.42	.72	.40	.72	.40			
CS	million pesos	37,907	.60	.53	.60	.49	.60	.49	.60	.49	.33	.19	.17	.13	(.02)	.13	(.01)	.15	(.01)	.12	(.01)	.09			
PS	million pesos	8,988	1.67	.28	1.67	.44	1.60	.36	1.58	.35	2.62	1.55	3.05	1.63	3.91	1.62	3.85	1.53	3.79	1.58	3.79	1.68			

Table C-5. MAAGAP Model Results after Varying the Ratio of Twice Irrigated to Once Irrigated Lands^a

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at:	
			63/37 ratio ^b	75/25 ratio ^b
Percent Increase or (Decrease) from the 1972 Base				
I. Shadow Prices				
A. Primary products				
Palay	Pesos per m.t.	551.95	--	--
Corn grain	" "	384.41	--	--
Sugarcane	" "	72.19	--	--
Coconuts	" nut	.12	--	--
Hogs	" head	93.50	--	--
Chickens	" "	5.30	--	--
B. Finished Products				
Rice	Pesos per m.t.	851.41	--	--
Corn grits	" "	481.94	--	--
Sugar	" "	984.00	--	--
Copra	" "	850.00	--	--
Poultry (dressed weight)	" "	5,293.41	--	--
Pork (dressed weight)	" "	5,555.79	--	--
Eggs	" "	5,488.53	--	--
C. Inputs				
1. Land				
J ₁	Pesos per hectare	510.80	(1.10)	(1.10)
J ₂	" "	443.80	(1.35)	(1.35)
I ₁	" "	249.40	(2.04)	(2.04)
I ₂	" "	169.30	(1.18)	(1.18)
R ₁	" "	240.9	(1.91)	(1.91)
R ₂	" "	--	--	--

Table C-5 (continued)

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at:	
			63/37 ratio ^b	75/25 ratio ^b
			Percent Increase or (Decrease) from the 1972 Base	
U ₁	Pesos per hectare	32.6	(2.45)	(2.45)
U ₂	" "	29.0	(.34)	(.34)
V ₂	" "	--	--	--
V ₁	" "	--	--	--
2. Hand tractor services	Pesos per day			
(Jan.-Feb.)	" "	--	--	--
(Mar.-April)	" "	--	--	--
(May-June)	" "	94.0	(0.64)	(0.64)
(July-Aug.)	" "	--	--	--
(Sept.-Oct.)	" "	--	--	--
(Nov.-Dec.)	" "	63.3	(1.11)	(1.11)
3. Four-wheel tractor service	Pesos per day			
(Jan.-Feb.)	" "	--	--	--
(Mar.-April)	" "	312.2	(2.75)	(2.75)
(May-June)	" "	312.2	(2.75)	(2.75)
(July-Aug.)	" "	312.2	(2.75)	(2.75)
(Sept.-Oct.)	" "	312.2	(2.75)	(2.75)
(Nov.-Dec.)	" "	325.9	(1.56)	(1.56)
4. Fertilizer nutrients				
Nitrogen	Pesos per kilo	1.50	3.3	3.3
Phosphorous	" "	2.0	3.0	3.0
Potassium	" "	1.14	3.5	3.5
5. Sugar capacity constraints				
Irrigated land	Pesos per hectare	22.60	.9	.9

Table C-5 (continued)

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at:	
			63/37 ratio ^b	75/25 ratio ^b
			Percent Increase or (Decrease) from the 1972 Base	
Rainfed land	Pesos per hectare	5.10	7.8	7.8
First class upland	" "	--	--	--
Second class upland	" "	1.10	(9.1)	(9.1)
<u>II. Activity Levels</u>				
A. Primary production				
Palay	1,000 m.t.	5,568	2.44	4.96
Corn grain	" "	1,871.0	(3.21)	(5.18)
Sugarcane	" "	18,582.0	--	--
Coconuts	Million nuts	8,080.0	--	--
Livestock:				
Backyard hogs	Million head	7.6	--	--
Commercial hogs	" "	.12	--	--
Semicommercial hogs	" "	.06	--	--
Commercial broiler	" "	3.17	--	--
Commercial layer	" "	4.18	--	--
Backyard layer	" "	50.10	--	--
B. Finished products				
Rice	Million m.t.	3.33	2.55	5.20
Corn grits	" "	1.25	(2.8)	(4.08)
Sugar	" "	2.73	--	--
Copra	" "	1.62	--	--
Pork (dressed weight)	" "	.32	--	--
Poultry (dressed weight)	" "	.04	--	--
Eggs	" "	.09	--	--

Table C-5 (continued)

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at:	
			63/37 ratio ^b	75/25 ratio ^b Percent Increase or (Decrease) from the 1972 Base
C. Import-export				
Corn grain import	1,000 m.t.	--	--	--
Copra export	"	1.32	--	--
Sugar export	"	1.15	--	--
Rice import	"	.32	--	--
D. Short-term capital				
Crops	Million pesos	1,627.05	.08	.6
Livestock	"	204.95	--	--
Milling	"	910.98	.26	.64
E. Fertilizer by type				
Urea (45-0-0)	1,000 m.t.	175.92	(1.0)	(.3)
Ammophos (16-20-0)	"	64.75	(6.0)	(6.0)
Complete (14-14-14)	"	291.19	(2.0)	(3.0)
Ammosul (21-0-0)	"	--	--	--
F. Fertilizer nutrients				
Nitrogen:				
Palay	"	130.29	(.99)	(.45)
Corn	"	75.14	1.02	.21
Sugar	"	7.03	(20.1)	(5.41)
Coconut	"	48.12	--	--
Phosphorous:				
Palay	"	--	--	--
Corn	"	53.71	(.17)	4.06
Sugar	"	34.97	3.09	6.86
Coconut	"	5.35	(22.06)	--
	"	13.39	(22.06)	--
	"	--	--	--

Table C-5 (continued)

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at:	
			63/37 ratio ^b	75/25 ratio ^b
			Percent Increase or (Decrease) from the 1972 Base	
Potassium	1,000 m.t.	40.77	1.55	3.43
Palay	"	17.77	3.67	8.15
Corn	"	2.00	--	--
Sugar	"	21.6	--	--
Coconut	"	--	--	--
G. Man labor (total)	Million man days	518.98	.27	.98
H. Hand tractor (total)	1,000 tractor days	438.0	--	--
I. Four-wheel tractor (total)	1,000 tractor days	312.0	(2.0)	(14.0)
J. Animal labor (total)	Million animal days	104.26	(1.0)	(2.0)
K. Net social benefit				
OBJ	Million pesos	41,270	.12	.25
CS	"	35,299	1.22	1.22
PS	"	5,971	(6.85)	(5.74)

^aThe MAAGAP 1972 base had a total irrigated land area of 904,200 hectares incorporated in the right hand side. Twice irrigated land totaled 478,900 hectares (53 percent), while once irrigated land was 425,300 hectares (47 percent).

^bRatios are in percentages.

Table C-6. MAAGAP Model Results in Real Terms (1972=100) after Varying the Price Ceiling for Rice^a

Description	Units	MAAGAP Solutions at Different Price Ceilings for Rice			
		1974	19843 Per	191143 Per	191293 Per
		MAAGAP Base	Metric Ton	Metric Ton	Metric Ton
--Percent Increase or (Decrease)-- from the 1974 Base					
I. Shadow prices					
A. Primary products -					
Palay	pesos per m.t.	744.32	(26.69)	(0.36)	--
Corn grain	pesos per m.t.	403.37	(5.06)	(0.07)	--
Sugarcane	pesos per m.t. (cane)	74.91	--	--	--
Coconuts	pesos per nut	.29	--	--	--
Hogs	pesos per head	131.40	8.0	0.15	--
Chickens	pesos per head	11.0	--	--	--
B. Intermediate products -					
Rice brokens	pesos per m.t.	403.37	(5.06)	(0.07)	--
Rice bran (cono)	pesos per m.t.	403.37	(5.06)	(0.07)	--
Rice bran (kiskisan)	pesos per m.t.	653.60	(14.17)	(0.19)	--
Corn brokens	pesos per m.t.	--	--	--	--
Corn bran (kiskisan)	pesos per m.t.	653.60	(14.17)	(0.19)	--
Corn bran (cono)	pesos per m.t.	403.37	(5.06)	(0.07)	--
C. Finished products -					
Rice	pesos per m.t.	1,147.16	(26.51)	(0.36)	--
Corn grits	pesos per m.t.	481.94	--	--	--
Sugar	pesos per m.t.	1,042.0	--	--	--
Copra	pesos per m.t.	1,650.70	--	--	--
Poultry meat (dressed weight)	pesos per m.t.	7,218.79	(0.71)	(.01)	--
Pork (dressed weight)	pesos per m.t.	7,248.2	(1.74)	(0.02)	--
Eggs	pesos per m.t.	7,144.61	(1.11)	(0.02)	--

Table C-6 (continued)

Description	Units	MAAGAP Solutions at Different Price Ceilings for Rice			
		1974	₱843 Per Metric Ton	₱1143 Per Metric Ton	₱1293 Per Metric Ton
		MAAGAP Base	--Percent Increase or (Decrease)-- from the 1974 Base		
D. Inputs -					
1. Land					
J ₁	pesos per hectare	735.50	(33.45)	(0.46)	--
J ₂	pesos per hectare	644.60	(45.06)	(0.47)	--
I ₁	pesos per hectare	377.70	(38.31)	(0.53)	--
I ₂	pesos per hectare	180.20	(6.77)	(0.11)	--
R ₁	pesos per hectare	363.10	(37.65)	(0.52)	--
R ₂	pesos per hectare	--	--	--	--
U ₁	pesos per hectare	56.40	(27.48)	(0.35)	--
U ₂	pesos per hectare	39.50	(8.35)	--	--
V ₁	pesos per hectare	8.20	(19.51)	--	--
V ₂	pesos per hectare	--	--	--	--
2. Four-wheel tractor service					
(January-February)	pesos per day	--	--	--	--
(March-April)	pesos per day	616.50	--	--	--
(May-June)	pesos per day	616.50	--	--	--
(July-August)	pesos per day	616.50	--	--	--
(September-October)	pesos per day	616.50	--	--	--
(November-December)	pesos per day	459.80	(38.89)	(0.54)	--
3. Hand tractor service					
(January-February)	pesos per day	--	--	--	--
(March-April)	pesos per day	--	--	--	--

Table C-6 (continued)

Description	Units	MAAGAP Solutions at Different Price Ceilings for Rice			
		1974 MAAGAP Base	₱843 Per Metric Ton	₱1143 Per Metric Ton	₱1293 Per Metric Ton
		--Percent Increase or (Decrease)-- from the 1974 Base			
4. Fertilizer by nutrients					
Food crops -					
(May-June)	pesos per day	130.40	(31.83)	(0.46)	--
(July-August)	pesos per day	--	--	--	--
(September-October)	pesos per day	--	--	--	--
(November-December)	pesos per day	121.50	--	--	--
Nitrogen					
Phosphorous					
Potassium					
Export crops					
Nitrogen					
Phosphorous					
Potassium					
II. Activity levels					
A. Primary production					
Palay	1,000 m.t.	5,718	(.82)	--	--
Corn grain	1,000 m.t.	1,967	--	--	--
Sugarcane	1,000 m.t.	21,139	--	--	--
Coconuts	million nuts	8,824	--	--	--

Table C-6 (continued)

Description	Units	1974 MAAGAP Base	MAAGAP Solutions at Different Price Ceilings for Rice				--Percent Increase or (Decrease)-- from the 1974 Base
			P843 Per Metric Ton	P1143 Per Metric Ton	P1293 Per Metric Ton	P1293 Per Metric Ton	
Livestock							
Backyard hogs	million heads	8.37	--	--	--	--	
Commercial hogs	million heads	0.16	--	--	--	--	
Semicommercial hogs	million heads	--	--	--	--	--	
Commercial broilers	million heads	3.06	--	--	--	--	
Commercial layer	million heads	4.10	--	--	--	--	
Backyard layer	million heads	47.50	--	--	--	--	
B. Finished products -							
Rice	million m.t.	3.41	(1.47)	--	--	--	
Corn grits	million m.t.	1.26	1.59	--	--	--	
Sugar	million m.t.	1.97	--	--	--	--	
Copra	million m.t.	1.76	--	--	--	--	
Pork (dressed weight)	million m.t.	0.34	--	--	--	--	
Poultry (dressed weight)	million m.t.	0.037	--	--	--	--	
Eggs	million m.t.	0.087	--	--	--	--	
C. Import - export -							
Corn grain import	1,000 m.t.	--	--	--	--	--	
Copra export	1,000 m.t.	1.44	--	--	--	--	
Sugar export	1,000 m.t.	1.30	--	--	--	--	
Rice import	1,000 m.t.	--	.9371 ^b	--	.2863 ^b	--	
D. Short-term capital -							
Food crops	million pesos	888.34	(0.45)	--	--	--	
Export crops	million pesos	904.48	--	--	--	--	

Table C-6 (continued)

Description	Units	1974 MAAGAP Base	MAAGAP Solutions at Different Price Ceilings for Rice		
			₱843 Per Metric Ton	₱1143 Per Metric Ton	₱1293 Per Metric Ton
			---Percent Increase or (Decrease)--- from the 1974 Base		
Livestock	million pesos	86.0	--	--	--
Milling	million pesos	1,500.0	--	--	--
E. Fertilizer by types -					
Food crops					
Urea (45-0-0)	1,000 m.t.	86.40	(2.12)	--	--
Ammonios (16-20-0)	1,000 m.t.	87.62	(0.37)	--	--
Complete (14-14-14)	1,000 m.t.	133.55	--	--	--
Amosul (21-0-0)	1,000 m.t.	--	--	--	--
Potash	1,000 m.t.	--	--	--	--
Export crops					
Urea (45-0-0)	1,000 m.t.	6.50	--	--	--
Ammonios (16-20-0)	1,000 m.t.	84.76	--	--	--
Complete (14-14-14)	1,000 m.t.	--	--	--	--
Amosul (21-0-0)	1,000 m.t.	--	--	--	--
Potash	1,000 m.t.	46.67	--	--	--
F. Fertilizer by nutrients -					
Nitrogen					
	1,000 m.t.	88.08	(1.0)	--	--
Palay					
	1,000 m.t.	67.9	(1.30)	--	--
Corn					
	1,000 m.t.	3.70	--	--	--
Sugar					
	1,000 m.t.	16.48	--	--	--
Coconut					
	1,000 m.t.	--	--	--	--

Table C-6 (continued)

Description	Units	MAAGAP Solutions at Different Price Ceilings for Rice			
		1974 MAAGAP Base	₱843 Per Metric Ton	₱1143 Per Metric Ton	₱1293 Per Metric Ton
			--Percent Increase or (Decrease)-- from the 1974 Base		
Phosphorous	1,000 m.t.	53.17	(0.11)	--	--
Palay	1,000 m.t.	36.68	(0.17)	--	--
Corn	1,000 m.t.	1.54	--	--	--
Sugar	1,000 m.t.	16.95	--	--	--
Coconut	1,000 m.t.	--	--	--	--
Potassium	1,000 m.t.	46.70	--	--	--
Palay	1,000 m.t.	17.16	--	--	--
Corn	1,000 m.t.	1.54	--	--	--
Sugar	1,000 m.t.	28.00	--	--	--
Coconut	1,000 m.t.	--	--	--	--
G. Man labor (total)	million man-days	586.52	0.07	--	--
Crops	million man-days	436.16	0.09	--	--
Livestock	million man-days	150.36	--	--	--
H. Hand tractor services (total)	1,000 tractor days	221.40	--	--	--
I. Four-wheel tractor (total)	1,000 tractor days	171.17	--	--	--
J. Animal labor (total)	million animal days	119.33	0.54	--	--

Table C-6 (continued)

Description	Units	1974 MAAGAP Base	MAAGAP Solutions at Different Price Ceilings for Rice			
			₱843 Per Metric Ton	₱1143 Per Metric Ton	₱1293 Per Metric Ton	
			--Percent Increase or (Decrease)-- from the 1974 Base			
K. Net social benefit -						
OBJ	million pesos	46,895	.30	.19	---	
CS	million pesos	37,907	3.21	.03	(.89)	
PS	million pesos	8,988	(1.36)	.84	3.39	

^aTo convert the prices into current term multiply them by 2.23 (WPI deflator).

^bNot in percent but actual 1000 metric tons.

Table C-7. MAAGAP Model Results after Varying the Availability of Both Hand and Four-Wheel Tractor Services from the 1972 Base^a

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at Different Levels of Theta ^b						
			Theta =	Theta =	Theta =	Theta =	Theta =	Theta =	
			0	30	60	130	160	200	
-----Percent Increase or (Decrease) from the 1972 Base-----									
I. Shadow prices									
A. Primary products -									
Palay	pesos per m.t.	551.95	1.49	1.49	.62	--	--	--	--
Corn grain	pesos per m.t.	384.41	(4.62)	(4.62)	(7.46)	--	--	--	--
Sugarcane	pesos per m.t.	72.19	--	--	--	--	--	--	--
Coconut	pesos per nut	.12	--	--	--	--	--	--	--
Hogs	pesos per head	93.50	(7.91)	(7.91)	(3.42)	--	--	--	--
Chickens	pesos per head	--	(1.25)	(1.25)	(1.25)	--	--	--	--
B. Finished products -									
Rice	pesos per m.t.	851.4	1.54	1.54	--	--	--	--	--
Corn grits	pesos per m.t.	481.9	(6.85)	(6.85)	(7.40)	--	--	--	--
Sugar	pesos per m.t.	984.0	--	--	--	--	--	--	--
Copra	pesos per m.t.	850.0	--	--	--	--	--	--	--
Poultry meat (dressed weight)	pesos per m.t.	5,293.4	(.84)	(.84)	(1.35)	--	--	--	--
Pork (dressed weight)	pesos per m.t.	5,555.8	(1.55)	(1.55)	(2.77)	--	--	--	--
Eggs	pesos per m.t.	5,488.5	(1.26)	(1.26)	(2.03)	--	--	--	--
C. Inputs -									
1. Land									
J ₁	pesos per hectare	510.8	24.90	24.90	5.15	(1.10)	(1.10)	(1.10)	(1.14)
J ₂	pesos per hectare	448.8	25.85	25.85	5.33	(1.35)	(1.35)	(1.35)	(1.40)
I ₁	pesos per hectare	249.4	32.62	32.62	9.70	(2.04)	(2.04)	(2.04)	(2.13)
I ₂	pesos per hectare	169.3	11.75	11.75	6.44	(1.18)	(1.18)	(1.18)	(1.24)

Table C-7 (continued)

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at Different Levels of Theta ^b						
			Theta = Theta = Theta = Theta = Theta =						
			0	30	60	130	160	200	500
-----Percent Increase or (Decrease) from the 1972 Base-----									
II. Activity levels									
A. Primary production									
Palay	1,000 m.t.	5,568.0	(4.44)	(3.14)	(1.63)	.47	.54	.63	1.31
Corn grain	1,000 m.t.	1,871.0	4.60	4.60	4.92	(1.60)	(1.60)	(1.60)	(1.60)
Sugarcane	1,000 m.t. of cane	18,582.0	(18.80)	(9.28)	.13	--	--	--	--
Coconuts	million nuts	8,080.0	--	--	--	--	--	--	--
Livestock									
Backyard hogs	million heads	7.6	--	--	--	--	--	--	--
Commercial hogs	million heads	.12	33.3	41.67	58.3	--	--	--	--
Sericoomercial hogs	million heads	.06	(66.67)	(83.33)	--	--	--	--	--
Commercial broilers	million heads	3.17	--	--	--	--	--	--	--
Commercial layers	million heads	4.18	--	--	--	--	--	--	--
Backyard layers	million heads	50.1	--	--	--	--	--	--	--
B. Finished products (production)									
Rice	million m.t.	3.33	(4.18)	(2.80)	(1.17)	.45	.51	.63	1.35
Corn grits	million m.t.	1.25	.32	.30	.32	(1.52)	(1.52)	(1.44)	(1.12)
Sugar	million m.t.	1.73	(12.51)	(9.26)	.12	--	--	--	--
Copra	million m.t.	1.62	--	--	--	--	--	--	--
Pork (dressed weight)	million m.t.	0.32	--	--	--	--	--	--	--
Poultry (dressed weight)	million m.t.	.04	--	--	--	--	--	--	--
Eggs	million m.t.	.09	--	--	--	--	--	--	--
C. Import - export -									
Corn grain import	1,000 m.t.	--	--	--	--	--	--	--	--
Copra export	1,000 m.t.	1.32	--	--	--	--	--	--	--

Table C-7 (continued)

Description	Units	MAAGAP Solutions at Different Levels of Theta ^b									
		1972 MAAGAP Base	Theta = Theta = Theta = Theta = Theta =								
			0	30	60	130	160	200	500	-----Percent Increase or (Decrease) from the 1972 Base-----	
Sugar export	1,000 m.t.	1.15	(28.7)	(13.91)	--	--	--	--	--	--	--
Rice import	1,000 m.t.	.32	--	--	--	--	--	--	--	--	--
D. Short-term capital -											
Crops	million pesos	1,627.05	5.64	3.54	(89.83)	(.40)	(.44)	50 -	(.75)	--	--
Livestock	million pesos	204.95	.74	.92	1.61	--	--	--	--	--	--
Milling	million pesos	910.98	(10.40)	(2.50)	(.48)	(.40)	(.02)	--	(.15)	--	--
E. Fertilizer by types -											
Urea (45-0-0)	1,000 m.t.	175.92	(54.23)	(37.53)	.14	.16	(1.74)	1.95	7.46	--	--
Ammonios (16-20-0)	1,000 m.t.	64.75	33.47	35.63	46.66	(14.92)	(14.76)	(14.56)	(13.08)	--	--
Complete (14-14-14)	1,000 m.t.	291.19	(4.12)	(.27)	.01	--	--	--	--	--	--
Amosul (21-0-0)	1,000 m.t.	--	--	--	--	--	--	--	--	--	--
F. Fertilizer by nutrients -											
Nitrogen	1,000 m.t.	130.29	(46.15)	(25.07)	3.80	(1.10)	(1.10)	(2.34)	(5.53)	--	--
Palay	1,000 m.t.	75.14	(14.84)	(9.97)	(6.45)	1.09	.16	(1.08)	(6.61)	--	--
Corn	1,000 m.t.	7.03	96.16	96.3	99.86	(31.86)	(31.86)	(31.86)	(31.86)	--	--
Sugar	1,000 m.t.	48.12	(76.39)	(52.81)	5.78	--	--	--	--	--	--
Coconut	1,000 m.t.	--	--	--	--	--	--	--	--	--	--
Phosphorous	1,000 m.t.	53.71	(4.95)	8.42	11.26	(3.73)	(3.69)	(3.50)	(3.15)	--	--
Palay	1,000 m.t.	34.97	(1.43)	(1.14)	(.09)	.06	.11	.20	.74	--	--
Corn	1,000 m.t.	5.35	109.35	109.72	114.02	(36.45)	(36.45)	(36.45)	(36.45)	--	--

Table C-7 (continued)

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at Different Levels of Theta ^b						
			Theta =	Theta =	Theta =	Theta =	Theta =	Theta =	Theta =
			0	30	60	130	160	200	500
			-----Percent Increase or (Decrease) from the 1972 Base-----						
Sugar	1,000 m.t.	13.39	(20.09)	(7.09)	(.15)	--	--	--	--
Coconut	1,000 m.t.	--	--	--	--	--	--	--	--
Potassium	1,000 m.t.	40.77	(4.10)	(.27)	.02	--	--	--	--
Palay	1,000 m.t.	17.17	(1.16)	(.93)	--	--	--	--	--
Corn	1,000 m.t.	2.0	2.0	(2.50)	--	--	--	--	--
Sugar	1,000 m.t.	21.60	(7.08)	--	.50	--	--	--	--
Coconut	1,000 m.t.	--	--	--	--	--	--	--	--
G. Chemicals -									
Weedicides	million pesos	5.33	(21.01)	(14.82)	(8.07)	2.44	2.81	3.19	5.25
Insecticides	million pesos	63.34	(10.77)	(1.63)	(2.37)	(.82)	(.82)	(.75)	(.74)
Veterinary	million pesos	9.88	(14.78)	(18.42)	(23.28)	--	--	--	--
H. Man labor -									
1. Grand total	million man-days	518.98	1.20	1.15	.72	(.29)	(.14)	(.19)	.60
2. Crops (subtotal)	million man-days	377.14	1.98	1.96	1.48	(.40)	(.20)	(.26)	.80
a. Palay	million man-days	172.12	6.85	4.85	2.57	(.64)	(.20)	(.34)	1.98
Period 01	million man-days	16.80	62.5	43.75	25.6	(5.48)	--	--	30.60
Period 02	million man-days	--	--	--	--	--	--	--	--
Period 03	million man-days	87.72	60	.44	.18	(.14)	(.27)	(.46)	(1.79)
Period 04	million man-days	54.06	1.11	.92	.02	--	.02	.02	.09
Period 05	million man-days	--	--	--	--	--	--	--	--
Period 06	million man-days	13.54	1.18	.81	.44	(.34)	(.81)	(1.40)	(1.55)

Table C. 7 (continued)

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at Different Levels of Theta ^b							
			Theta =	Theta =	Theta =	Theta =	Theta =	Theta =	Theta =	
			0	30	60	130	160	200	500	
			-----Percent Increase or (Decrease) from the 1972 Base-----							
b. Corn										
	million man-days	85.64	.71	.61	1.31	(.47)	(.47)	(.47)	(.47)	
Period 01	million man-days	--	--	--	--	--	--	--	--	
Period 02	million man-days	--	--	--	--	--	--	--	--	
Period 03	million man-days	--	--	--	--	--	--	--	--	
Period 04	million man-days	38.26	(.81)	.94	(.16)	--	--	--	--	
Period 05	million man-days	27.82	(.90)	(1.04)	(.18)	--	--	--	--	
Period 06	million man-days	19.56	5.98	6.29	(2.04)	(2.04)	(2.04)	(2.04)	(2.04)	
c. Sugar										
	million man-days	44.83	(12.4)	(3.4)	.09	--	--	--	--	
Period 01	million man-days	.64	3.13	3.13	--	--	--	--	--	
Period 02	million man-days	16.35	(19.82)	(9.72)	--	--	--	--	--	
Period 03	million man-days	9.22	(9.22)	(1.19)	--	--	--	--	--	
Period 04	million man-days	8.57	5.13	1.17	.12	--	--	--	--	
Period 05	million man-days	8.57	5.13	1.17	.12	--	--	--	--	
Period 06	million man-days	1.48	--	--	--	--	--	--	--	
d. Coconut										
	million man-days	74.55	--	--	--	--	--	--	--	
Period 01	million man-days	12.73	--	--	--	--	--	--	--	
Period 02	million man-days	12.12	--	--	--	--	--	--	--	
Period 03	million man-days	12.73	--	--	--	--	--	--	--	
Period 04	million man-days	12.12	--	--	--	--	--	--	--	
Period 05	million man-days	12.73	--	--	--	--	--	--	--	
Period 06	million man-days	12.12	--	--	--	--	--	--	--	
3. Livestock (total)										
	million man-days	141.84	(.84)	1.02	1.33	--	--	--	--	

Table C-7 (continued)

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at Different Levels of Theta ^b									
			Theta = Theta = Theta = Theta = Theta =									
			0	30	60	130	160	200	500	-----Percent Increase or (Decrease) from the 1972 Base-----		
I. Hand tractor services (grand total)	1,000 tractor days	438.0	--	(33.3)	(66.67)	30.0	60.0	100.0	250.9			
Palay (subtotal)	1,000 tractor days	438.0	--	(33.3)	(66.67)	30.0	60.0	100.0	250.9			
Period 01	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 02	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 03	1,000 tractor days	219.0	--	(70)	(40.0)	30	60.0	100.0	400.0			
Period 04	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 05	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 06	1,000 tractor days	219.0	--	(70.0)	(40.0)	30.0	60.0	100.0	400.0			
J. Four-wheel tractor services (grand total)	1,000 tractor days	312.3	--	(54.9)	(27.43)	.79	(6.88)	(16.07)	--			
1. Palay (subtotal)	1,000 tractor days	161.5	--	(33.3)	(66.67)	1.54	(12.44)	(31.08)	--			
Period 01	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 02	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 03	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 04	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 05	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 06	1,000 tractor days	161.5	--	(70.0)	(70.00)	1.54	(12.44)	(31.08)	--			
2. Corn (subtotal)	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 01	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 02	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 03	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 04	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 05	1,000 tractor days	--	--	--	--	--	--	--	--			
Period 06	1,000 tractor days	--	--	--	--	--	--	--	--			

Table C-7 (continued)

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at Different Levels of Theta ^b									
			Theta = Theta = Theta = Theta = Theta =									
			0	30	60	90	120	150	180	210	240	270
			-----Percent Increase or (Decrease) from the 1972 Base-----									
3. Sugar (subtotal)	1,000 tractor days	150.80	--	--	--	--	--	--	--	--	--	--
Period 01	1,000 tractor days	--	--	--	--	--	--	--	--	--	--	--
Period 02	1,000 tractor days	--	--	--	--	--	--	--	--	--	--	--
Period 03	1,000 tractor days	98.61	--	(50.87)	(1.73)	--	--	--	--	--	--	--
Period 04	1,000 tractor days	52.19	--	(50.91)	(1.76)	--	--	--	--	--	--	--
Period 05	1,000 tractor days	--	--	--	--	--	--	--	--	--	--	--
Period 06	1,000 tractor days	--	--	--	--	--	--	--	--	--	--	--
K. Animal labor (grand total) -	million animal days	104.26	3.62	2.80	.80	(.33)	(.52)	(0.77)	(2.41)			
1. Palay	million animal days	47.66	4.36	3.11	1.62	(.71)	(1.13)	(1.68)	(5.29)			
Period 01	million animal days	--	--	--	--	--	--	--	--	--	--	--
Period 02	million animal days	--	--	--	--	--	--	--	--	--	--	--
Period 03	million animal days	44.16	1.24	.93	.36	.27	(.54)	(.88)	(5.25)			
Period 04	million animal days	--	--	--	--	--	--	--	--	--	--	--
Period 05	million animal days	--	--	--	--	--	--	--	--	--	--	--
Period 06	million animal days	3.50	43.71	30.57	17.43	(6.29)	(8.57)	(11.71)	(4.57)			
2. Corn	million animal days	37.13	.31	.33	.08	--	--	--	--	--	--	--
Period 01	million animal days	--	--	--	--	--	--	--	--	--	--	--
Period 02	million animal days	--	--	--	--	--	--	--	--	--	--	--
Period 03	million animal days	--	--	--	--	--	--	--	--	--	--	--
Period 04	million animal days	26.47	.83	.94	.15	--	--	--	--	--	--	--
Period 05	million animal days	11.66	(.34)	(.43)	--	--	--	--	--	--	--	--
Period 06	million animal days	1.0	(6.0)	(7.00)	(1.00)	--	--	--	--	--	--	--

Table C-7 (continued)

Description	Units	1972 NAACAP Base	NAACAP Solutions at Different Levels of Theta ^b									
			Theta = Theta = Theta = Theta = Theta =									
			0	30	60	90	120	150	180	210	240	270
-----Percent Increase or (Decrease) from the 1972 Base-----												
3. Sugar	million animal days	11.41	13.85	11.48	0.3	--	--	--	--	--	--	--
Period 01	million animal days	.28	3.57	3.57	--	--	--	--	--	--	--	--
Period 02	million animal days	.89	12.36	10.11	--	--	--	--	--	--	--	--
Period 03	million animal days	3.62	14.09	11.60	.28	--	--	--	--	--	--	--
Period 04	million animal days	3.28	14.33	11.89	.30	--	--	--	--	--	--	--
Period 05	million animal days	3.28	14.33	11.89	.30	--	--	--	--	--	--	--
Period 06	million animal days	.06	16.67	16.67	--	--	--	--	--	--	--	--
4. Coconut	million animal days	6.06	--	--	--	--	--	--	--	--	--	--
Period 01	million animal days	--	--	--	--	--	--	--	--	--	--	--
Period 02	million animal days	2.02	--	--	--	--	--	--	--	--	--	--
Period 03	million animal days	--	--	--	--	--	--	--	--	--	--	--
Period 04	million animal days	2.02	--	--	--	--	--	--	--	--	--	--
Period 05	million animal days	--	--	--	--	--	--	--	--	--	--	--
Period 06	million animal days	2.02	--	--	--	--	--	--	--	--	--	--
I. Net social benefit -												
ORJ	million pesos	41,270	(.43)	(.21)	(.02)	--	.01	.01	.01	.02	.02	.02
CS	million pesos	35,299	(.80)	(1.0)	.58	.23	.28	.28	.28	.28	.28	.28
PS	million pesos	5,971	1.74	4.43	(3.60)	(1.68)	(1.64)	(1.60)	(1.60)	(1.56)	(1.56)	(1.56)

^aThe 1972 base period incorporated in the righthand side (RHS) of NAACAP model a total available tractor days of 219,000 for hand tractor and 161,500 for four-wheel tractor, respectively.

^bTheta refers to the percentage of variation for both hand and four-wheel tractor days from the 1972 base. Theta = 0 means that no tractor services were supplied at all; theta = 30 means that only 30 percent of the hand tractor and four-wheel tractor services from the 1972 base was available; etc. The variation of tractor service availability therefore covered at least six segments, i.e., from zero to 300 percent of the 1972 base.

Table C-2 (cont. Inued)

Description	Units	MAAGAP Solutions at Different Levels of Theta ^b											
		1972		Theta=		Theta=		Theta=		Theta=		Theta=	
		Base	0	10	20	40	60	80	115	190	475	800	
-----Percent Increase or (Decrease) from the 1972 Base-----													
Phosphorous	1,000 m.t.	34.97	(.17)	(.14)	(.11)	(.09)	(.06)	(.03)	.03	.17	.71	.97	
Palay	"	5.35	109.72	98.69	76.82	65.79	43.92	21.87	(16.45)	(36.45)	(36.45)	(36.45)	
Corn	"	13.39	—	—	—	—	—	—	—	—	—	—	
Sugar	"	—	—	—	—	—	—	—	—	—	—	—	
Coconut	"	40.77	—	—	—	—	—	—	—	—	—	—	
Potassium	"	17.17	—	—	—	—	—	—	—	—	—	—	
Palay	"	2.00	—	—	—	—	—	—	—	—	—	—	
Corn	"	21.60	—	—	—	—	—	—	—	—	—	—	
Sugar	"	—	—	—	—	—	—	—	—	—	—	—	
Coconut	"	—	—	—	—	—	—	—	—	—	—	—	
G. Chemicals													
Weedicides	Million pesos	5.33	(7.62)	(6.57)	(5.07)	(4.50)	(3.00)	(1.50)	1.13	3.00	5.07	5.44	
Insecticides	"	63.34	2.59	2.34	1.82	1.56	1.04	.52	(.39)	(.77)	(.71)	(.95)	
Veterinary	"	9.88	(23.58)	(23.78)	(23.78)	(20.24)	(13.26)	(6.28)	—	—	(43.22)	(43.12)	
H. Man labor													
1. Grand Total	Million man days	518.98	.48	.40	.22	.19	.13	.07	(.13)	(.24)	.47	1.15	
2. Crops (subtotal)	"	377.14	1.16	1.04	.81	.69	.46	.23	(.18)	(.33)	.64	1.58	
a. Palay	"	172.12	1.86	1.68	1.31	1.12	.74	.37	(.29)	(.49)	1.24	3.69	
Period 01	"	16.80	15.77	14.23	11.07	9.46	6.31	3.15	(2.38)	(1.90)	26.79	49.88	
Period 02	"	—	—	—	—	—	—	—	—	—	—	—	
Period 03	"	87.72	.44	.40	.31	.26	.17	.09	(.07)	(.41)	(1.69)	(2.36)	
Period 04	"	54.06	(.02)	(.02)	(.02)	(.02)	(.02)	—	—	.02	.09	.13	
Period 05	"	—	—	—	—	—	—	—	—	—	—	—	
Period 06	"	13.54	1.33	1.18	.96	.81	.52	.30	(.22)	(1.26)	(1.85)	.07	
b. Corn	"	85.64	1.38	1.24	2.14	—	—	—	(.21)	(.17)	(.17)	—	
Period 01	"	—	—	—	—	—	—	—	—	—	—	—	
Period 02	"	—	—	—	—	—	—	—	—	—	—	—	
Period 03	"	28.26	—	—	—	—	—	—	—	—	—	—	
Period 04	"	27.82	—	—	—	—	—	—	—	—	—	—	
Period 05	"	19.56	—	—	—	—	—	—	—	—	—	—	
Period 06	"	44.83	6.03	5.47	4.24	3.63	2.40	1.18	(.92)	(2.04)	(2.04)	(2.04)	
c. Sugar	"	.64	.02	.02	.02	—	—	—	(.42)	(.02)	(.02)	(.02)	
Period 01	"	—	—	—	—	—	—	—	—	—	—	—	
Period 02	"	16.35	—	—	—	—	—	—	—	—	—	—	
Period 03	"	9.22	—	—	—	—	—	—	—	—	—	—	
Period 04	"	8.57	—	—	—	—	—	—	—	—	—	—	
Period 05	"	8.57	—	—	—	—	—	—	—	—	—	—	
Period 06	"	1.47	.68	.68	.68	—	—	—	—	—	—	—	
d. Coconut	"	74.55	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	—	—	—	—	
Period 01	"	12.78	—	—	—	—	—	—	—	—	—	—	
Period 02	"	12.12	—	—	—	—	—	—	—	—	—	—	
Period 03	"	12.73	—	—	—	—	—	—	—	—	—	—	
Period 04	"	12.12	—	—	—	—	—	—	—	—	—	—	
Period 05	"	12.73	—	—	—	—	—	—	—	—	—	—	
Period 06	"	12.12	—	—	—	—	—	—	—	—	—	—	
3. Livestock (subtotal)	"	141.00	(1.33)	(1.33)	(1.33)	(.43)	.75	(.35)	—	—	—	—	

Table C-8 (continued)

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at Different Levels of Theta ^b											
			Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	
			0	10	20	40	60	80	115	190	475	800	Percent Increase or (Decrease) from the 1972 Base	
I. Hand Tractor Services														
(Grand Total)	1,000 tractor days	438.0	—	(90.0)	(70.0)	(60.0)	(40.0)	(20.0)	15.0	90.0	250.43	253.39		
1. Fallow (subtotal)	"	438.0	—	(90.0)	(70.0)	(60.0)	(40.0)	(20.0)	15.0	90.0	250.43	253.37		
Period 01	"	—	—	—	—	—	—	—	—	—	—	—		
Period 02	"	219.0	—	(90.0)	(70.0)	(60.0)	(40.0)	(20.0)	15.0	90.0	375.0	526.93		
Period 03	"	—	—	—	—	—	—	—	—	—	—	—		
Period 04	"	—	—	—	—	—	—	—	—	—	—	—		
Period 05	"	—	—	—	—	—	—	—	—	—	—	—		
Period 06	"	—	—	—	—	—	—	—	—	—	—	—		
2. Corn (subtotal)	"	219.0	—	(90.0)	(70.0)	(60.0)	(40.0)	(20.0)	15.0	90.0	125.87	(20.14)		
Period 01	"	—	—	—	—	—	—	—	—	—	—	—		
Period 02	"	—	—	—	—	—	—	—	—	—	—	—		
Period 03	"	—	—	—	—	—	—	—	—	—	—	—		
Period 04	"	—	—	—	—	—	—	—	—	—	—	—		
Period 05	"	—	—	—	—	—	—	—	—	—	—	—		
Period 06	"	—	—	—	—	—	—	—	—	—	—	—		
3. Sugar (subtotal)	"	—	—	—	—	—	—	—	—	—	—	—		
Period 01	"	—	—	—	—	—	—	—	—	—	—	—		
Period 02	"	—	—	—	—	—	—	—	—	—	—	—		
Period 03	"	—	—	—	—	—	—	—	—	—	—	—		
Period 04	"	—	—	—	—	—	—	—	—	—	—	—		
Period 05	"	—	—	—	—	—	—	—	—	—	—	—		
Period 06	"	—	—	—	—	—	—	—	—	—	—	—		
J. Four-wheel tractor services														
(Grand Total)	"	312.3	—	—	—	—	—	—	—	(13.65)	(51.71)	(51.71)		
K. Animal Labor (Grand Total)	Million animal days	104.26	—	—	—	(.62)	.41	.21	(.14)	(.70)	(2.00)	(2.35)		
1. Fallow	"	47.66	—	—	—	1.32	.90	.44	(.33)	(1.55)	(4.41)	(5.16)		
Period 01	"	—	—	—	—	—	—	—	—	—	—	—		
Period 02	"	—	—	—	—	—	—	—	—	—	—	—		
Period 03	"	—	—	—	—	—	—	—	—	—	—	—		
Period 04	"	44.16	—	—	—	.54	.36	.36	(.14)	(.79)	(4.76)	(3.26)		
Period 05	"	—	—	—	—	—	—	—	—	—	—	—		
Period 06	"	—	—	—	—	—	—	—	—	—	—	—		
2. Corn	"	3.50	19.14	17.43	13.43	11.43	7.71	3.71	(2.86)	(10.86)	—	28.29		
Period 01	"	39.13	—	—	—	—	—	—	—	—	—	—		
Period 02	"	—	—	—	—	—	—	—	—	—	—	—		
Period 03	"	—	—	—	—	—	—	—	—	—	—	—		
Period 04	"	26.47	—	—	—	—	—	—	—	—	—	—		
Period 05	"	11.66	—	—	—	—	—	—	—	—	—	—		
Period 06	"	1.0	—	—	—	—	—	—	—	—	—	—		
3. Sugar	"	11.41	—	—	—	—	—	—	—	—	—	—		
Period 01	"	.28	—	—	—	—	—	—	—	—	—	—		
Period 02	"	.89	—	—	—	—	—	—	—	—	—	—		
Period 03	"	3.62	—	—	—	—	—	—	—	—	—	—		
Period 04	"	3.28	—	—	—	—	—	—	—	—	—	—		
Period 05	"	3.28	—	—	—	—	—	—	—	—	—	—		
Period 06	"	.06	—	—	—	—	—	—	—	—	—	—		

Table C-8 (continued)

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at Different Levels of Theta ^b									
			Theta=0	Theta=10	Theta=20	Theta=40	Theta=60	Theta=80	Theta=115	Theta=190	Theta=475	Theta=800
			-----Percent Increase or (Decrease) from the 1972 Base-----									
4. Coconut	Million animal days	6.06	-	-	-	-	-	-	-	-	-	-
Period 01	"	-	-	-	-	-	-	-	-	-	-	-
Period 02	"	2.02	-	-	-	-	-	-	-	-	-	-
Period 03	"	-	-	-	-	-	-	-	-	-	-	-
Period 04	"	2.02	-	-	-	-	-	-	-	-	-	-
Period 05	"	-	-	-	-	-	-	-	-	-	-	-
Period 06	"	2.02	-	-	-	-	-	-	-	-	-	-
L. Net Social Benefit												
OBJ	Million pesos	41,270.00	(.02)	(.02)	(.02)	(.01)	(.01)	(.004)	-	.02	.06	.09
CS	"	35,299.00	.58	.54	.45	.48	.46	.28	.28	.31	.31	.28
PS	"	5,971	(3.75)	(3.46)	(2.77)	(2.96)	(2.92)	(2.84)	(1.68)	(1.57)	(1.39)	(1.07)

^aThe 1972 base period had a total available hand tractor services of 219,000 tractor days. The procedure taken here is varying the availability of hand tractor services, while holding the four-wheel tractor supply of services constant.

^bTheta here refers to the percentage change from the hand tractor services 1972 base. Theta = 0 means that no hand tractor service was supplied; Theta = 30 means that only 30 percent of the 1972 base was supplied; etc., totaling to ten segments of parametric variation.

Table C-9. MACAP Model Results after Varying the Availability of Four-Wheel Tractor Services from the 1972 Base^a

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at Different Levels of Theta ^b					
			Theta=0	Theta=10	Theta=20	Theta=30	Theta=40	Theta=63 167
-----Percent Increase or (Decrease) from the 1972 Base-----								
I. Shadow Prices								
A. Primary Production								
Palay	Pesos per m.t.	551.95	14.94	.54	(.55)	(.55)	(.55)	—
Corn grain	" "	384.41	(4.62)	(4.62)	(6.55)	(6.55)	(6.55)	—
Sugar cane	" "	72.19	—	—	—	—	—	—
Coconuts	Pesos per nut	.12	—	—	—	—	—	—
Hogs	Pesos per head	93.50	(7.91)	(2.14)	(2.89)	(2.89)	(2.89)	—
Chickens	" "	8.00	(1.25)	(1.25)	(1.25)	(1.25)	(1.25)	—
B. Finished Products								
Rice	Pesos per m.t.	851.41	15.40	0.93	—	—	—	—
Corn grits	" "	481.94	(6.85)	(4.71)	(6.49)	(6.49)	(6.49)	—
Sugar	" "	984.00	—	—	—	—	—	—
Copra	" "	850.00	—	—	—	—	—	—
Poultry meat (dressed weight)	" "	5,293.41	(.84)	(.84)	(1.19)	(1.19)	(1.19)	—
Pork (dressed weight)	" "	5,555.78	(1.55)	(1.55)	(2.38)	(2.38)	(2.38)	—
Eggs	" "	5,488.53	(1.26)	(1.26)	(1.78)	(1.78)	(1.78)	—
C. Inputs								
1. Land								
J1	Pesos per hectare	510.80	24.90	7.01	5.38	5.38	5.38	(1.10)
J1	" "	443.80	8.49	8.49	6.74	6.74	6.74	(1.35)
I2	" "	249.40	12.19	12.19	10.10	10.10	10.10	(2.04)
I1	" "	169.30	11.75	11.75	8.15	8.15	8.15	(5.14)
R1	" "	240.90	31.34	11.54	9.46	9.46	9.46	(1.18)
R2	" "	—	—	—	—	—	—	(1.91)
U1	" "	32.60	5.52	5.52	1.23	1.23	1.23	(2.45)
U2	" "	29.00	(6.90)	(6.90)	(8.97)	(8.97)	(8.97)	0.34
V1	" "	—	—	—	—	—	—	—
V2	" "	—	—	—	—	—	—	—
2. Hand Tractor Services								
(January-February)	Pesos per day	—	—	—	—	—	—	—
(March-April)	" "	—	—	—	—	—	—	—
(May-June)	" "	94.0	22.55	4.89	3.62	3.62	3.62	.85
(July-August)	" "	—	—	—	—	—	—	(.64)
(September-October)	" "	—	—	—	—	—	—	—
(November-December)	" "	63.30	27.96	8.06	6.48	6.48	6.48	1.74
3. Four-Wheel Tractor Services								
(January-February)	Pesos per day	—	—	—	—	—	—	—
(March-April)	" "	312.20	(17.14)	(17.14)	(17.14)	(17.14)	(17.14)	(5.96)
(May-June)	" "	312.20	531.10	479.60	479.60	447.50	447.50	(2.75)
(July-August)	" "	312.20	(17.14)	(17.14)	(17.14)	(17.14)	(17.14)	(5.96)
(September-October)	" "	312.20	(17.14)	(17.14)	(17.14)	(17.14)	(17.14)	(5.96)
(November-December)	" "	325.90	32.65	10.68	9.02	9.02	9.02	2.61
4. Fertilizer Nutrients								
Nitrogen	Pesos per kilo	1.50	(18.67)	(18.67)	(18.67)	(18.67)	(18.67)	(6.00)
Phosphorous	" "	2.00	(19.00)	(19.00)	(19.00)	(19.00)	(19.00)	(6.50)
Potassium	" "	1.14	(18.42)	(18.42)	(18.42)	(18.42)	(18.42)	(6.14)
								3.51

Table C-9 (continued)

Description	Units	1972 MAGAP Base	MAGAP Solutions at Different Levels of Theta ^b									
			Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	Theta=
			0	10	20	30	40	63	167	-----Percent Increase or (Decrease) from the 1972 Base-----		
Phosphorous	1,000 m.t.	53.71	5.08	6.31	7.48	8.51	9.42	8.68	(3.63)			
Palay	"	34.71	(1.23)	(1.26)	(1.26)	(1.00)	(0.69)	—	—			
Corn	"	5.35	109.35	108.22	108.22	109.72	111.03	87.10	(36.45)			
Sugar	"	13.39	(20.09)	(14.64)	(9.93)	(7.09)	(4.78)	—	—			
Coconuts	"	—	—	—	—	—	—	—	—			
Potassium	"	40.77	(4.15)	(2.31)	(0.74)	(0.27)	(0.17)	—	—			
Palay	"	17.17	(1.16)	(1.16)	(1.16)	(0.93)	(0.64)	—	—			
Corn	"	2.00	2.00	3.00	3.00	2.50	(2.00)	—	—			
Sugar	"	21.60	(7.08)	(3.70)	(0.74)	—	—	—	—			
Coconuts	"	—	—	—	—	—	—	—	—			
G. Chemicals	Million pesos	78.55	(10.36)	(7.38)	(5.26)	(3.82)	(2.80)	(1.55)	(0.60)			
Medicines	"	5.33	(13.70)	(12.57)	(11.26)	(9.76)	(8.26)	(4.88)	2.06			
Insecticides	"	63.34	(8.73)	(5.10)	(1.86)	(0.21)	.93	2.19	(0.92)			
Veterinary	"	9.88	(19.03)	(19.23)	(23.79)	(23.79)	(23.79)	(23.79)	—			
H. Man Labor	Million man days	518.98	.53	0.61	.63	.62	.57	.37	(0.31)			
1. Grand Total	"	377.14	1.12	1.24	1.38	1.36	1.29	1.02	(0.43)			
2. Crop. (subtotal)	"	172.12	4.98	4.54	4.08	3.54	2.97	1.88	(0.71)			
a. Palay	"	16.80	46.67	42.02	37.32	32.68	28.04	17.26	(7.26)			
Period 01	"	—	—	—	—	—	—	—	—			
Period 02	"	87.72	0.16	0.16	0.16	0.13	0.08	—	—			
Period 03	"	—	—	—	—	—	—	—	—			
Period 04	"	54.06	1.15	1.17	1.17	0.94	0.63	—	—			
Period 05	"	—	—	—	—	—	—	—	—			
Period 06	"	13.54	(0.15)	(0.15)	(0.15)	(0.15)	(0.07)	(0.07)	(0.47)			
b. Corn	"	85.64	0.71	0.42	0.42	0.61	0.84	1.10	—			
Period 01	"	—	—	—	—	—	—	—	—			
Period 02	"	—	—	—	—	—	—	—	—			
Period 03	"	38.26	(0.81)	(1.10)	(1.10)	(.94)	(.68)	—	—			
Period 04	"	27.82	(.90)	(1.29)	(1.29)	(1.04)	(.75)	—	—			
Period 05	"	19.56	5.98	5.83	5.83	5.98	6.08	4.81	(2.04)			
Period 06	"	44.83	(11.04)	(7.81)	(4.84)	(3.30)	(2.14)	—	—			
c. Sugar	"	0.64	3.13	7.81	7.81	3.13	3.13	—	—			
Period 01	"	16.35	(19.82)	(16.27)	(12.91)	(9.72)	(6.42)	—	—			
Period 02	"	9.22	(9.22)	(5.53)	(2.28)	(1.19)	(0.26)	—	—			
Period 03	"	8.57	(5.13)	(2.22)	0.58	1.17	0.82	—	—			
Period 04	"	8.57	(5.13)	(2.22)	0.58	1.17	0.82	—	—			
Period 05	"	1.48	—	—	—	—	—	—	—			
Period 06	"	74.55	—	—	—	—	—	—	—			
d. Coconut	"	12.73	—	—	—	—	—	—	—			
Period 01	"	12.12	—	—	—	—	—	—	—			
Period 02	"	12.12	—	—	—	—	—	—	—			
Period 03	"	12.12	—	—	—	—	—	—	—			
Period 04	"	12.12	—	—	—	—	—	—	—			
Period 05	"	12.12	—	—	—	—	—	—	—			
Period 06	"	12.12	—	—	—	—	—	—	—			
3. Livestock (subtotal)	"	141.84	(1.06)	(1.06)	(1.35)	(1.35)	(1.35)	(1.35)	—			

Table C-9 (continued)

Description	Units	1972 MAAGAP Base	MAAGAP Solutions at Different Levels of Theta ^b									
			Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	Theta=	Theta=
			0	10	20	30	40	63	167	167	167	167
			-----Percent Increase or (Decrease) from the 1972 Base-----									
4. Coconut	Million animal days	6.06	—	—	—	—	—	—	—	—	—	—
Period 01	"	—	—	—	—	—	—	—	—	—	—	—
Period 02	"	2.02	—	—	—	—	—	—	—	—	—	—
Period 03	"	—	—	—	—	—	—	—	—	—	—	—
Period 04	"	—	—	—	—	—	—	—	—	—	—	—
Period 05	"	—	—	—	—	—	—	—	—	—	—	—
Period 06	"	2.02	—	—	—	—	—	—	—	—	—	—
L. Net Social Benefit												
OKJ	Million pesos	41,270.00	(0.38)	(0.31)	(0.24)	(0.18)	(0.12)	—	—	—	—	—
CS	"	35,299.00	(0.83)	0.38	0.54	0.55	0.55	0.55	0.55	0.55	0.28	0.28
PS	"	5,971	2.26	(4.41)	(4.91)	(4.49)	(4.07)	(3.26)	(3.26)	(3.26)	(1.67)	(1.67)

^aThe 1972 base period had a total available four-wheel tractor services of 161,500 tractor days. The procedure taken here was varying the availability of four-wheel tractor services while holding the hand tractor supply of services constant.

^bTheta refers to the percentage change from the stock of four-wheel tractor services, 1972 base. Theta = 0 means that no four-wheel tractor services were supplied at all. Theta = 10 means that only 10 percent of the 1972 base was supplied, etc., totaling to seven segments of parametric variation.

Table C-10. Comparison of the MAAGAP Model Results after Incorporating Crop Losses Due to Floods and Other Disasters

Description	Units	MAAGAP Results		Percent Increase or (Decrease) for the 1972 Base
		1972 Base	With Crop Losses	
I. Shadow Prices				
A. Primary products				
Palay	Pesos per m.t.	551.95	759.17	37.5
Corn grain	" "	384.41	458.10	19.2
Sugarcane	" " of cane	72.19	72.19	--
Coconut	" nut	0.12	0.12	--
Hogs	" head	93.5	81.9	(12.4)
Chickens	" "	8.0	8.5	(6.2)
B. Intermediate products				
Rice brokers	Pesos per m.t.	384.41	458.1	19
Rice bran (cono)	" "	384.41	527.33	37
Rice bran (kiskisan)	" "	562.07	713.35	27
Corn brokers	" "	--	--	--
Corn bran (kiskisan)	" "	562.07	713.35	27
Corn bran (cono)	" "	447.23	569.28	27
C. Finished products				
Rice	Pesos per m.t.	851.41	1,147.15	35
Corn grits	" "	481.94	538.6	12
Sugar	" "	984.0	984.0	--
Copra	" "	850.0	850.0	--
Poultry (dressed weight)	" "	5,293.4	5,107.6	(3.5)
Pork (dressed weight)	" "	5,555.8	5,913.9	6.4
Eggs	" "	5,488.5	5,218.4	(4.9)

Table C-10 (continued)

Description	Units	MAAGAP Results		Percent Increase or (Decrease) for the 1972 Base
		1972 Base	With Crop Losses	
D. Selected inputs				
1. Land				
Twice irrigated land (first season)	Pesos per hectare	510.8	742.0	45
Twice irrigated land (second season)	" "	443.8	652.0	47
Once irrigated land (first season)	" "	249.4	377.3	51
Once irrigated land (second season)	" "	109.3	208.0	23
Rainfed (first season)	" "	240.9	362.2	50
Rainfed (second season)	" "	--	--	--
First class upland (first season)	" "	32.6	42.7	31
First class upland (second season)	" "	29.0	35.2	21
2. Tractor services				
Hand tractor (May-June)	Pesos per day	94.0	134.8	39.0
" (Nov-Dec)	" "	63.3	93.3	47.0
Four wheel tractor (March-April)	" "	312.2	346.2	11.0
Four wheel tractor (May-June)	" "	312.2	346.2	11.0
Four wheel tractor (July-August)	" "	312.2	346.2	11.0
Four wheel tractor (Sept.-Oct.)	" "	312.2	346.2	11.0

Table C-10 (continued)

Description	Units	MAAGAP Results		Percent Increase or (Decrease) for the 1972 Base
		1972 Base	With Crop Losses	
Four wheel tractor (Nov.-Dec.)	Pesos per day	325.9	492.0	51.0
3. Fertilizer nutrients				
Nitrogen	Pesos per kilo	1.50	1.68	12.0
Phosphorous	" "	2.00	2.24	38.0
Potassium	" "	1.14	1.27	11.0
4. Feeds				
Feed for backyard hogs	Pesos per m.t.	562.10	713.4	26.9
Feed for commercial hogs	" "	384.40	458.1	19.0
Feed for backyard layer	" "	552.0	713.4	29.0
Feed for commercial layer	" "	230.6	295.6	28.0
Feed for commercial broiler	" "	230.6	274.9	19.0
II. Activity Levels				
A. Primary Production				
Palay	1,000 m.t.	5,568	4,603	(17.0)
Corn grain	" "	1,871	1,774	(5.1)
Cane sugar	" "	18,582	18,458	(.60)
Coconuts	Million nuts	8,080	7,908	(2.1)
Backyard hogs	" heads	7.6	7.5	(1.3)
Commercial hogs	" "	0.12	0.12	--
Semicommercial hogs	" "	.06	.06	--
Commercial broilers	" "	3.17	3.30	4.1
Commercial layers	" "	4.18	3.60	(13.9)
Backyard layers	" "	50.1	50.1	--

Table C-10 (continued)

Description	Units	MAAGAP Results		Percent Increase or (Decrease) for the 1972 Base
		1972 Base	With Crop Losses	
E. Selected inputs				
Short-term capital	Million pesos	3,396.01	3,317.3	(2.4)
Fertilizer (by types)	1,000 m.t.	533.1	539.9	1.3
Fertilizer (nutrients)				
Nitrogen	1,000 m.t.	130.3	134.5	3.2
Phosphorous	" "	53.7	53.3	(0.8)
Potassium	" "	40.8	40.8	--
Chemicals	Million pesos	78.6	79.3	0.9
Man labor	Million man days	518.98	517.3	(0.3)
Hand tractor	1,000 tractor days	438	438	--
Four wheel tractor	" "	312.9	312.9	--
Animal labor	" "	104.3	104.3	--
F. Social welfare				
OBJ	Million pesos	41,270	40,545	(1.8)
C.S.	" "	35,299	34,210	(3.2)
P.S.	" "	5,971	6,335	6.1

VITA

Leonardo Gonzales Y Alpendo was born on the 6th of December, 1943, at Careb, Bagabag, Nueva Vizcaya, Philippines. He attended high school at St. Jerome's Academy (Bagabag) and graduated Valedictorian in 1960. He received a Bachelor of Science degree, cum laude from St. Mary's College (Bayombong) in 1965.

After graduation, he accepted a job as a classroom teacher at the Father Villaverde High School until 1967. He joined the Asian Social Institute (ASI) Graduate School of Economics as a research assistant in 1967 and finished his Master's degree in economics from the same institution in 1971. Shortly thereafter, he accepted a job as an economics researcher with the First National City Bank of New York, Philippine Branches.

In the Summer of 1971 he was awarded a Fulbright-Hays scholarship to study in the United States. He formally started his graduate study program at The University of Tennessee in September 1971. From July 1974 to September 1975 the author was a recipient of a USDA/USAID travel research grant to the Philippines, where he participated in Project Agricultural Diversification and Markets (ADAM) and collected the data for his dissertation.

He is married to the former Vivian U. Alvarez of Pangil, Laguna, Philippines. They have one daughter, Ava Vivian.