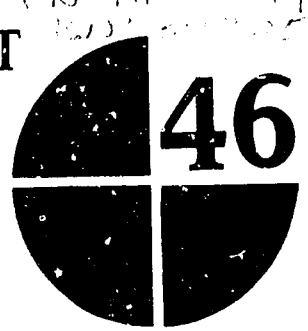
RESEARCH REPORT



THE EFFECTS ON INCOME DISTRIBUTION AND NUTRITION OF ALTERNATIVE RICE PRICE POLICIES IN THAILAND

Prasarn Trairatvorakul

November 1984

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FOREWORD

The research program of the International Food Policy Research Institute has been particularly concerned with the food consumption and nutritional status of low-income consumers. The effects of food subsidies, both explicit and implicit, have been analyzed in a number of countries, as have the production effects of the various food pricing regimes. These issues are best analyzed by detailed empirical studies of the impact of changes in food prices on various socioeconomic groups according to their varying consumption patterns and income sources and levels. In this context, the secondary effects on employment in food production also need to be taken into account.

Prasarn Trairatvorakul analyzes the specific case of Thailand's rice export tax and its concomitant reduced domestic price of rice to both producers and consumers. Trairatvorakul demonstrates a disaggregated approach that sorts out the complex effects of changes in the rice price on several groups of producers and consumers. The conclusion reached—that a reduction in the export tax would have little impact on the rural poor, while making the urban poor worse off and leaving the relative income distribution of the population as a whole virtually unchanged—has important implications for fiscal policy as well as for policy aimed at income distribution and agricultural growth.

The complexity of the problem analyzed by Trairatvorakul necessarily raises many questions about assumptions, logic, and sources of data. The study lays out in detail the considerations that went into those choices. Thus the report provides a careful analysis with well-documented conclusions as well as an analytical approach expected to be useful for studying the equity implications of food price policies under similar or quite different conditions.

John W. Mellor

Washington, D.C.
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Most of the data used in this analysis are taken from the 1975/76 Socioeconomic Survey conducted by the National Statistical Office of Thailand. The author would like to thank Oey Meesook of the World Bank, who obtained a compilation of the complete data set and shared it with the author, and Varai Waramontri of the NSO, who was helpful in clarifying the data.

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1

SUMMARY

Rice policy is of overriding concern to government decisionmakers in Thailand for a number of reasons. Rice production employs a large part of the country's total labor force—56 percent in the wet season and 18 percent in the dry season in 1977. Semisubsistence farmers and the landless poor make up a major portion of the labor force. Rice is the primary source of calories—40-90 percent of total calorie intake—and is the major determinant of the real income of the poor. About 20 percent of the total household consumption expenditures of the poor go to rice.

Thailand is one of the largest exporters of rice. The government collects a substantial amount of export taxes and uses export control to regulate the domestic price. This has been more successful in keeping the price low than in supporting the price when there is a surplus in the world market. In general the low domestic rice price benefits consumers and hurts producers. A part of the tax falls on foreign consumers. The tax revenue contributes to government finances, but the contribution is relatively small.

Thai policymakers and scholars have debated for a number of years whether the government should change its policy and allow the domestic price of rice to reflect export prices. This study analyzes the effects of changes in the rice price on low-income people in Thailand. Contrary to what is widely believed, the study finds that net gains to the rural poor from increases in the rice price would be minimal. Most of the gains would accrue to large commercial farmers. Many small farmers subsist on the paddy they produce, and many are net purchasers of rice. The top three deciles of rural households, the richest households, would receive about 48 percent of the total net gains to the rural sector. Only about 13 percent of the rural net gains would go to the bottom four deciles, the impoverished group.

However, even if the income gained by paddy farmers from an expansion in paddy production is included and the nominal wage rates of all wage earners are adjusted to the rise in the price of rice, the top three deciles of rural households would receive 37 percent of the total net gains to the rural sector. The bottom four deciles would gain only about 27 percent.

In this study a partial equilibrium approach is used to determine the effects of specific rice price policies. Instead of constructing a general equilibrium model, the critical elements of the model are delineated and analyzed one by one to examine the interactions among them.

The responses of cultivated areas and production yields of wet- and dry-season crops to changes in rice prices are estimated. The price-wage link is not investigated in detail; however, Floyd's formula is used to calculate the elasticity of the wage rate with respect to rice price. The formula is basically derived from a Cobb-Douglas production function.

In the consumption analysis, several methods of disaggregating the sample are investigated. The disaggregated consumption parameters for specific groups of the population are estimated directly using a large cross-sectional data set. For the study of the effect of rice price changes on the calorie intake of paddy farmers, the income effect due to price changes is also included.

The sample population is disaggregated as much as possible so that the distributional effects can be determined more precisely. Most of the results represent short-run effects; long-run effects may be different.

The core data set used in this study is the 1975/76 Socioeconomic Survey conducted by the National Statistical Office of Thailand. A total of 12,189 households was included in the survey, and they constitute a representative sample of the total population. This data set is supplemented by data from other sources as required.

The aggregated response of rice production to price changes is estimated to be 0.36 in the short run. The highest statistically significant estimate is for the yield response of the second crop. Second crops are possible

only on irrigated land, where farmers tend to have higher incomes than those with only rainfed land.

According to this study, the Thai rural labor market is quite responsive to market demand. However, hired labor is only a small portion of total labor use in rice production. The effects of rice price changes on the rural farm wage rate depend on the size of the supply elasticity of hired labor in the rice sector, which is difficult to estimate.

This study tentatively suggests that the supply elasticity of hired labor could be quite high, in which case the impact on rural wages would be minimal. However, it is beyond the scope of this study to estimate the exact labor supply elasticity or the effects on the urban wage rate.

Urban high-income consumers on the average spend as much on rice as urban low-income consumers, but the relative burden on the urban poor from rice price increases is higher. When data for the urban and rural poor are combined, changes in the rice price have only a small effect on the incidence of poverty. The net income transfer seems to flow from urban consumers and government-controlled funds to large commercial farmers. The effect on overall income distribution, however, is minimal.

The consumption analysis is based on household expenditure data. Hence, it is not possible to identify actual malnourished individuals or to examine questions such as the proper amount of rice for preschool children to consume. But, based on a daily calorie requirement of 2,500 calories for each adult-equivalent consumption unit, about half of the Thai urban and rural households are found to have calorie deficiencies.

However, within each income group, calorie intake varies widely. It is not always true that the consumers whose incomes are below a cutoff point will consume fewer calories than those above that point. Thus, both income and actual calorie intake are combined to disaggregate the sample households into four groups: low income and low calorie intake; low income but high calorie intake; high income but low calorie intake; and high income and high calorie intake.

The high-income-but-low-calorie-intake group tends to consume more expensive calories and has the lowest marginal propensity to consume foods. They are more likely to be found among the self-employed with paid workers; the self-employed professionals; and the management, administrative, and professional employees.

Those in the low-income-but-high-calorie-intake group spend a larger proportion of their household budget on cheap sources of calories such as rice and have a high marginal propensity to consume foods. Those in the low-income-and-low-calorie-intake group also choose inexpensive calories, but they are unable to acquire enough to meet their needs because their incomes are low, although they are often employed. Their family sizes are also found to be larger than the sample averages.

The total sample households are disaggregated by income, calorie intake, socioeconomic group, type of rice consumed, size of marketable surplus, and by combinations of these variables. The consumption parameters using calorie intake to select the sample groups are biased and inconsistent. When the sample is disaggregated according to income, however, the own-price elasticity of rice consumption of specific socioeconomic groups—basically those made up of the poor—is significantly negative in the long run, ranging from -0.4 to -0.7. Because rice is the major source of calories for these people, the effects on total calorie intake of rice price changes are large.

The socioeconomic groups that are found to be most vulnerable to changes in the rice price because their average incomes are low are small paddy farmers, small farmers of other crops, those in fishing and forestry, the self-employed without paid workers, farm workers, production workers, and general workers.

Among the paddy farmers, sources of income are quite diverse. Most of them, however, are small farmers. Fifty-eight percent sell less than 10 percent of their production, and many of them are net purchasers of rice. Only about 30-50 percent of total rice production is sold, depending on crop conditions. The price elasticities of marketable surplus are positive, ranging from 0.8 to 1.2.

The paddy farmers' desire to acquire food is similar to that of other groups of consumers, but paddy farmers are more likely to consume rice than other consumers. Consumption of home-produced rice can save the farmer on the average about 20 percent of the selling price of paddy due to savings in marketing costs. However, the price elasticities of rice consumption converted to calorie intake for the paddy farmers are neg-

ative, ranging from - 0.3 to - 0.8.That is, when the price of rice rises, the farmers are likely to sell more and eat less, and because other foods are not substituted for rice, calorie intake also declines.

Therefore, one should not expect that any government policy to increase the domestic price of rice will significantly alleviate rural poverty. The gains in real income of the rural poor would be quite small. For both the rural and urban poor who are net purchasers of rice, the losses in real income can be substantial in relation to their low incomes. These people may respond by decreasing the amount of rice consumed. And since their present calorie intakes are already low, a higher rice price could be harmful to their nutritional status.

2

INTRODUCTION

Rice is the primary source of calories for all Thais. It is the basic ingredient of most meals; other foods are mere embellishments. Thailand has one of the world's highest rates of per capita rice consumption, nearly 500 grams per day. Burma consumes 400 grams per capita per day; Japan, 300; the Republic of Korea, 300; India, 170; Brazil, 130; and the United States, 9. For some socioeconomic groups, such as farmers and the rural and urban poor, the spending on rice is remarkably high—about 20 percent of total household expenditures and about 40 percent of expenditures on food and beverages. Thus the rice price is an important determinant of real income among low-income Thais.

Paddy production employs 56 percent of the total labor force in the country during the wet season and 18 percent during the dry season according to the 1977 Labor Force Survey. The value added created by rice production as a percentage of GDP in constant prices declined steadily from 14 percent in 1967 to 6 percent in 1975 due to the increasing diversification of the national economy, yet it is still one of the largest sources of employment. In addition to the labor force in paddy production, there is significant employment in rice milling and in rice trade. During 1966-68 rice exports accounted for 30 percent of the total export values. This figure declined to 20 percent during the period 1969-75 and to 14 percent in 1983 as crops in the domestic production system became more diversified.

The Thai rice system is intimately related to the world grain system. The government intervenes in rice trade, both domestically and internationally. A principal policy objective of the Thai government is to control export volumes to ensure that sufficient domestic supplies are available at acceptable consumer prices. These prices are normally well below world market prices. Consequently, most of the control measures used by the government depress the rice prices received by farmers. In addition to these general pricing policies, in some years the government maintains a two-tier domestic price scheme, which makes rice available to the urban and rural poor at a lower price.

The information available on the income, consumption, and nutritional effects of existing and alternative pricing policies is insufficient. Whereas the economy-wide effects have been estimated in the past, less is known about the impact on specific population groups, such as the rural and urban poor. What if the rice price were to increase or decrease by a certain amount in real terms? How would the distribution of income among the Thai population change? Additional research on this topic is expected to improve the foundation for policy design.

The objective of this study is therefore to answer the following specific policy questions:

1. If the domestic rice price were to increase or decrease by a certain amount in real terms, what would be the effect on the incidence of poverty and inequality in Thailand?
2. Who will gain and lose and by how much from such policy changes? Can these population groups be identified?
3. What will be the effect of a rice price change on the output of paddy?
4. What will be the effect on the rural farm wage rate?
5. What will be the effect on the calorie intake of consumers?
6. What will be the effect on the calorie intake of paddy farmers?

Background

Government intervention in rice trade began on a massive scale soon after World War II. Monopolistic control of rice exports by the government's Rice Office lasted until 1954, when its efforts to control private ex-

porters were modified to take the form of issuing export licenses and collecting fees. Other policy measures were introduced later on, and some of them are still being used today. The primary objective in the old days seemed to be to generate government revenue. This objective has become secondary since the country's economy has expanded and diversified. The primary concern for Thai policymakers today is to ensure that the rice surplus is traded at prices deemed suitable to producers, consumers, the government, and foreign buyers.

There are already many studies on the economic efficiency and the political economy of these policy interventions.[1] The common debates in these studies center around the issues of how elastic the world market demand for Thai rice is and whether the domestic marketing system is competitive. Economists who believe that the world market demand for Thai rice is not perfectly elastic argue for an optimal tax rate for rice exports. The question of competitiveness is related to the question of how much paddy farmers will benefit from a reduction in export control. Nevertheless, there is at least a common agreement among these scholars that these export control measures have resulted in a domestic price of rice that in normal years is substantially below the world market price.

Here it will be enough to provide a brief description of these policies and to delineate their relationship to the policy questions given in this chapter. Instead of looking at the political economy and economic efficiency of these policies, this study will address their distributional and nutritional effects.

In a review of rice policies in a number of countries, Timmer and Falcon identified eight objectives that most nations generally pursue. They include generation of farm income, government revenue, and foreign exchange and promotion of self-sufficiency, consumer welfare, domestic price stability, regional development (equity), and adequate nutrition.[2] For Thailand, which is already self-sufficient, promotion of self-sufficiency is not relevant. In his study of the history of Thai rice policies during 1955-73, Siamwalla judged that regional development and nutrition were not considered by Thai policymakers.[3] He concluded that in 1955 government revenue and foreign exchange were most important in determining policy. In 1973, however, price stability, farm income, consumer welfare, and foreign exchange were all more important than government revenue.

Adopting the same method of assessment for 1983, one is tempted to include equity and nutrition in the list. There is a distinction, however, between the officially stated objectives and those observed in actual policy implementation, and these two objectives still receive little consideration. The weights assigned by Siamwalla for 1973 may have changed only slightly by 1983. The objective of domestic price stability still receives the highest emphasis from Thai policymakers. Hence, the policy mechanisms that are described in the following sections have the common goal of insulating the Thai domestic rice economy from price fluctuations in the international market.

Policy Mechanisms

There are five major mechanisms that the government uses to control rice exports. Three of these are tax related: export duties, rice premiums, and rice reserve requirements. The other two are government-to-government (G-G) sales and export quotas. How much these mechanisms are applied is partly in-

[1] Selected studies include Ammar Siamwalla, Chirmsak Pinthong, and Vatchariya Tosanguan, *Agricultural Pricing and Marketing Policy in Thailand* (Bangkok: National Economic and Social Development Board, 1981) (in Thai); Trent Bertrand, *Thailand Case Study of Agricultural Input and Output Pricing* World Bank Staff Working Paper 385 (Washington, D.C.: World Bank, 1980); Chung Ming Wong, "A Model for Evaluating the Effects of the Thai Government Taxation of Rice Exports on Trade and Welfare," *American Journal of Agricultural Economics* (February 1978): 65-73; Ammar Siamwalla, "A History of Rice Policies in Thailand," *Food Research Institute Studies* 14 (No. 3, 1975): 233-249; Bertrand Renaud and Phiphit Suphaphiphat, "The Effects of the Rice Export Tax on the Domestic Rice Price Level in Thailand," *The Malayan Economic Review* 16 (April 1971): 84-102; and Sura Sanittanont, "Thailand's Rice Export Tax: Its Effects on the Rice Economy" (Ph.D. dissertation, University of Wisconsin, 1966).

[2] C. Peter Timmer and Walter P. Falcon, "The Political Economy of Rice Production and Trade in Asia," in *Agriculture in Development Theory* ed. Lloyd Reynolds (New Haven: Yale University Press, 1975), pp. 373-408.

[3] Ammar Siamwalla, "A History of Rice Policies in Thailand."

fluenced by market conditions. Normally, the desired domestic prices for milled rice and paddy are agreed upon by the government cabinet. Most policies are implemented by the Ministry of Commerce through its Department of Foreign Trade.

Export Duties and Rice Premiums

In an economic sense rice premiums and reserve requirements are considered as export taxes. Of the three types of taxes, only the export tax is set by the legislature; the export premium and the rice reserve requirement are created by the executive branch and it is under its jurisdiction to impose, repeal, or modify these taxes. The export tax is considered to be an ad valorem tax (one with rates varying according to market prices).

The rice premium is more important than the export tax because it is generally larger in scale and subject to large and rapid adjustments. It is a fixed rate per ton, which is equivalent to a specific tax, as opposed to an ad valorem tax. The rate varies according to the grade and is altered at irregular intervals by the Ministry of Commerce. Since 1974, the proceeds have been designated as the Farmers' Aid Fund. They are controlled by the Ministry of Agriculture and Cooperatives.[4]

Rice Reserve Requirements

The rice reserve requirements are amounts of rice that exporters are required to sell to the government at below-market prices. They are a fixed proportion of a specified grade of rice for every ton exported. Their sole purpose is to ensure that the government has a supply of rice that can be sold in urban rice shops in Bangkok at a price below current retail market prices (apparently without regard for urban dwellers' income). The rice reserve was first introduced on a limited scale in 1962 and reintroduced on a major scale in August 1966.

The reserve requirement is usually abolished or suspended when there is a surplus of domestic supplies that causes retail prices to fall below a level that the government feels is politically acceptable. It has often been a clumsy and ineffective mechanism for export control, sometimes producing the opposite effects of those intended. When reserve ratios are high, the amount of rice moving into the reserve is substantial. For example, contributions to the reserve were equal to 39 percent of annual exports in 1973 and 59 percent in 1974.

Because the price paid by the government for reserve rice is less than the Bangkok wholesale price and presumably less than the price exporters pay, the exporter incurs a loss on the rice delivered to the reserve. In 1973, for example, losses incurred by exporters on rice reserves ranged from about 1,100 baht per ton to 2,600 baht per ton.[5]

Government-to-Government Sales

G-G sales are direct sales between two governments based on contracts between the Thai government (usually represented by the Department of Foreign Trade, Ministry of Commerce) and a foreign government or governmental organization. Most of the Thai G-G exports are of low-quality rice (including 15 to 45 percent broken rice and special mixtures), white broken rice, and parboiled rice. Only a small amount of high-quality rice is exported G-G.

Export Quotas

The export quota is a direct control over the volume of rice exports, especially during periods of short supply on the domestic market, when it has proven more effective than raising the rice premium. In particular, when a world shortage arises, as in 1972-73, importers are willing to buy rice at higher prices. Rice premiums alone, however, do not curb exports sufficiently to assure domestic supply at the desired prices. For example, in mid-1973 the government had to impose an export ban on white rice. Export quotas are also used by the government during years of normal supply.

Price Support

In addition to these export intervention policies, in recent years when prices have been weak, the government has initiated a small, ineffective price-support program,

[4] A brief description of the role of the Farmer's Aid Fund is given in Chapter 8.

[5] Before mid-1981, U.S. $1.00 equaled 20-21 baht; in mid-1981 the baht was devalued to U.S. $1.00 equals 23 baht. In November 1984, the baht was floated against the U.S. dollar and its initial value was set at U.S. $1.00 equals 27 baht.

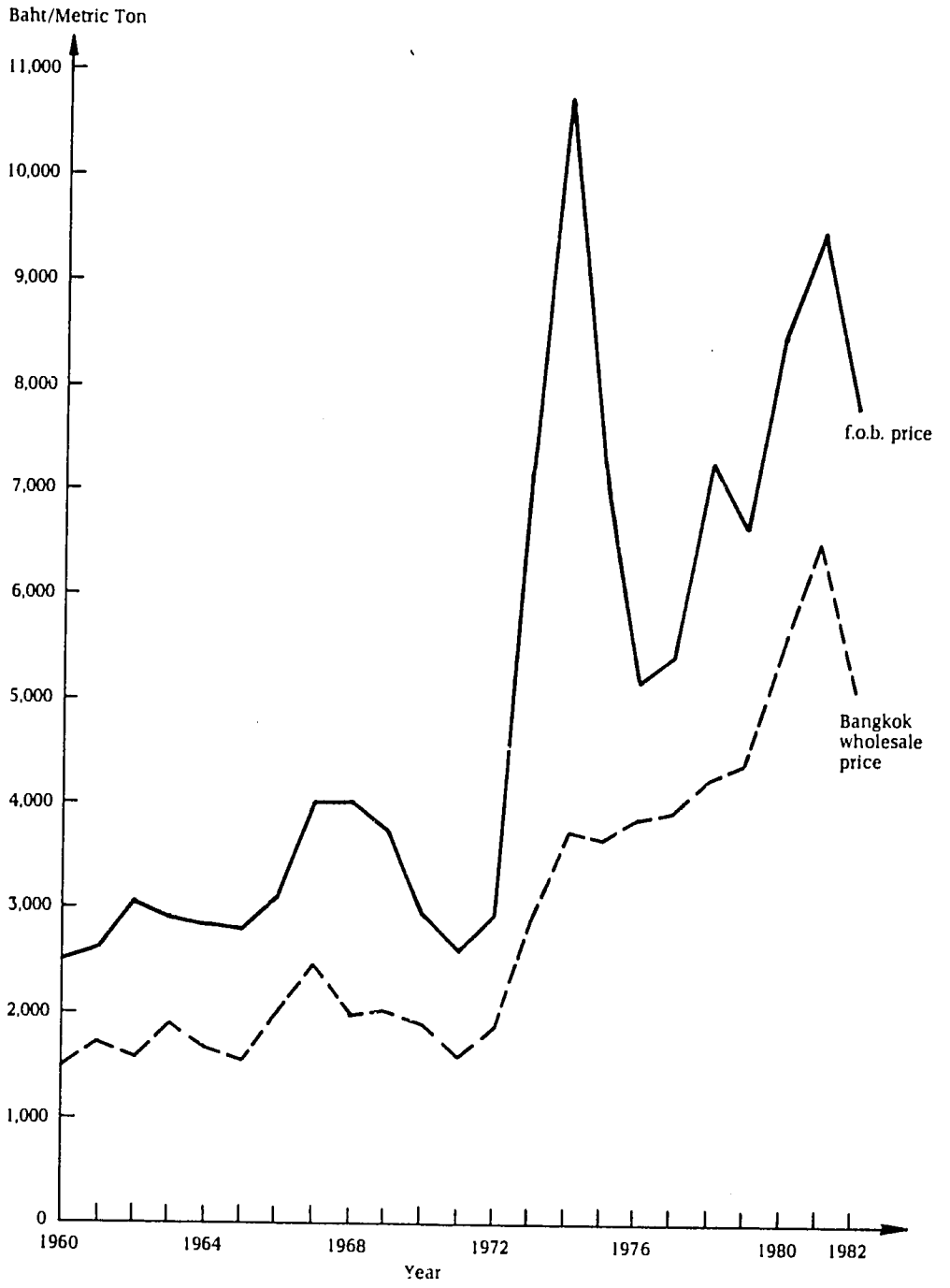
making limited purchases of paddy in the domestic market. The program is not large enough to cover all output. So the domestic paddy prices remain linked to world prices through export taxes, and there are no secondary effects in the market to raise the domestic paddy price through the whole market. Additional demand created by limited government purchase is more artificial than real. If the price paid is higher than the market price, the program in effect gives a government subsidy to the farmers (or rice millers) who participate in the program. If market prices are paid, the government purchase in effect takes away the market shares of the private sector.

Policy Implications

Most of the government's export control policies have resulted in low domestic prices for rice. This is shown clearly in Figure 1. During the past two decades the wholesale price of 5 percent broken milled rice in the Bangkok market has ranged from only 35 percent of the f.o.b. export price in 1974 to about 75 percent in 1976. The weighted average was 63 percent during the period 1960-82.

In recent years the Thai government has been under pressure from many directions to reevaluate the method of setting the domestic rice price. The recommendations range from trying to close the gap between the domestic price and the world market price (leaving only the necessary marketing costs and profits between them) to calibrating the rice price in an effort to close the welfare gap between the paddy farmers and the urban consumers. One common feature of all these recommendations is the possibility of shifting upward the whole structure of domestic rice prices. The task of this study is to identify and quantify where possible the distributional and nutritional effects of such price increases.

Figure 1—Wholesale and export prices of Thai milled rice, 5 percent broken, 1960-82



Sources: The f.o.b. rice prices were obtained from the Thailand Board of Trade, and the wholesale prices from the Bank of Thailand.

3

RICE PRICE, POVERTY, AND INCOME DISTRIBUTION

Methodology and Assumptions

To examine the effects of alternative pricing policies on the real incomes of different groups of the population, this study uses the 1975/76 Socioeconomic Survey (SES). In addition to the detailed information on household expenditures and income patterns, the data set gives information on quantities and values of paddy produced and sold by rice farmers. That the sample households were systematically selected to represent the total population during the corresponding years is crucial to this study. The poverty incidence is measured using the calculated poverty line based on the minimum income needed to acquire an adequate diet. Two methods are employed to determine the incidence of poverty under different policy scenarios: simple head counts of those below the poverty line and Sen's somewhat more sophisticated poverty index.[6] Relative inequality is measured using Gini coefficients. The simulation exercise is carried out under conditions of no change in the price of rice and increases of 10, 20, 30, 40, and 50 percent.[7]

In order to estimate the current and short-run effects of a rise in the price of rice without relying on statistical estimates of the production response of paddy farmers, the effects on the wage rate, and the influence on rice consumption, the following assumptions are made in the initial simulation: first, the influence of supply changes caused by price changes on farmers' incomes is negligible; second, the influence of rice price changes on the wage rate is also negligible; and third, rice price changes have no influence on rice consumption. Estimates obtained under these assumptions provide a first approximation of short-run effects. These assumptions will be detailed in subsequent chapters, thus providing more exact estimates. In Chapter 8 additional scenarios will be provided as these assumptions are modified.

Since the current supply of rice is predetermined by the production decisions and the weather conditions of the previous year, production may take at least a year to respond to price changes. The wage rate is determined by the supply and demand of labor, and labor demand is in turn determined by the decision to increase production. Hence, in the short term, the first and second assumptions are quite valid.

The consumption parameters are estimated in Chapters 6 and 7. Because the poverty lines are calculated based on adequate diets, each household must consume at least the minimal amount of calories to be considered nutritionally satisfactory. Because rice is the single most important item in the Thai diet, substitution for rice is quite unlikely; the assumption that there is no adjustment of consumption is justified. The following components are used in the methodology.

Poverty Lines

Poverty lines are estimated by calculating the minimum income needed to acquire the minimum diet considered adequate. An example is given in Table 1 based on the normal consumption pattern of the Thai population as estimated by the World Bank.[8] One set of required incomes is calculated for the rural population and another for the urban pop-

[6] Amartya Sen, *Poverty and Famines* (London: Oxford University Press, 1981).

[7] These calculations determine the short-run effects and are valid when the changes in the rice price are not very high (say 10-20 percent). At 40-50 percent, however, determination of the longer-term dynamic aspects becomes necessary. Political consideration is also called for. The 40 and 50 percent increases are included to show the possible extreme cases under the assumptions.

[8] World Bank, *Thailand: Income Growth and Poverty Alleviation* (Washington, D.C.: World Bank, 1980).

Table 1—Daily per capita food consumption, rural and urban consumers, 1975/76

Food Item	Rural					
	Calories/ Day	Percent of Total Calories	Grams/Day	Kilograms/ Year	Baht/ Kilogram	Baht/Year
Milled rice	1,515.2	76.6	414.0	151.1	2.48[a]	374.7
Rice noodles	...	...	...	...	...	...
Pork	122.7	6.2	30.2	11.0	21.67[a]	238.4
Catfish	29.7	1.5	30.3	11.1	21.85	242.5
Eggs	5.9	0.3	3.6	1.3	19.13	24.9
Cowpeas	...	...	...	...	...	...
Chinese cabbage	13.8	0.7	76.7	28.0	5.42	151.7
Bananas	5.9	0.3	5.9	2.2	2.36[a]	5.2
Lard	263.1	13.3	29.2	10.7	18.94	202.7
Sugar	15.8	0.8	4.5	1.6	5.88	9.4
Fish sauce	5.9	0.3	34.7	12.7	7.34	93.2
Total	1,978.0	100.0	...	...	...	1,342.7

Food Item	Urban					
	Calories/ Day	Percent of Total Calories	Grams/Day	Kilograms/ Year	Baht/ Kilogram	Baht/Year
Milled rice	1,321.3	66.8	361.0	131.8	2.48[a]	326.9
Rice noodles	33.7	1.7	16.6	6.1	3.56	21.7
Pork	176.0	8.9	43.3	15.8	20.35[a]	321.5
Catfish	43.5	2.2	44.4	16.2	16.85	273.0
Eggs	17.8	0.9	10.9	4.0	19.13	76.5
Cowpeas	4.0	0.2	10.8	3.9	6.34	24.7
Chinese cabbage	25.7	1.3	142.8	52.1	4.41	229.8
Bananas	9.9	0.5	9.9	3.6	3.27[a]	11.8
Lard	320.4	16.2	35.5	18.0	18.71	243.2
Sugar	21.8	1.1	6.2	2.3	5.85	13.5
Fish sauce	3.9	0.2	22.9	8.4	5.97	50.2
Total	1,978.0	100.0	...	...	...	1,592.8

Sources: World Bank, *Thailand Income Growth and Poverty Alleviation* (Washington, D.C.: World Bank, 1980); mission calculations based on the report of the Sixth ASEAN Workshop on Food Habits and In-Field Implementation of Nutrition Program, Manila, November 5-11, 1978; Food and Agriculture Organization of the United Nations, *Food Composition Table for Use in East Asia* (Rome: FAO, 1972); Thailand, Ministry of Commerce, *Consumer Price Indexes for Bangkok Metropolis and Northern Region, 1976* (Bangkok: MOC, 1977). Preliminary estimates of food and nonfood expenditures for the lowest 20th percentile of consumers are taken from Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Note: Prices given are for 1975/76. In addition, those in rural areas spent an average of 637.7 baht on nonfoods and those in urban areas spent 1,367.8 on nonfoods.

[a] According to the Ministry of Commerce, Department of Business Economics, the price of rice was about 4.50 baht per kilogram, that of pork was about 31.00 baht per kilogram, and that of bananas about 5.60 baht per kilogram. According to World Bank sources, the price data given in this table are for lower qualities of these three items.

ulation. The figures in Table 1 are given in 1975/76 prices and correspond with the SES data set used in this analysis.[9]

In Table 2 the poverty lines are estimated on a monthly per capita basis based on the following price scenarios: no change in the rice price and increases in the rice price of 10, 20, 30, 40, and 50 percent.

[9] The price data for milled rice, pork, and bananas used in Table 1 are questionable. Data obtained from the Ministry of Commerce indicates that prices of these foods were higher. The calculations are left unchanged here so that the results from this study will be compatible with previous studies in this area, including those by the World Bank. In Chapter 6 the price data for these three items are corrected.

Poverty Incidence

Each time the rice price is increased, the incomes of rice producers are also increased, depending on the amount of paddy produced. Under the assumption of constant wages, the incomes of other consumers are not changed. Let I_0 represent the monthly current incomes of the sample households under existing conditions, I_{10} represent the new monthly current incomes after a 10 percent increase in the rice price, and VP represent the annual value of paddy production.

For rice producers,

$$I_{10} = I_0 + [(VP \times 0.10)/12 \text{ months}]; \quad (1)$$

for other consumers,

$$I_{10} = I_0. \quad (2)$$

In all of the following calculations, a conversion ratio of 0.66 is used to convert the quantity of paddy to the equivalent quantity of milled rice. Income is calculated on a per capita basis. There is no correction of the per capita income based on the number of adults and children in the household or the possible economies of scale in consumption in order to be consistent and comparable with previous works on the Thai data set. In Chapter 6, a nutritional scale is used for this adjustment.[10]

When the rice price changes, both income distribution and the poverty line change. The poverty line is altered on the basis of new expenditures on rice. The simulation will detect how many households in each region, community type, and socioeconomic group move into and out of poverty based on their new income levels and new poverty lines.

Aside from simply counting the number of households falling below the poverty line, Sen's poverty index can be used to take into account the gap between the households' income and these poverty lines.

Sen's poverty index is defined by the formula

$$P = H[I + (1 - I)G], \quad (3)$$

where

P = index of poverty incidence,

H = the proportion of households falling below the poverty line,

I = the percentage shortfall of the average income of the poor below the poverty line, and

G = the Gini coefficient for the poor.

Income Distribution

When the rice price changes, changes are possible in both the incomes and expenditures of the sample households. In analyzing the effects on the incidence of poverty, changes in household expenditures have already been incorporated in the new poverty lines. Thus the incremental expenditures from rice price increases are not included in equations (1) and (2). In contrast, the calculation of new incomes in this section must incorporate changes in expenditures to determine the final real incomes of these households.[11] New incomes can be calculated for rice producers:

$$I_{10} = I_0 + [(VP \times 0.10)/12 \text{ months}] - (E \times 0.10); \quad (4)$$

and for other consumers:

$$I_{10} = I_0 - (E \times 0.10), \quad (5)$$

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[10] Discussion of the use of the equivalence scale can be found in, for example, Angus Deaton, "Inequality and Needs: Some Experimental Results in Sri Lanka," in *Population and Development Review*, special issue on "Income Distribution and the Family," a supplement to 8 (1982): 34-49. Such correction is not expected to significantly change the results in this chapter. From equations (1) and (2), the total sums of the nominal incomes of the population are increased by the 10 percent price rise. This increase also corresponds with the rise in the population expenditures. Hence, the real incomes of the total population remain the same.

[11] An alternative way to calculate the new real income is to construct a price index $\pi = (1 + r)^s$, where r is the fractional change in the rice price and s, the budget share of rice. Then $I_{10} = I_0 \pi$. However, when considering the expansion of the following power series, the two methods of calculation should yield similar results:

$$(1 \pm x)^n = 1 \pm nx + [(n(n-1)x^2)/2!] + [(n(n-1)(n-2)x^3)/3!] + \ldots (x^2 < 1).$$

Table 2—Rural and urban poverty lines at 1975/76 rice prices and after rice price increases of 10 to 50 percent

Rice Price Increase	Rural Areas[a]	Urban Areas[b]
(percent)	(baht/person/month)	
0	165.0	246.7
10	169.4	251.2
20	173.7	256.6
30	178.3	261.9
40	182.9	267.3
50	187.5	272.7

Source: Based on daily per capita food consumption data in Table 1.

[a] Rural areas include sanitary districts and villages in Northern, Northeastern, Central and Eastern, and Southern regions and the suburban and fringe areas of Bangkok. A sanitary district is a community that is urbanized less than a municipal area but more than a village.

[b] Urban areas include municipal areas of the four regions and the Bangkok metropolis.

where E is the monthly expenditure on rice by the sample households.

The indexes used to measure the income distribution are Gini coefficients.[12] The Gini coefficient is:

$$G = 1 + (1/H) - (2/HY)[\Sigma_1^H \rho(h)y^h], \quad (6)$$

where

H = total number of households,

y^h = per capita income of household h,

Y = total amount of the per capita income y^h, and

$\rho(h)$ = high to low rank assigned to household h based on y^h.

Changes in the Incidence of Poverty

If the rice premium is rescinded completely, in some years the domestic price of rice may go up as much as 50 percent.[13]

Table 3 shows the number of households moving into and out of poverty and the changes in the overall incidence of poverty. As expected under the assumption of constant wages, no households that do not produce rice move out of poverty, but a significant number of households that do produce rice move into poverty when the rice price increases. As shown in the last column, the national average of the incidence of poverty improves (declines) slightly as rice prices increase up to 30 percent and becomes worse (rises) at 40 and 50 percent. But the sizes of these changes are small.[14]

In Table 4, changes in the incidence of poverty are disaggregated by region and community type. As expected, the incidence in the municipal areas, sanitary districts, and most of the Greater Bangkok metropolitan area[15] increases as the rice price increases, whereas the incidence in the villages decreases except in the Southern Region, which is a rice-deficit area. The last row in Table 4 shows the distribution of the actual number of households in the total population. In 1976 there were about 7.9 million households in Thailand. Therefore a decrease in the poverty incidence of half a percentage point indicates about 39,500 fewer households in poverty.

Sen's poverty index shows that increasing the rice price by increments of 10 percent up to 50 percent can cause poverty in the municipal areas, sanitary districts, and the Bangkok metropolitan area to increase almost steadily (Table 5), whereas poverty in the villages improves slightly with lower price increases and worsens with price increases of 40 and

[12] A discussion of different ways to measure inequality can be found in Amartya Sen, *On Economic Inequality* (Oxford: Clarendon Press, 1973). Equation (6) is taken from Angus Deaton, "Inequality and Needs," pp. 34-49.

[13] No distinction between nonglutinous and glutinous rice is made here for two reasons. First, in the production data of the 1975/76 SES, the distinction between these two types of rice is not reliable. (This does not hold true, however, for the consumption data.) Second, in general there is a strong correlation between prices for these two types of rice.

[14] The incidence of poverty rises when the rice price is increased by 40 percent because the real income of one group of the population increases, whereas that of another group decreases. The proportion of these two population groups varies for different increases in the rice price. However, the concern here is not with the absolute extent of poverty but with the changes in the extent of poverty that occur as the rice price changes.

[15] These are administrative units. Sanitary districts are generally small towns in rural areas. The Greater Bangkok metropolitan area includes not only the city core but suburban and fringe areas made up of the provinces of Nonthaburi, Pathumthani, and Samut Prakan.

Table 3—Number and percentage of households in poverty in 1975/76 and changes in the percentage of poor households when the rice price increases 10 to 50 percent

Rice Price Increases	Rice Growers		Others		National Average	
	Number of Households	Percent of Households Below the Poverty Line	Number of Households	Percent of Households Below the Poverty Line	Number of Households	Percent of Households Below the Poverty Line
(percent)						
0						
Poor households	1,110,465	33.68	436,450	16.39	1,546,915	25.96
All households	3,296,895		2,662,770		5,959,665	
10						
In	10,920	32.45	25,825	17.36	36,745	25.71
Out	-51,475		0		-51,475	
20						
In	17,520	31.37	51,205	18.31	68,725	25.54
Out	-93,760		0		-93,760	
30						
In	22,560	30.34	75,910	19.24	98,470	25.38
Out	-132,640		0		-132,640	
40						
In	31,680	29.64	110,335	20.53	142,015	25.57
Out	164,975		0		-164,975	
50						
In	39,655	29.16	132,115	21.35	171,770	25.67
Out	188,915		0		-188,915	

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: The number of households in this table are obtained by weighting the number of sample households by the reciprocals of the sampling fractions. In and out mean the number of households moving into and out of poverty.

50 percent. Nonmonotonic changes in the poverty indexes are possible where both the income distribution and the poverty lines change simultaneously through changes in the prices of rice.

A belief widely held in Thai economic literature is that if the domestic price of rice is increased, all rice farmers will be better off. This is not true according to these findings. Table 3 shows that there are some rice farmers who cannot produce enough to cover their own consumption. In this report these farmers, whose gross production is less than their own consumption, are called net purchasers of rice.[16]

Among the farmers who produce at least some rice, those who claim rice farming as their primary enterprise were selected. Even among these farmers about one-fourth (25.69 percent) are net purchasers.

Table 6 shows the share of the population engaged in producing and distributing rice in 1975/76. The rice farmers who are net purchasers constitute about 12.7 percent of the total population (based on the number of households). In 1975/76 they produced about 4.6 percent of the total rice production by farmers who claimed rice farming as their primary enterprise, but they consumed 17.6 percent of the total human consumption of rice, which was more than their share based on the number of households.

Table 7 shows that small farm households consume more of the rice they produce

[16] An earlier work that found results along this line but using data from India is John W. Mellor, "Food Price Policy and Income Distribution in Low-Income Countries," *Economic Development and Cultural Change* 27 (October 1978): 1-26.

Table 4—Percent of poor households by community type and region at 1975/76 rice prices and after rice price increases of 10 to 50 percent

Rice Price Increase	Municipal Areas				Sanitary Districts				Villages				Greater Bangkok			National Average
	Northern Region	Northeastern Region	Central and Eastern Region	Southern Region	Northern Region	Northeastern Region	Central and Eastern Region	Southern Region	Northern Region	Northeastern Region	Central and Eastern Region	Southern Region	Metropolis	Suburbs	Fringe Areas	
							(percent)									
0	13.5	16.9	9.1	16.4	15.7	21.4	6.1	14.2	31.6	42.5	11.5	28.3	6.5	4.6	6.4	25.96
10	14.2	17.5	9.9	17.8	15.7	21.0	6.1	15.1	31.1	41.8	11.0	28.9	6.8	4.8	5.1	25.71
20	13.9	18.2	10.3	18.7	16.3	22.2	6.5	15.1	30.3	41.3	10.7	29.5	7.2	4.8	5.4	25.54
30	13.9	19.8	11.0	19.1	17.0	21.6	6.5	15.1	29.9	40.6	10.6	29.6	8.0	4.6	6.4	25.38
40	14.2	20.5	11.8	19.9	17.0	21.8	7.0	16.0	29.4	40.6	10.9	30.8	8.5	4.6	6.7	25.57
50	14.4	21.1	12.0	21.4	17.6	22.5	7.4	17.0	29.4	40.3	10.8	31.4	9.2	4.5	6.4	25.67
							(1,000 households)									
Total number of households	133	136	125	132	215	258	261	106	1,473	2,176	1,139	774	973[a]	...[a]	...[a]	7,901

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).
Notes: Greater Bangkok includes the Bangkok metropolis and the provinces of Nonthaburi, Pathumthani, and Samut Prakan. The municipal areas and the metropolis are urban, whereas the sanitary districts, villages, suburbs, and fringe areas are considered rural.

[a] The total number of households in the Greater Bangkok area was not disaggregated.

Table 5—Index of poor households by community type at 1975/76 rice prices and after rice price increases of 10 to 50 percent

Rice Price Increase	Municipal Areas	Sanitary Districts	Villages	Greater Bangkok
(percent)				
0	0.0545	0.0553	0.1199	0.0350
10	0.0568	0.0557	0.1179	0.0346
20	0.0583	0.0571	0.1165	0.0351
30	0.0596	0.0579	0.1158	0.0367
40	0.0620	0.0594	0.1164	0.0381
50	0.0633	0.0614	0.1171	0.0398

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: Sen's Poverty Index is used to determine the incidences of poverty (see Amartya Sen, *Poverty and Famines* [Oxford: Oxford University Press, 1981]). Greater Bangkok includes the Bangkok metropolis and the provinces of Nonthaburi, Pathumthani, and Samut Prakan. The municipal areas and the metropolis are urban, whereas the sanitary districts, villages, suburbs, and fringe areas are considered rural.

than large farm households. Most of the marketable surplus came from larger farms.

As mentioned earlier, one of the objectives of this study is to identify the parts of the population that are more likely to be hurt by an increase in the rice price. Therefore results similar to those shown in Table 3 are disaggregated into socioeconomic groups in Table 8.

The classification of households into socioeconomic groups is based on their main source of livelihood, kind of economic activity, and occupation. It is possible for a household to operate a small farm but for the earnings of household members working off the farm as common laborers to exceed farm profits (including income in kind). Such a household would be classified as a household of general workers. In Table 8 some rice growers are classified in the professional group and some in the general workers group.

According to Table 8, the following socioeconomic groups are most susceptible to being hurt, that is, to moving below the poverty line: the nonfarm self-employed without paid workers, farm workers, clerical workers, production workers, general workers,

Table 6—Share of population producing and distributing rice, 1975/76

Rice Producers and Distributors	Share of Total Population	Share of Gross Production[a]	Share of Total Consumption
		(percent)	
Total rice-farm households	49.5	92.6	58.6
Deficit farms	12.7	4.6	17.6
Surplus farms	36.8	88.0	41.0
Nonfarm rural population	37.6	6.9	32.6
Urban population	12.9	0.5	8.8

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: The rice-farm households are those that describe their primary occupation as rice farming. Deficit farm households consume more rice than they produce. Surplus farm households grow more rice than they consume. The nonfarm rural population includes cash crop farmers who do not primarily produce rice.

[a] It is not possible to find net production from feed and seeds and rent because some of these disposals were aggregated and cannot be identified separately. However, sharecropping is not as widely practiced in Thailand as in some other countries.

Table 7—Utilization and net marketable surplus of rice by farm size, 1975/76

Farm Size	Amount of Rice						
	Produced	Consumed at Home	Bartered	Used for Feed and Seed	Stored	Sold	Sold as Percentage of Gross Production
(rai)	(metric tons of rice)						(percent)
Less than 2	9	9	0	0	1	0	4.4
2 - 4	229	144	16	8	37	24	10.5
5 - 9	1,001	556	95	33	180	136	13.6
10 - 14	1,411	663	155	51	159	302	21.4
15 - 19	968	440	92	43	126	255	26.3
20 - 29	1,975	698	173	93	268	711	36.0
30 - 39	1,669	477	158	88	209	705	42.2
40 - 49	1,109	261	99	52	107	552	49.8
50 - 69	1,841	343	165	83	183	996	54.1
70 - 99	914	136	45	58	110	507	55.5
100 or more	693	106	27	36	65	463	66.8
Total	11,819	3,833	1,025	546	1,445	4,650	39.3

Source: Calculated from data in Thailand, National Statistical Office, "1975-76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: The conversion ratio is 1 ton of paddy to 0.66 ton of rice. The sum of rice consumed at home, bartered, used for feed and seed, stored, and sold is not necessarily equal to gross production because there may be carry-over from the previous years. The samples are not weighted. One hectare equals 6.25 rai.

and some farm operators who do not grow rice. Data on income and calorie intake also confirm the observations regarding these vulnerable groups. Food consumption analyses of these sample households are given in detail in Chapters 6 and 7.

Income Distribution

The effects on inequality as indicated by the distribution of income is measured by the Gini coefficients, as given in equation (6). Although there are drawbacks in using household surveys to measure the income distribution among the total population, because the very rich in the country are seldom included in the sample survey, the SES is the best data set available to study the changes in these indexes.

Table 9 summarizes the indexes with no change in the rice price and with increases of 10, 30, and 50 percent, distributed by region, type of community, and the national average. All in all, there are only slight changes, which indicates that increasing the price has little effect on income distribution even in specific regions and community types. There are several reasons for this. First, although rice expenditures may have constituted up to 20 percent of the total household expenditures for some socio-economic groups, a 50 percent increase in the rice price would increase their household expenditures by only 10 percent.[17] Second, income transfers between rice farmers and other consumers may help to balance out the effects. Of course, income distribution data reflect the large increases in rich farmers' incomes that poverty indexes ignore.

[17] An increase in expenditures of 10 percent is substantial for poor households but may have little effect on the income distribution of the total population.

Table 8—Flow of households in and out of poverty when the rice price increases by 10 to 50 percent, by socioeconomic group, 1975/76

Socioeconomic Group	Rice Growers			Percent of Rice Price Increase									
	All Households	Households Below the Poverty Line	Percent of Households Below the Poverty Line	10		20		30		40		50	
				In	Out	In	Out	In	Out	In	Out	In	Out
	(1,000 households)			(1,000 households)									
Farm operators owning land													
Less than 2 rai	15	8	53.33	0	0	0	0	0	0	0	0	0	0
2 - 4 rai	130	57	43.85	0	-1	0	-3	1	-3	4	-3	3	-4
5 - 9 rai	360	180	50.00	2	-5	3	-10	4	-14	4	-16	4	-20
10 - 19 rai	654	310	47.40	1	-9	2	-22	3	-28	5	-40	5	-43
20 - 39 rai	586	216	36.86	3	-9	3	-16	3	-28	5	-32	7	-41
More than 40 rai	333	56	16.82	0	-9	0	-13	0	-17	1	-22	1	-24
Farm operators renting land													
Less than 5 rai	56	34	60.71	0	0	0	0	1	0	1	-1	2	-1
5 - 19 rai	245	94	38.37	1	-8	2	-11	2	-15	2	-19	3	-19
More than 20 rai	267	61	22.85	0	-10	0	-14	0	-21	0	-27	0	-31
Fishing and forestry	46	8	17.39	...	0	1	0	1	0	1	0	2	0
Self-employed, nonfarm													
With paid workers	9	1	11.11	0	0	0	0	0	0	0	0	0	0
Without paid workers	153	21	13.73	3	0	3	-1	3	-1	3	-1	3	-1
Professionals	2	0	0	0	0	0	0	0	0	0	0	0	0
Farm workers	100	26	26.00	1	0	3	-1	3	-2	3	-2	3	-2
Management and administrators	30	0	0.67	0	0	0	0	0	0	0	0	0	0
Clerical	58	5	8.62	1	0	1	-1	2	-1	2	-1	2	-1
Production workers	90	10	11.11	0	0	1	0	1	0	1	0	2	0
General workers	103	13	12.62	1	0	1	0	1	-1	2	-1	3	-2
Economically inactive													
Assistance and pension	51	9	17.65	0	0	0	0	0	0	0	0	0	0
Property income	7	1	14.29	0	0	0	0	0	0	0	0	0	0
Subtotal	3,297	1,110	33.67	11	-51	18	-94	23	-133	32	-165	40	-189

(continued on p. 28)

Table 8—Continued

Socioeconomic Group	Others			Percent of Rice Price Increase									
	All Households	Households Below the Poverty Line	Percent of Households Below the Poverty Line	10		20		30		40		50	
				In	Out	In	Out	In	Out	In	Out	In	Out
	(1,000 households)			(1,000 households)									
Farm operators owning land													
Less than 2 rai	27	8	29.63	0	0	0	0	0	0	0	0	0	0
2 - 4 rai	52	30	57.69	0	0	2	0	2	0	4	0	4	0
5 - 9 rai	70	29	41.43	1	0	2	0	2	0	4	0	5	0
10 - 19 rai	83	29	34.94	3	0	4	0	7	0	9	0	9	0
20 - 39 rai	100	23	23.00	1	0	4	0	6	0	14	0	17	0
More than 40 rai	55	8	14.55	0	0	0	0	0	0	0	0	0	0
Farm operators renting land													
Less than 5 rai	27	12	44.44	0	0	1	0	1	0	1	0	1	0
5 - 19 rai	36	16	44.44	0	0	1	0	1	0	3	0	3	0
More than 20 rai	24	4	16.67	0	0	0	0	1	0	1	0	1	0
Fishing and forestry	79	25	31.65	1	0	2	0	2	0	3	0	4	0
Self-employed, nonfarm													
With paid workers	64	0	0.47	1	0	1	0	1	0	1	0	1	0
Without paid workers	609	75	12.32	4	0	9	0	14	0	17	0	22	0
Professionals	3	0	0	0	0	0	0	0	0	0	0	0	0
Farm workers	182	49	26.92	3	0	4	0	8	0	13	0	16	0
Managers and administrators	201	2	1.00	0	0	0	0	0	0	0	0	0	0
Clerical	372	18	4.84	2	0	5	0	7	0	11	0	12	0
Production workers	244	25	10.25	2	0	4	0	6	0	7	0	9	0
General workers	236	54	22.88	5	0	10	0	14	0	18	0	21	0
Economically inactive													
Assistance and pension	156	22	14.10	1	0	2	0	3	0	4	0	6	0
Property income	38	7	18.42	0	0	0	0	0	0	0	0	1	0
Subtotal	2,663	436	16.37	26	0	51	0	76	0	110	0	132	0
Total	5,960	1,546	25.94	37	-51	69	-94	99	-133	142	-165	172	-189

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).
Notes: The numbers in the table are rounded to the nearest thousand. In and out mean the number of households moving in and out of poverty.

Table 9—Gini coefficients of the distribution of income by community type and region at 1975/76 rice prices and after rice price increases of 10, 30, and 50 percent

Community Type/Region	Rice Price Increase			
	0	10	30	50
	(percent)			
National average[a]	0.4532	0.4539	0.4554	0.4601
Municipal areas				
Northern Region	0.4388	0.4407	0.4445	0.4484
Northeastern Region	0.4105	0.4129	0.4177	0.4239
Central and Eastern Region	0.4128	0.4158	0.4207	0.4258
Southern Region	0.4615	0.4648	0.4704	0.4763
Sanitary districts				
Northern Region	0.3826	0.3831	0.3869	0.3932
Northeastern Region	0.4625	0.4641	0.4681	0.4729
Central and Eastern Region	0.3989	0.3995	0.4039	0.4112
Southern Region	0.3679	0.3714	0.3788	0.3869
Villages				
Northern Region	0.3761	0.3811	0.3939	0.4092
Northeastern Region	0.3422	0.3446	0.3516	0.3612
Central and Eastern Region	0.3730	0.3750	0.3827	0.3935
Southern Region	0.4052	0.4082	0.4152	0.4231
Greater Bangkok	0.3976	0.3977	0.3988	0.4010

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: Greater Bangkok includes the Bangkok metropolis and the provinces of Nonthaburi, Pathumthani, and Samut Prakan. The municipal areas and the metropolis are urban, whereas the sanitary districts, villages, suburbs, and fringe areas are considered rural.

[a] Samples are unweighted.

4

THE RESPONSE OF PADDY SUPPLY TO PRICE CHANGES

Do Thai paddy farmers respond to price changes? This question is still under debate despite the large number of empirical studies of Thai paddy farmers as well as of farmers in other developing countries. Some of these results are given in Appendix 1, Table 42. There are two views: one that Thai paddy farmers respond positively to price changes of rice and another that institutional constraints render any price response insignificant. The major problem of all these quantitative studies is the lack of reliable and consistent data.

Though continuing this debate here may be of only limited value, the question has relevant policy implications for this study. The Thai government's export policies on rice implicitly serve as policies on domestic prices of rice and paddy. Low domestic prices of rice may affect the question of production expansion and crop diversification. One argument against these policies is that they may limit the dynamism caused by expansion of paddy production in the rural areas where the bulk of the poor live. Increased production creates jobs and incomes that can create further rounds of activities through the production linkages. At the micro level, farmers' responses to price changes also reflect their flexibility in the use of production inputs, which has welfare policy implications. This study also concerns the effects on the consumption of the paddy farmers from such price policies. Any responsiveness to price changes could affect farmers' marketable surplus, home consumption, and farm incomes in general. Therefore this chapter aims to obtain better estimates of the supply responses of Thai paddy farmers.

The Model

The output response function for rice may be expressed as a function of a number of relevant variables:

$$Q_t^* = f_Q(P_t^*, F_t^*, C_t^*, T_t^*, I_t^*, R_t^*), \qquad (7)$$

where

Q_t^* = the desired paddy output in production period t;

P_t^* = the expected price of paddy after harvest season t;

F_t^* = the index of expected prices of the factors of production during planting season t;

C_t^* = the expected prices of competing crops in period t;

T_t^* = paddy production technology;

I_t^* = irrigation; and

R_t^* = expected weather conditions.

However, the actual sequence of decisions made by farmers probably differs from the order of the variables in equation (7). A farmer may react to expected relative prices by planting more land, but once the crop is planted the only thing he can do is adjust for yield. Hence, it is desirable to disaggregate the production output into the intended cultivated area (A_t^*) and the planned output yield (Y_t^*). Each may be specified separately:

$$A_t^* = f_A(P_t^*, C_t^*, T_t^*, I_t^*, R_t^*); \qquad (8)$$

and

$$Y_t^* = f_Y(P_t^*, F_t^*, T_t^*, I_t^*). \qquad (9)$$

Since $Q_t^* = A_t^* \times Y_t^*$, it can easily be determined that the elasticity of output (ξqp) is the sum of the area response (ξap) and the yield response (ξyp):

$$\xi qp = \xi ap + \xi yp. \qquad (10)$$

The equations to be estimated for the

area and yield responses are specified in the same way by Prakongtanapan.[18]

Area Response

The area response may be expressed as:

$$\log A_t = \pi_0 + \pi_1 \log P_{t-1} + \pi_3 \log H_{t-1} + \pi_4 \log I_t + \pi_5 \log R_t + \pi_6 \log A_{t-1} + U_t, \quad (11)$$

where

A_t = area planted with rice;

P_{t-1} = lagged price of paddy (deflated by the wholesale price index or the price index of nonrice crops);

H_{t-1} = lagged technology variable represented by the lagged percentage of total rice farm area planted with high-yielding varieties;

I_t = irrigation variable (ratio of the irrigated area to the total rice cultivated area); and

R_t = weather variable (annual rainfall).

The price index of competing crops was originally included in equation (11), but there was multicollinearity between it and P_{t-1}, so it was dropped.

Influences from the prices of other crops vary from region to region. In the Central Region, where most of the area is lowland suitable for rice cultivation, the substitutability between rice and the major upland crops like corn and cassava is low. In contrast, substitutability may be higher in many areas in the Northeast, which are more suitable to these upland crops. Attempts to estimate the supply response function of rice in the subregions using both rice price and prices of the competing crops may be found in a study by Pongsrihadulchai.[19] In his study the supply parameters are estimated for agroeconomic zones. However, Pongsrihadulchai had serious problems in finding reliable price data for zones and no model seems to fit the data well.

In another study Dowling and Krongkaew also tried to estimate the supply response functions for subregions, using the same models as those used in Behrman's pioneering work, but they also had problems in finding reliable price data for competing crops.[20]

The estimation in this report is done for the whole country where price data seem to be available and more reliable. These data are disaggregated into the major wet-season and the minor dry-season crops. The paddy price is deflated by the wholesale price index.

Yield Response

The independent variables used in the yield response equations are:

P_{ft-1} = the lagged average price of paddy deflated by the fertilizer price index;

I_t = the ratio of irrigated area to the total cultivated area in rice;

H_{t-1} = the lagged percentage of total cultivated area sown with HYVs of rice; and

R_t = the average annual rainfall.

The rainfall variable is needed because weather conditions influence the difference between the actual production yield and the planned production yield. The yield response equation may be written as:

$$\log Y_t = \Omega_0 + \Omega_1 \log P_{ft-1} + \Omega_2 \log I_t + \Omega_3 \log H_{t-1} + \Omega_4 \log R_t + V_t. \quad (12)$$

There are three major sources of production and area data: agricultural statistics compiled by the Thai Ministry of Agriculture

[18] The relationship between planned and realized values is specified in a Nerlovian-type adjustment model. The reasons for these specifications can be found in Somsak Prakongtanapan, "Changes in the Supply Responses of Aggregate Rice Output in Thailand" (M.A. thesis, University of the Philippines, 1976).

[19] Apichart Pongsrihadulchai, "Supply Analysis of Important Crops in Thailand" (Ph.D. dissertation, Iowa State University, 1981).

[20] J. Malcolm Dowling and Medhi Krongkaew, *Agricultural Supply Response of Some Major Crops in Thailand*, Research Report 41 (Bangkok: Thammasat University, 1983); and Jere R. Behrman, *Supply Response in Underdeveloped Agriculture: A Case Study of Four Major Annual Crops in Thailand, 1937-1963* (Amsterdam: North Holland, 1968).

and Cooperatives (MOAC), the world rice statistics from the International Rice Research Institute (IRRI), and the data bank of the Thammasat University Faculty of Economics.[21]

The estimation of area and yield response in this report relies on the production and area data from the Thammasat University data bank. Cultivated area is used in the estimation of area response, and harvested area is used in the estimation of yield response. These estimations are carried out for the wet- and the dry-season paddy crops separately. Most of the wet-season crops are rainfed, whereas most of the dry-season crops are irrigated. All area planted in the dry season is believed to be sown with HYVs. The important data used in the following estimations are given in Appendix 1, Tables 43 and 44.

The cultivated area and production yields of the wet- and dry-season crops during 1955-80 are plotted in Figures 2 and 3. Production yields of the wet-season crops have almost stagnated, while the yields of the dry-season crops have increased, though the dry-season cultivated area is still small.

Estimation Procedures and the Results

The time series data used in this estimation are for the period 1955-80. In the following analyses the estimates are separated for the wet- and the dry-season crops. Because dry-season crops became significant only after 1966, a Chow Test was conducted for the wet-season crops only, and no statistical evidence of a structural shift in the supply curve was found, despite the introduction of HYVs in late 1969, a sharp increase in fertilizer use in 1971, and changes in the offices collecting agricultural statistics in the 1960s. Therefore, data for the whole period 1955-80 is used in the estimation. The equations of the crops of the two seasons are also estimated in parallel in order to compare the weighted average supply elasticity with the combined supply elasticity.[22]

The area and yield response equations are first estimated using the ordinary least squares (OLS) method; Table 10 shows the area responses and Table 11 those for yield. The Durbin-Watson (D.W.) statistic in the yield equation indicates that there is a problem of autocorrelation (Table 11). The D.W. statistic in the area equations may be biased because the lagged dependent variable is included (Table 10). Although a number of the t-statistics in the equations in Table 10 are not significant, the correlation coefficients (R^2s) are quite high, indicating the possibility of multicollinearity among the variables of area planted in HYVs and area irrigated. Both autocorrelation and multicollinearity are therefore examined.

These same equations are estimated using the generalized least squares (GLS) method under the assumption that the disturbances are generated by a first-order autoregressive process. The results in the area equations do not change much, and the values of the autocorrelation coefficients (ρs) are also low. However, in the yield equations there is less evidence of autocorrelation.

The technique used to correct for multicollinearity combines the conversion of principal components and the theory of multiple comparisons of Scheffé, a technique developed by Mundlak.[23] The computer program used to estimate the third parts of Tables 10 and 11 was also provided by Mundlak. The results in the area equations change markedly, particularly the price terms, which now become significant. In the dry-season equation, the irrigation coefficient appears to be more influential than price. The results in the yield equations also change somewhat.

This computer program also includes an Orcutt-Cochrane algorithm to correct for autocorrelation. Although inclusion of this algorithm in the program is expected to correct for both autocorrelation and multicollinearity, the weakness of the algorithm

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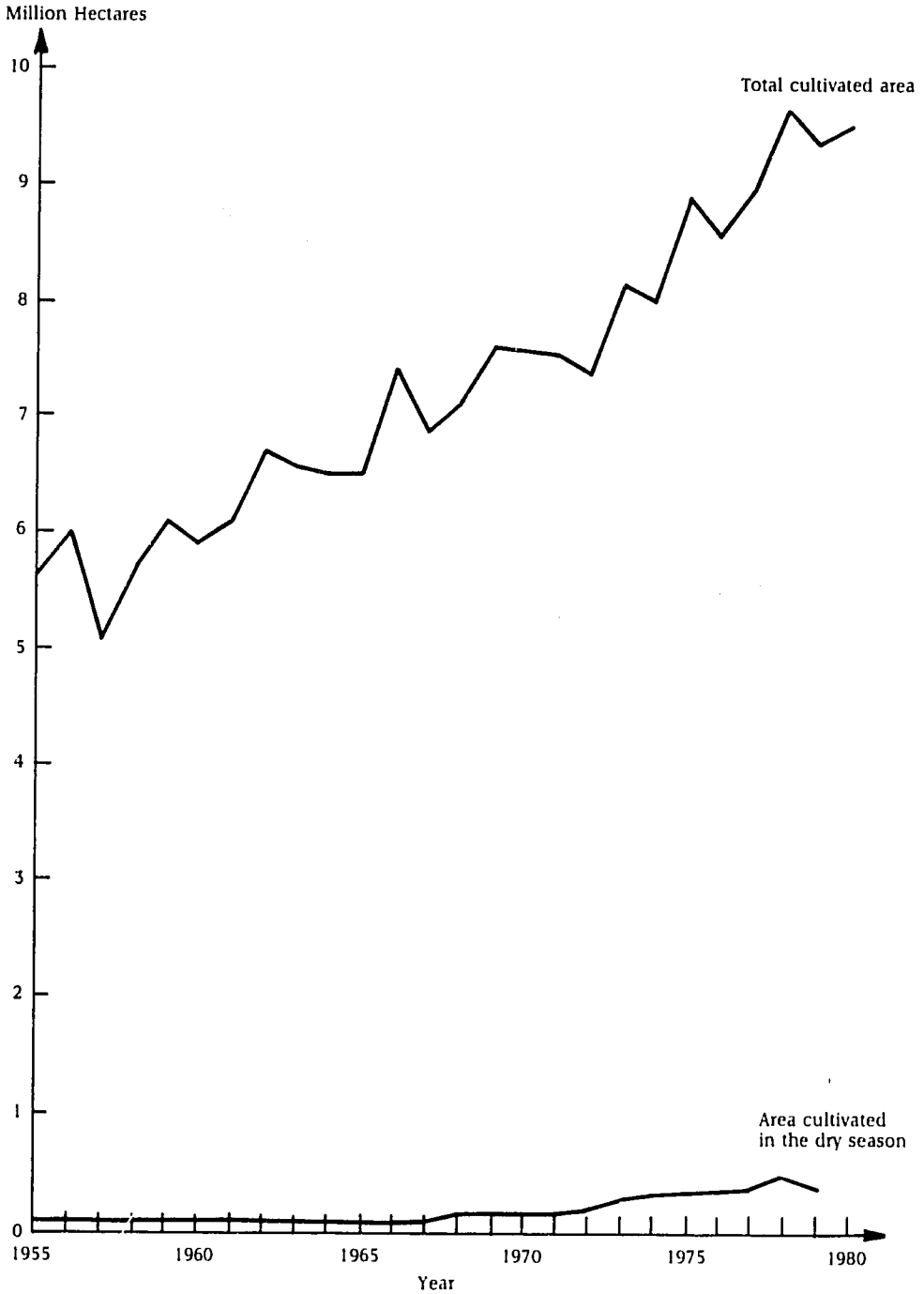
[21] Thailand, Ministry of Agriculture and Cooperatives, *Agricultural Statistics*, various years (Bangkok: MOAC, 1983); Adelita C. Palacpac, *World Rice Statistics* (Los Baños: International Rice Research Institute, 1982); Thammasat University, "Faculty of Economics Data Bank," Bangkok, 1982 (computer printout).

[22] In this chapter "supply elasticity" is used in the sense of "production elasticity."

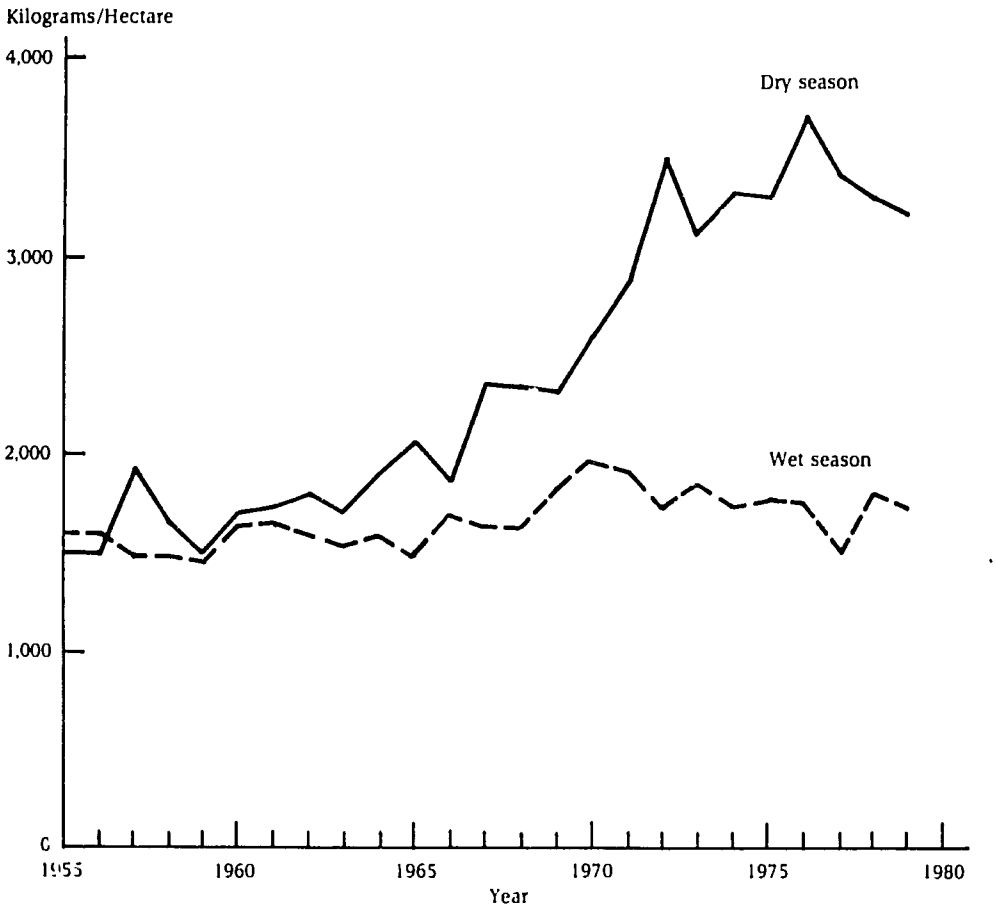
[23] Yair Mundlak, "On the Concept of Non-Significant Functions and Its Implications for Regression Analysis," *Journal of Econometrics* 16 (May 1981): 139-149.

Figure 2—Total cultivated area of paddy and paddy area cultivated in the dry season, 1955-80



Source: Thammasat University, "Faculty of Economics Data Bank," Bangkok, 1982 (computer printout).
Note: Total cultivated area includes both wet- and dry-season paddy crops.

Figure 3—Yield of paddy in the wet and dry seasons, 1955-80



Source: Thammasat University, "Faculty of Economics Data Bank," Bangkok, 1982 (computer printout).

remains. Only the cases where ρs in the Orcutt-Cochrane iterations indicate signs of convergence are reported in the final sections of the two tables. The results seem to be somewhat improved from those in the third section, except for the dry-season yield equation, where the significant coefficient of the annual rainfall variable is hard to explain. If it is for the previous year, it reflects water availability.

Thus the area response elasticities are obtained from the third section of Table 10. For the yield response elasticities, the estimates for crops of the two seasons combined and dry-season crops are obtained from the fourth section of Table 11, and the yield elasticity of wet-season crops is obtained from the third section. The yield equation for wet-season crops indicates that autocorrelation may not be a serious problem for this equation.

The final estimates of the area and yield response elasticities are summarized in Table 12. After correcting for the problems of autocorrelation and multicollinearity, the short-run area response elasticities are estimated to be 0.25 for area and 0.11 for yield. Hence, the short-run supply elasticity is 0.36 and the long-run supply elasticity is approximately 0.65.

Table 10—Area response equations estimated using four methods, 1957-79

Log A_t	$= \pi_0$	$+ \pi_1 \log P_{t-1}$	$+ \pi_3 \log H_{t-1}$	$+ \pi_4 \log I_t$	$+ \pi_5 \log R_t$	$+ \pi_6 \log A_{t-1}$	$+ U_t$	n	R^2 (Corrected)	F	D.W.[a]	ρ
Ordinary least squares method												
Two crops combined	2.425	0.074 (0.44)	0.025 (1.64)	-0.172 (-0.89)	0.294 (1.79)	0.688 (3.14)		23	0.837	23.645	2.197	...
Wet-season crops	2.666	0.078 (0.47)	0.021 (1.53)	-0.186 (-0.94)	0.284 (1.73)	0.674 (3.03)		23	0.791	17.655	2.218	...
Dry-season crops	2.489	0.337 (-0.61)	...	1.953 (3.26)	0.057 (0.11)	1.047 (25.71)		23	0.975	215.743	2.126	...
Generalized least squares method												
Two crops combined	1.690	0.074 (0.46)	0.022 (1.55)	-0.136 (-0.72)	0.296 (1.81)	0.736 (3.59)		23	0.975	148.750	2.278	-0.11
Wet-season crops	1.813	0.079 (0.51)	0.018 (1.43)	-0.148 (-0.78)	0.287 (1.76)	0.730 (3.52)		23	0.977	162.723	2.303	-0.12
Dry-season crops	2.452	-0.297 (-0.56)	...	2.057 (3.50)	0.069 (0.13)	1.046 (27.52)		23	0.979	214.115	2.018	-0.08
Corrected for multicollinearity[b]												
Two crops combined	4.250	0.289 (5.26)	0.034 (10.46)	-0.057 (-0.38)	0.424 (3.32)	0.490 (9.87)		23	0.861	...	2.147	...
Wet-season crops	4.519	0.287 (5.57)	0.021 (7.29)	-0.026 (-0.18)	0.416 (3.07)	0.480 (7.80)		23	0.805	...	2.214	...
Dry season crops	2.492	-0.337 (-0.61)	...	1.953 (3.27)	0.057 (0.11)	1.047 (25.71)		23	0.980	...	2.126	...
Corrected for autocorrelation and multicollinearity												
Two crops combined	...	...	...	...	...	...		...	...	...	...	...
Wet-season crops	...	...	...	...	...	...		...	...	...	...	...
Dry-season crops	1.333	-0.378 (-0.74)	...	0.045 (0.13)	-0.206 (-3.18)	1.009 (16.96)		23	0.950	...	0.263	0.39

Source: Calculated from data in Appendix 1, Tables 43 and 44.
Note: t-statistics are in parentheses.

[a] The Durbin-Watson statistics may be biased because the lagged dependent variable is included as a regressor.

[b] The method for correcting for multicollinearity is taken from Yair Mundlak, "On the Concept of Non-Significant Functions and Its Implications for Regression Analysis," *Journal of Econometrics* 16 (May 1981): 139-149. The computer program is available from the author.

Table 11—Yield response equations estimated using four methods, 1957-79

Log Y_t	$= \Omega_0$	$+ \Omega_1 \log P_{n-1}$	$+ \Omega_2 \log I_t$	$+ \Omega_3 \log R_t$	$+ \Omega_4 \log H_{t-1}$	$+ V_t$	n	R^2 (Corrected)	F	D.W.	ρ	Conclusion on Autocorrelation[a]
Ordinary least squares method												
Two crops combined	-2.847	0.036 (0.61)	0.121 (0.80)	0.453 (3.13)	0.023 (2.21)		24	0.451	5.718	0.897	...	Indeterminate, close to positive autocorrelation
Wet-season crops	-2.970	0.016 (0.27)	0.130 (0.87)	0.486 (3.41)	0.015 (1.44)		24	0.346	4.042	1.008	...	Indeterminate
Dry-season crops	-0.250	0.641 (4.71)	0.340 (0.72)	-0.390 (-0.78)	...		22	0.546	9.432	0.723	...	Positive autocorrelation
Generalized least squares method												
Two crops combined	-2.539	0.021 (0.36)	0.005 (0.04)	0.404 (3.68)	0.021 (1.70)		24	0.545	6.744	1.494	0.41	Indeterminate, close to no autocorrelation
Wet-season crops	-2.729	0.019 (0.31)	0.006 (0.04)	0.428 (3.74)	0.011 (0.93)		24	0.494	5.689	1.564	0.36	No autocorrelation
Dry-season crops	0.121	0.355 (2.61)	0.701 (1.99)	-0.109 (-0.35)	...		22	0.186	2.255	0.993	0.52	Indeterminate
Corrected for multi-collinearity[b]												
Two crops combined	-1.437	-0.002 (-0.04)	-0.021 (-0.20)	0.271 (2.66)	-0.031 (3.08)		24	0.548	...	1.048	...	...
Wet-season crops	-3.163	0.041 (3.40)	0.033 (0.29)	0.470 (3.49)	0.000 (-0.14)		24	0.368	...	0.765	...	...
Dry-season crops	-0.248	0.641 (4.71)	0.341 (0.72)	-0.390 (-0.78)	...		22	0.611	...	0.723	...	...
Corrected for autocorrelation and multi-collinearity												
Two crops combined	-0.199	0.080 (3.40)	-0.072 (-1.83)	0.025 (1.58)	0.05 (2.13)		24	0.385	...	1.129	0.28	...
Wet-season crops	...	...	...	...	...		...	...	...	...	...	...
Dry-season crops	-0.714	0.589 (4.28)	0.855 (4.28)	-0.134 (-4.28)	...		22	0.478	...	0.311	0.37	

Source: Calculated from data in Appendix I, Tables 43 and 44.

[a] Evaluation is based on Durbin-Watson statistics, one-tail test $\alpha = 0.01$.

[b] The method for correcting for multicollinearity is taken from Yair Mundlak, "On the Concept of Non-Significant Functions and Its Implications for Regression Analysis," *Journal of Econometrics* 16 (May 1981): 139-149. (The computer program is available from the author.)

Table 12—Summary of area and yield response elasticities, 1957-79

Type of Estimation	Area Response Elasticity	Yield Response Elasticity	Supply Elasticity
Area and yield			
Wet-season crops	0.287	0.041	...
	(5.57)	(3.40)	
Dry-season crops	-0.337	0.589	...
	(-0.61)	(4.28)	
Weighted average[a]	0.253	0.107	...
Long run	0.57[b]	...	...
Supply			
Short run			
Weighted average	...	...	0.36
Two crops combined	...	...	0.37
Approximate long run	...	...	0.65[c]

Sources: Calculated from data in Tables 10 and 11.
Note: The numbers in parentheses are t-statistics.

[a] The weights used are 0.88 for the wet season and 0.12 for the dry season.

[b] This is 0.289/(1 - 0.490).

[c] This is the sum of the area and yield response elasticities for the two crops combined (0.57 and 0.080).

5

THE EFFECTS OF RICE PRICE CHANGES ON THE RURAL FARM WAGE RATE

One argument against the low domestic price of rice in Thailand is that it discourages production, which decreases the demand for labor and depresses the rural wage rate. Two hypotheses are subsumed in this argument: first, that rice production is labor intensive, and second, that the rural labor market is efficient in the sense that there is no significant pool of unemployed or underemployed labor.[24] That rice cultivation is a major activity in rural Thailand is indisputable.

An empirical study by Bertrand and Squire presents a strong case for the second hypothesis.[25] The authors argue that the Thai rural labor market is quite efficient. In off-peak seasons farm workers or farmers normally find work away from the farm, and in the peak seasons women and children work in the rice paddies.

The first hypothesis—that rice production is labor intensive—depends on what crops or goods it is compared with and what techniques of production are used. A study by Tinprapha finds that the labor/capital ratios in the production of rice, corn, cassava, and sugarcane vary widely by region.[26] This phenomenon could be caused by different techniques and technology employed in different regions. In general, rice production is not more labor intensive than other crops.

A change in the rice price may also cause shifts in crop production patterns. The effects on employment will be largely determined by the employment intensity of rice production compared to production of other crops and the elasticity of substitution between them with respect to price. For example, in a study of Bangladesh, increasing rice prices reduced the incomes of the poor by transferring area from jute to rice, which increased unemployment because jute production is more labor intensive than rice production.[27] However, as discussed in Chapter 4, it is not likely that a substitute for rice will be found in the Central Plain where most of the Thai rice is grown and where most of the hired labor in rice production is employed. An increase in the rice price may not bring about as dramatic a shift in crops in Thailand as it did in Bangladesh.

If there is no large pool of unemployed labor in rural Thailand, an increase in labor demand can cause an increase in labor wages. It is not the purpose of this report to prove if the unemployment-underemployment hypothesis is relevant. This chapter is based on the premise that the supply of labor is probably neither perfectly elastic nor perfectly inelastic. An increase in labor demand will affect wages. However, the rural labor supply in Thailand may be highly elastic and the size of this effect may not be large.

The aim of this chapter is therefore to quantify the elasticities of farm wage rates with respect to an increase in rice production induced by rice price increases. In Chapter 3 farm workers were identified as one of the vulnerable groups of consumers who would be hurt by an increase in the rice price if their wages were fixed. If the assumption of fixed wages is to be relaxed, information about the impact on farm wage rates is needed.

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[24] If rice production were not labor intensive, the argument might still hold, but the impact on the wage rate would not be significant. Similarly, labor demand would increase irrespective of the existence of a pool of unemployed labor but the wage rate would not be significantly affected.

[25] Trent Bertrand and Lyn Squire, "The Relevance of the Dual Economy Model: A Case Study of Thailand," *Oxford Economic Papers* 32 (November 1980): 480-511.

[26] Chatri Tinprapha, "Employment and Agricultural Products in Thailand: A Case Study of Rice, Maize, Cassava, and Sugar Cane" (M.A. thesis, Thammasat University, 1979).

[27] Raisuddin Ahmed, *Agricultural Price Policies Under Complex Socioeconomic and Natural Constraints: the Case of Bangladesh*, Research Report 27 (Washington, D.C.: International Food Policy Research Institute, 1981).

The Elasticities of Wage Rates

Figure 4 describes the relationship between the domestic and export sectors of rice in Thailand. If the government were to reduce the export rice premium, T, until it approaches zero, the price of rice, P_0, would rise to P_1 and the new production would be Q_1. The gross farm income would rise to P_1Q_1 and the demand for all factors would change accordingly. For example, at the bottom of Figure 4, labor demand would increase from L_0 to L_1. The prices of factors with the least elastic supplies are expected to rise the most. Because the labor supply is more elastic than land, the price of land will rise more than wages. If the supply of farm labor were perfectly elastic, the wage rate would remain unchanged.[28]

This problem is similar to the effects of farm price supports on the returns to land and labor in U.S. agriculture, with no controls on production output and marketing. The elasticities of the prices of two factors with respect to product prices can be derived.[29] The starting point is the assumption of linear and homogeneous production functions. The formula can be generalized to include more than two factors if the production function is defined as Cobb-Douglas and the elasticities of substitution are thereby restricted to unity. The elasticity of the equilibrium price of labor with respect to production prices can be written as:[30]

$$\pi(\bar{P}_l, P_x) = [K_a(\beta_l + 1/\beta_a + 1) + K_l + K_c(\beta_l + 1/\beta_c + 1)]^{-1}, \quad (13)$$

where

$\bar{P}_l$ = equilibrium price of labor or the wage rate;

P_x = the product price or the price of rice;

$\pi(\bar{P}_l, P_x)$ = the elasticity of the equilibrium wage rate with respect to the price of rice;

K_a, K_l, K_c = relative factor shares of land, labor, and capital; and

$\beta_a, \beta_l, \beta_c$ = supply elasticities of land, labor, and capital.

Thus, if the labor supply is elastic, that is, if the value of β_l is high, the impact of an increase in the rice price on the labor wage rate will be slight and vice versa. There are six necessary parameters in this formula: three on relative factor shares and three on factor supply elasticities. Ranges of values of factor shares are obtained from separate studies, which will be explained later. Although reliable estimates of factor supply elasticities cannot be found in the literature, it is possible to derive a plausible range of values for the supply elasticities of land and capital, based on supportive empirical evidence. Many studies have shown that it is difficult to obtain a reliable estimate of the labor supply elasticity, but an attempt will be made here. The sensitivity of the wage rate to different values of labor supply elasticities will also be tested.

The Rural Labor Supply Function

A large portion of the literature in development economics has supported the idea that surplus labor exists in rural developing countries. These studies hypothesize that there is a dual labor market in rural areas where the supply price of labor exceeds its marginal products. However, a recent empirical study indicates that the rural Thai

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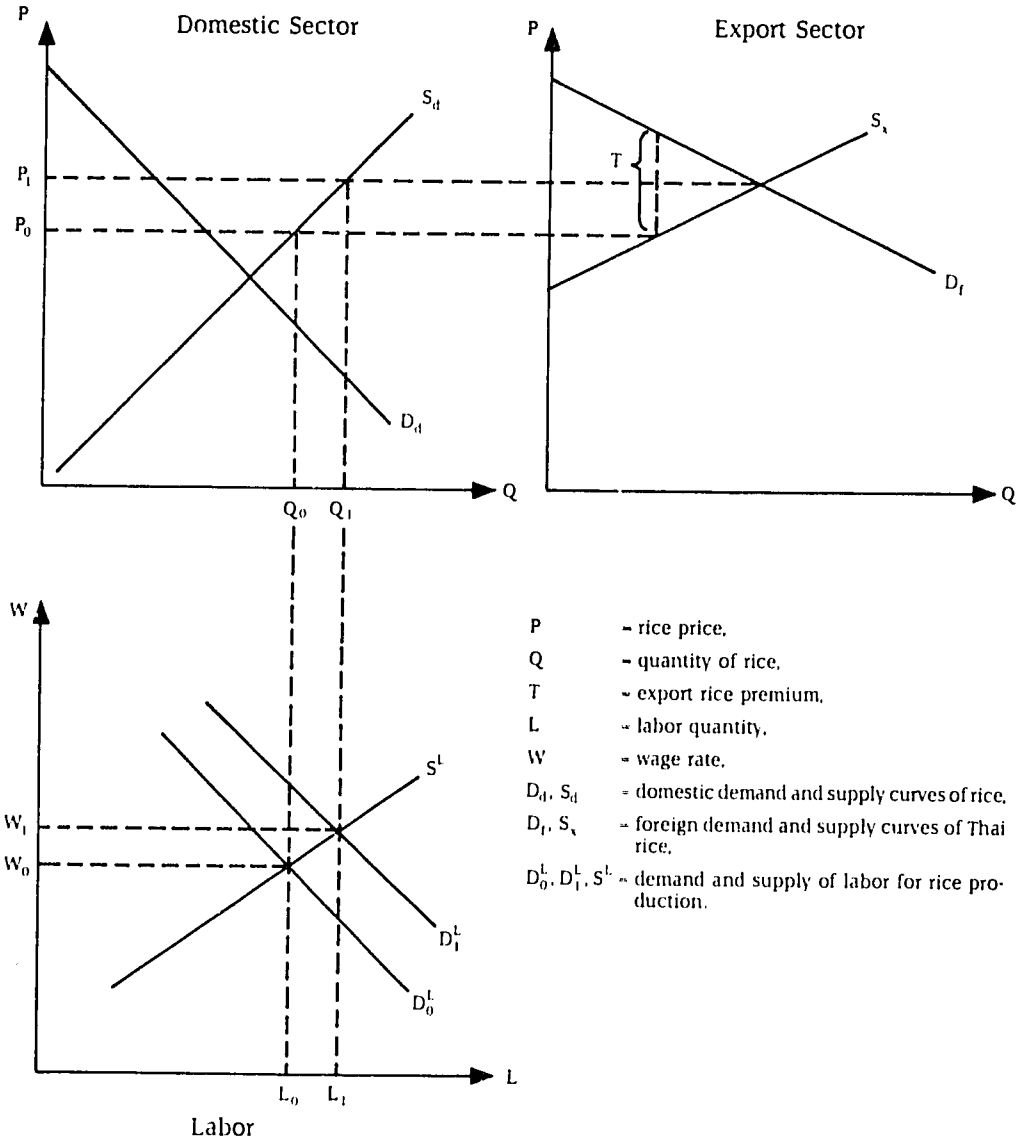
[28] In Figure 4 the supply schedules for domestic and export rice are connected in the sense that the supply schedule for export rice is the residual of total domestic supply over total domestic demand. The foreign-market conditions would then determine the export price. When the Thai government's export policy is incorporated, the domestic price of rice can be determined. In this report the domestic price represents the net effect from all these influences. Hence, the variables for foreign demand and export tax do not appear in the calculations in this chapter or in the estimation of the labor supply function in Appendix 2.

[29] John E. Floyd, "The Effects of Farm Price Supports on the Returns to Land and Labor in Agriculture," *Journal of Political Economy* 73 (April 1965): 148-158.

[30] Ibid. In this study it is not possible to estimate the traditional production function and to derive a labor demand function from it because the necessary data on the quantity of labor input and the wage rate specific to each household in the data set are not available. So this approach is adopted instead. Readers interested in a more traditional approach may wish to see an exercise using the profit function (a dual model of the production function) for Thai paddy farmers (Kumpol Puapanichya and Jerachone Sriswasdilek, "Food and Agricultural Policy Analysis: Input Demand and Output Supply in Rice and Upland Crop Production," Kasetsart University, Bangkok, 1982 [mimeographed]).

Figure 4—Domestic and export sectors of rice and their effects on labor



P = rice price.
Q = quantity of rice.
T = export rice premium.
L = labor quantity.
W = wage rate.
D_d, S_d = domestic demand and supply curves of rice.
D_f, S_x = foreign demand and supply curves of Thai rice.
D_0^L, D_1^L, S^L = demand and supply of labor for rice production.

labor market is reasonably efficient and well integrated.[31]

These studies are based more on supportive evidence of labor employment than on rigorous statistical estimation, probably because there are serious obstacles to such

[31] Bertrand and Squire, "The Relevance of the Dual Economy Model." Bertrand and Squire cite the following studies of the dual labor market hypothesis: F.H. Fuhs and J. Vingerhoets, "Rural Manpower, Rural Institutions and Rural Employment in Thailand," Bangkok, 1972 (mimeographed); Thailand, Office of the National Economic and Social Development Board, *The Fourth Five Year Plan*, 1977-81 (Bangkok: NESDB, 1977); United Nations, Economic and Social Commission for Asia and the Pacific, Committee for Coordination of Investigation of the Lower Mekong Basin, "Production Costs of a Number of Major Agricultural Products in the Lower Mekong Basin," Bangkok, January 1975 (mimeographed), World Bank, *Appraisal of Chao Phya Irrigation Improvement Project* (Washington, D.C.: World Bank, 1973); and World Bank, *Appraisal of the Northeast Thailand Irrigation Improvement Project* (Washington, D.C.: World Bank, 1974).

analyses. It is often difficult to define the labor supply and to find the appropriate wage rate. Labor supply may have a different meaning according to the members of the family who are supplying the labor. It also depends on the intensity of the labor used and the length of a working day. Sometimes people choose to be unemployed (labor is traded for leisure), and sometimes a large labor force may exist, but lack of mobility may prevent it from reaching the labor site. The wage rate is also difficult to define appropriately.[32] Previous attempts to estimate labor supply functions using the Thai data have had only limited success.[33]

The primary objectives of the 1975/76 SES were to calculate the consumer price index and to study the expenditure patterns of Thai households. Thus there are several limitations to the analysis of labor supply using this data set, and data from other sources are also resorted to in this report. The estimation of the rural labor supply function for paddy production is given in Appendix 2.[34]

All the labor supply elasticities estimated are high, even when two alternatives for the allocation of hired labor are used (ranging from 8.40 to 13.50).[35] Still, a labor supply elasticity of 8.40 to 13.50 is very high—almost perfectly elastic. Therefore, in analyzing the effect of rice price changes on the rural wage rate, sensitivity analyses for values ranging from 1.00 to 10.00 are appropriate.

The high elasticity of the hired labor supply in this calculation is an indication of what the labor supply response to seasonal wage changes is. Because the amount of hired labor is only about a tenth of the total demand for labor, a slight movement of the total labor available between the peak and the off-peak season can bring about a substantial change in the percentage of hired labor available. It has also been argued that labor supply in the peak season may come from "surplus labor," rather than being a response to a wage rate increase. Hence, the estimate may have captured the shifts in both the labor demand and supply curves rather than in the slope of the supply curve.[36] This study, however, addresses the effects of an increase in the whole structure of the paddy price, not the seasonal changes. If the whole price structure of paddy increases, paddy production may increase; the question then is whether hired labor will be flexible in its response to total labor demand.

This question is partly answered by examining how much hired labor is used in paddy production in comparison with the total labor force available for paddy production and the total agricultural labor force. Table 13 gives employment figures for 1977 in both the off-peak and the peak seasons. Obviously, hired labor in paddy production constituted only a small percentage of total labor used in paddy production—about 4 percent in both the peak and off-peak seasons. The percentages are even smaller when compared with the total agricultural labor force—2.9 percent in the peak season and 1.4 percent in the off-peak season. As a per-

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[32] Some discussion of these problems can be found in Pranab Bardhan, "Labor Supply Function in a Poor Agrarian Economy," *American Economic Review* 69 (March 1979): 73-83.

[33] A study by Banno estimates the nonfarm and off-farm labor supply functions using data from the Rural Off-Farm Employment Assessment Project in Thailand, 1980-81. However, the wage variables offer only limited explanations of the labor supply and the samples are not representative. In some cases the results are even contradictory (Yasuo Banno, "Farm Household Labor Supply in Non- and Off-Farm Work in Rural Thailand" [M. Econ. thesis, Thammasat University, 1982]).

[34] Theoretically, the labor supply function is zero degree homogeneous in prices and wages taken together. As the first approximation, labor supply is modeled as a function of the real wage (relative to rice price). However, one may assume that a world price for rice is given, so that the domestic price (P_d) is the world price less the export tax and is exogenous to the system; that labor demand is a function of domestic prices of rice (P_d) and other crops (P_o) expressed as ratios of the wage (w), and that labor supply depends on P_d/w only. The labor market equilibrium then requires: Demand = Supply or $L_D(P_d/w, P_o/w) = L_S(P_d/w)$. Again, other crops are assumed to be irrelevant. Hence, labor market equilibrium implies that P_d/w is constant, that is, that money wages fully adjust to tax-induced price changes. Therefore, in Appendix 2, where the labor supply function is estimated, the variable wage is not divided by the domestic price of rice.

[35] That the labor supply may be highly elastic is supported by Bertrand's observation that the Thai rural labor market responds to the opportunities of higher returns (Trent Bertrand, *Thailand: Case Study of Agricultural Input and Output Pricing*, World Bank Staff Working Paper 385 [Washington, D.C.: World Bank, 1980]). A study in Northwestern Malaysia on the rural labor supply also found a highly elastic labor supply of more than 4.00 (Clive Bell, Peter Hazell, and Roger Slade, *Project Evaluation in Regional Perspective* [Baltimore and London: The Johns Hopkins University Press, 1982]).

[36] This argument, however, is inconsistent with the empirical evidence in support of a more efficient and well-integrated labor market in Thailand (Bertrand and Squire, "The Relevance of the Dual Economy Model").

Table 13—Employment in agriculture compared with total employment in the off-peak season, January to March 1977, and in the peak season, July to September 1977

Employment	Self-Employed	Professional and Managerial	Clerical and Sales Workers	Agriculture Workers	Production and Transportation Workers	Total
			(number of workers)			
Off-peak season						
Paddy	2,362,523	...	...	114,009	700	2,477,232
Other crops	3,889,116	85	147	596,051	344	4,485,743
Other agriculture	469,576	192	85	74,475	35,878	580,206
Nonagriculture	2,817,596	580,596	449,060	5,646	2,315,974	6,168,872
Total	9,538,811	580,873	449,292	790,181	2,352,896	13,712,053
Peak season						
Paddy	10,500,465	...	...	419,510	40	10,920,015
Other crops	2,509,989	...	873	424,806	3,753	2,939,421
Other agriculture	353,907	277	140	62,400	11,376	428,100
Nonagriculture	2,399,562	540,807	422,082	5,910	1,915,745	5,284,106
Total	15,763,923	541,084	423,095	912,626	1,930,914	19,571,642

Source: Thailand, National Statistical Office, "Labor Force Survey, 1977 Data Tape," Bangkok, 1977.

centage of total hired labor, hired labor in paddy production constitutes only about 14 percent in the off-peak season. The figure is higher in the peak season—about 46 percent. However, if the wage rate is increased, some additional hired labor would be expected to flow from the self-employed agricultural workers, which is a much larger group than hired labor. There may also be an increase in the use of self-employed labor. Hence, the amount of hired labor required in paddy production is small when compared to the total labor force in the rural areas.

The parameters estimated from the labor supply functions may in fact be impact multipliers,[37] rather than actual labor supply elasticities, because constraints have not been applied to the supply of other production factors. It is implicitly assumed that the cost of production expansion is very low, and that the mobility of labor is costless. If these constraints are imposed, the actual labor supply elasticities could be lower.

Finally, competition for labor from other crops, which has not been included in the model, could decrease the actual labor supply elasticity of paddy production. Although the substitutability with other upland crops may be low for cultivated land, it is expected to be high for labor.

Before the effects of rice price changes on the rural wage rate can be calculated, however, the question of family labor must be considered.

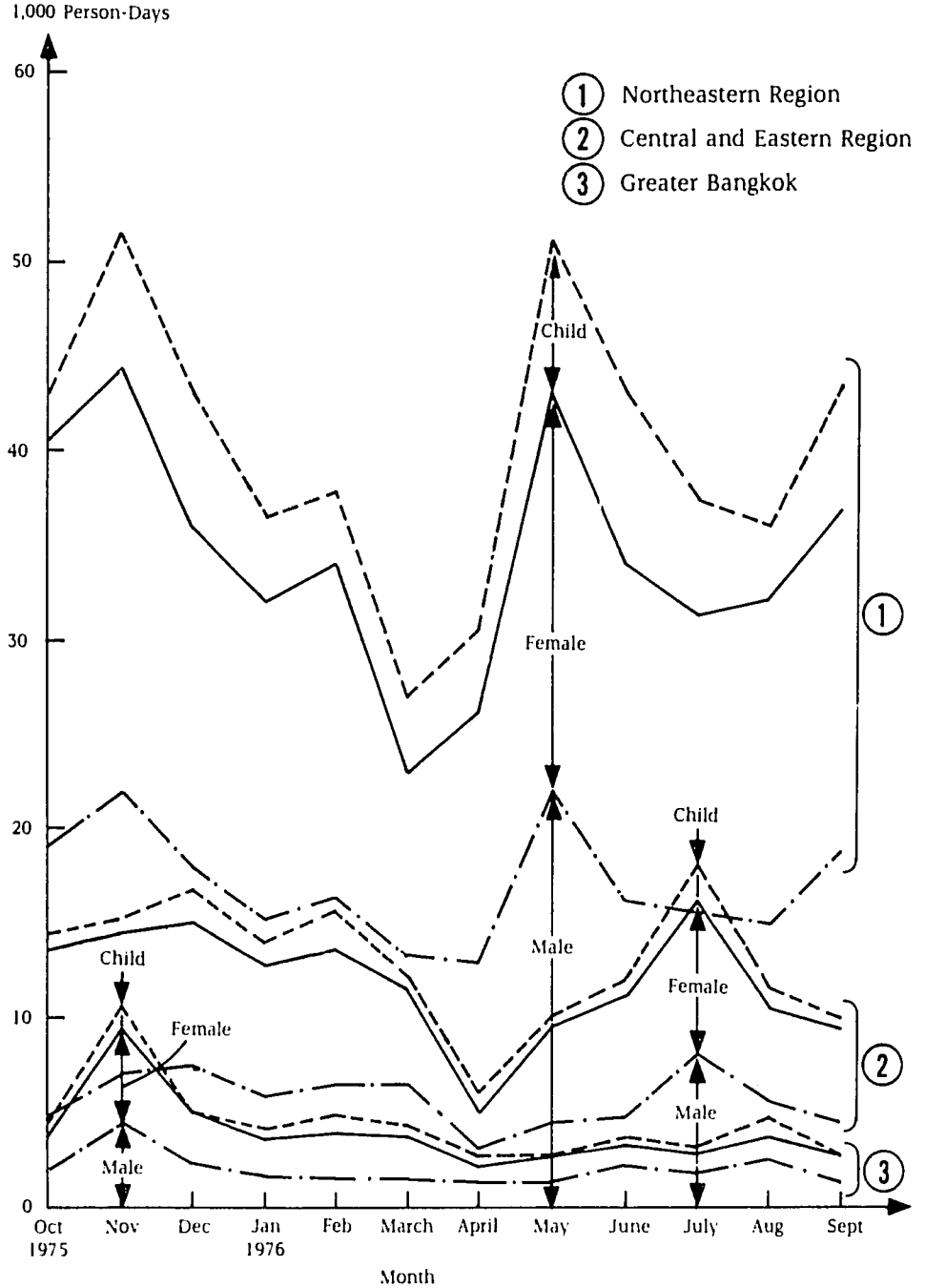
Composition of Family Labor

Family labor consists of labor from male and female adult members and child labor (those 15 years old or below). The monthly total family labor supply is broken down into three different sources and is plotted by region in Figure 5. Through most of the year, female labor participation is substantial. In peak seasons the participation by females and children increases. In off-peak seasons their share of total family labor in paddy production is reduced. This phenomenon is supported by empirical observations and indicates the responsiveness of the farm family to changes in labor demand over the cropping seasons. Without family participation, the demand for hired labor during the peak seasons would have been even higher.

The increased share of female and child labor indicates that during the peak seasons, male adult labor is fully occupied. During the off-peak seasons, men, women, and children may all obtain off-farm work, or they may simply be at leisure.

[37] Impact multipliers indicate changes of one variable caused by changes in another variable irrespective of the possibility of changes of all other variables besides the two.

Figure 5—Composition of family labor in paddy farm households in the Northeastern and Central and Eastern Regions and Greater Bangkok, 1975/76



Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Note: Greater Bangkok includes the Bangkok metropolis and the provinces of Nonthaburi, Pathumthani, and Samut Prakan.

The participation of female and child labor in the Northeastern Region seems to have been more persistent than in the Central and Eastern Region or the Greater Bangkok metropolitan area. This is consistent with the fact that most of the rice farmers in the Northeastern Region were less market-oriented and resorted to less hired labor than those in the Central and Eastern Region.

The Effects of Rice Price Changes on Rural Wage Rates

In equation (13) the primary source of the values of the relative factor shares of land, labor, and capital (K_a, K_l, and K_c) is the Survey of Agricultural Production conducted by the Division of Agricultural Economics of MOAC for 1977/78. Ranges of these values are $K_a = 0.20 - 0.53$, $K_l = 0.33 - 0.68$, and $K_c = 0.14 - 0.32$.[38] There are variations in the relative factor shares because of differences in the crops planted, the techniques used in production, the quality of land, and so forth. According to Setboonsarng, however, the average values of these factor shares are $K_a = 0.4$, $K_l = 0.3$, and $K_c = 0.3$.[39] The average values are used in this report. An implicit assumption is made that the sample households are using optimal shares of the factors, which is necessary in order to use Floyd's formula in the analysis of the effects on wages.

Although an estimate of the supply elasticity of land (β_a) could not be found in any statistical study, it is believed to be very low. First, according to planted area data from MOAC, the expansion of area for rice cropping was much slower in the late 1960s and 1970s than in the two decades after World War II.

	Annual Growth Rate (percent)
1947-56	2.5
1957-66	4.6
1967-76	1.9

Second, it is generally accepted that surplus land for rice cropping no longer exists in Thailand. Most new upland areas are appropriate only for such crops as corn, cassava, and sugarcane, which in normal years are more profitable than rice. Conversion of these land areas to rice production would be difficult and costly.

Third, the response of area to price changes in Chapter 4 was low. Although it is probably an underestimate, a zero value is selected for this parameter. Equation (13) and β_l in Appendix 2 indicate that a slightly higher value of β_a will not appreciably alter the results.

The main capital inputs used on Thai rice farms are water buffalo, tractors, plows and harrows, water pumps, and hand tools. (In this particular analysis, factors besides land and labor are also assumed to be in the capital category.) The supply of these capital inputs depends on the supply of financial capital in the agricultural sector. Empirical evidence indicates that in the short run the supply of funds to agriculture in Thailand is not highly elastic; in fact, it is quite inelastic. Agricultural credit is considered to be riskier than normal. Whereas demand for funds might depend on the interest rate, the supply of funds depends on the expected return on loans, and the perceived risk could have an adverse effect on the supply of loans. Private financial institutions are often unwilling to lend to agriculture, and rural branches of these institutions normally lack the authority to make decisions on loans.[40]

In the long run flows of funds into the rice sector can be more elastic. If there is a structural increase in the domestic price of rice, rice production becomes more profitable. The values of cultivated land and other farm assets also increase. The rice sector will attract more financial capital. In the long run the flow of financial capital can be unlimited.

Two values of supply elasticity of capital (β_c) are assumed in the computation—a zero value in the short run and an infinite value in the long run. A zero value may be an un-

[38] Tinprapha, "Employment and Agricultural Products in Thailand," Table 5.2.

[39] Suthad Setboonsarng, "Pricing Agricultural Commodities Under Policy Constraints with Reference to Rice in Thailand" (Ph.D. dissertation, University of Hawaii, 1983).

[40] Chaiwat Wibulsawasdi and Benjawan Meesrikul, "The Structure of Domestic Financial Institutions in Thailand (1972-1978)," *Journal of Economic and Business Administration* 8 (April-June 1979): 167-186. (In Thai.)

derestimation but is not totally unreasonable considering the arguments given earlier. In fact, when examining equation (13) and the values of the supply elasticity of labor (β_l), a slightly higher value of β_c would not appreciably change the final result. The same argument is applied for the infinite value in the long run.

For the values of β_l, both the values obtained from the estimates in Appendix 2 and different values from 1.0 to 10.0 are used. The plausible range of values for the parameters that are used to estimate the impact of rice price changes on rural wage rates are summarized:

Supply elasticity	
Labor	
Northeastern Region	8.39
Central and Eastern Region	11.53
Greater Bangkok	13.50
Sensitivity test	1.00 – 10.00
Land	0
Capital	
Short run (assumed)	0
Long run (assumed)	∞
Relative share of	
Labor	0.3
Land	0.4
Capital	0.3

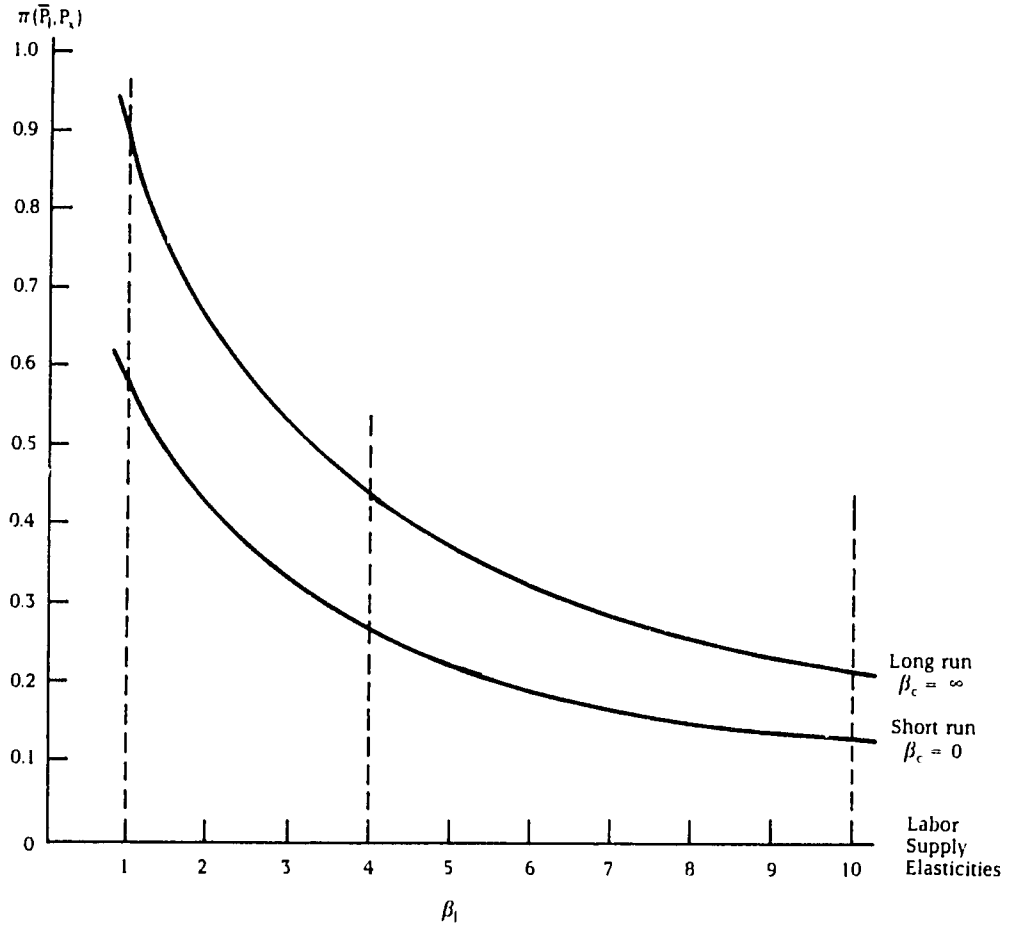
Using the estimates of the labor supply elasticities, in the short run the elasticities of the wage rate with respect to the price of rice for the three regions are 0.15 for Northeastern, 0.11 for Central and Eastern, and 0.10 for the Bangkok areas. In the long run these elasticities are 0.25, 0.19, and 0.16. The results of a sensitivity analysis using different values of labor supply elasticity are plotted in Figure 6. As expected, when the labor supply is highly elastic, the effect on the wage rate is small.

The impact on the wage rate shown in Figure 6 is an inverse function of the labor supply elasticity showing a smoothly decelerating rate of change. If the elasticity of the labor supply is arbitrarily set between 4.00 and 10.00, the effect on the wage rate will be less than 0.26 in the short run. Only when the labor supply elasticity is low will such an impact be high.

Another important question that is not included in this study is the effects of rice price changes on the urban wage rate and on nonagricultural employment. This is a complicated issue, and it is beyond the scope of this study to deal with it in detail.[41] Nevertheless, one may argue that low, stable real food prices favor growth in urban employment. One of the results of the Thai rice policy has been to make food prices more stable than would have been the case otherwise.

[41] See for example John W. Mellor, "Food Price Policy and Income Distribution in Low-Income Countries."

Figure 6—Changes in the effect of the price of rice on the rural wage rate for various labor supply elasticities



Source: Calculations of the author based on equation (13).

$\pi(\bar{P}_I, P_r)$ = the elasticity of the equilibrium wage rate with respect to the price of rice, and

β_I = the elasticity of labor supply.

6

THE EFFECTS OF RICE PRICE CHANGES ON THE CALORIE INTAKE OF CONSUMERS

In the previous chapters the effects of rice price changes were measured largely by their effects on the real incomes of consumers and producers. In this and the following chapter they are measured by their effects on nutritional status. In a survey by Kennedy and Pinstrup-Andersen, the five most important factors affecting the nutritional status of an individual are:[42] (1) the availability of food in the market or on the farm, (2) the ability of the individual's household to obtain the food that is available, (3) the desire of the leading members of the household to obtain food to which they have access, (4) the use of the food obtained by the household and by the individual to meet nutritional needs, and (5) the health of the individual. Malnutrition may result from deficiencies in any one or more of these five factors.

Rice price policy is more closely related to factors (2) and (3), the ability and desire of household members to obtain food. Although dietary status is only one component of nutritional status, an inadequate dietary intake may lead to nutritional deficiency. It is partially because of the established links between diet and certain diseases, such as thiamine deficiency and beriberi or vitamin A deficiency and night blindness, that clinicians began to assess dietary intake as an indirect measure of nutritional status.

Clinical evidence indicates that there is a malnutrition problem in Thailand. In order of their seriousness the important types of malnutrition are identified as protein-calorie malnutrition; deficiencies in thiamine, riboflavin, vitamin A, iron, and iodine; and that which causes kidney stones and gallstones.[43]

The type of malnutrition that is most often seen in Thailand is protein-calorie malnutrition, which may be a result of low household purchasing power determined largely by household income and food prices. A study of protein-calorie malnutrition, therefore, is intimately related to the study of the effects on nutrition of rice price policies in Thailand.

This chapter is divided into three parts: the first part provides information on food consumption patterns of the Thai population; the second attempts to identify the poor and malnourished; and the third tries to quantify the relationship between food consumption of different population groups and changes in incomes and prices.

The figures for calorie intake used in this analysis are derived from the data on food and beverage expenditures in the 1975/76 SES. Price data, which are introduced exogenously, are monthly averages by region that do not change with consumers' incomes. For a description of this calculation, see Appendix 3. These calorie figures represent total calorie intake by the sample households in the survey weeks.

The frequency distribution of daily per capita calorie intake of urban and rural households is given in Figure 7. The sample households are disaggregated because urban and rural diets are quite different, and the sampling fractions for different community types also vary.[44] The mean per capita daily calorie intake of urban households is 2,137 calories and of rural households, 2,179 calories.

An average daily per capita calorie consumption of less than 1,000 calories is considered too low and that of more than 4,000

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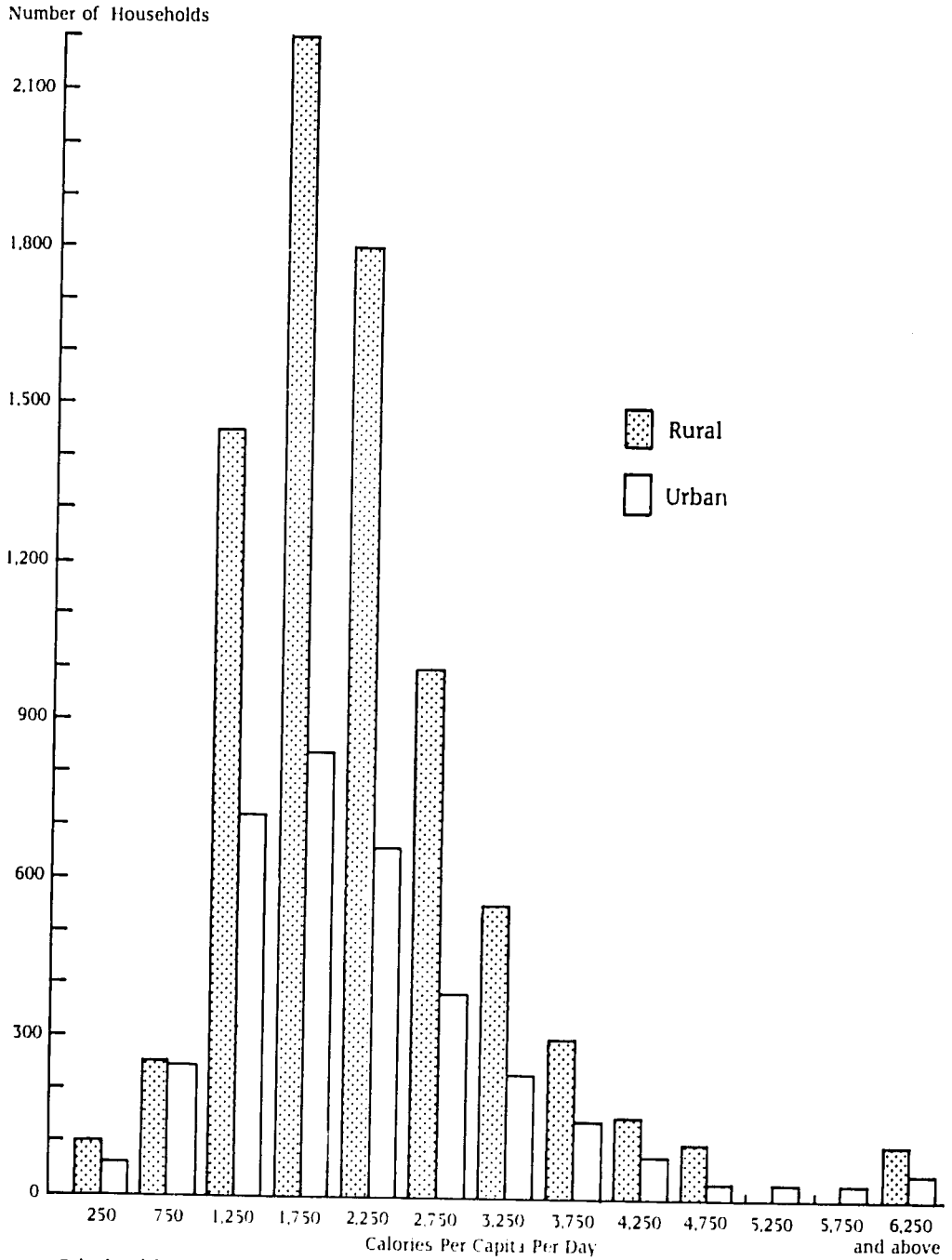
[42] See Eileen T. Kennedy and Per Pinstrup-Andersen, *Nutrition-Related Policies and Programs: Past Performances and Research Needs* (Washington, D.C.: International Food Policy Research Institute, February 1983).

[43] Thailand, National Economic and Social Development Board, Subcommittee on Food and Nutrition Development, *Report for National Development Plan on Food and Nutrition (1977-81)* (Bangkok: NESDB, February 1977). (In Thai.)

[44] The sampling fractions in the 1975/76 SES data set are as follows: Greater Bangkok = 1/300, Municipal Areas = 1/175, Sanitary Districts = 1/360, and Villages = 1/840. In the following calculation, households in the core city of Bangkok and those in the municipal areas are considered to be urban. The rest are rural. Although the sampling fractions of sanitary districts and villages differ, their dietary composition and consumer preferences are much more similar than those in the municipal areas.

Figure 7—Distribution of the daily per capita calorie intake of urban and rural households, 1975/76



Source: Calculated from data in Thailand National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Note: Average daily per capita calorie consumption of less than 1,000 calories is arbitrarily considered too low in this report, while more than 4,000 calories is too high. Of the 3,434 urban households in the sample, 301 households consumed less than 1,000 calories per capita per day, and 187 consumed more than 4,000 calories per capita per day. Of the 7,790 rural households, 317 consumed less than 1,000 calories per capita per day, and 338 consumed more than 4,000 calories per capita per day. In urban areas the mean was 2,137 calories and the standard deviation was 1,196. In rural areas these figures were 2,179 and 1,104.

calories too high (these figures are arbitrary). Possible causes of underestimation of the actual household calorie intake may be incomplete records of food expenditures or undervaluation of food expenditures because a portion of the food consumed is received free as a gift, or home-produced, or consumed somewhere else but not reported. Overestimation may be caused by the inclusion of food fed to guests or unusually expensive food that is not distinctively recorded.

The sample households at the two extremes are inspected for any consistent patterns in socioeconomic class, income, whether they are rice farmers, and so forth. The results show that these sample households are fairly randomly distributed. In the following calculations these observations are excluded to prevent a potential bias problem, but this should not decrease the representativeness of the SES data set.

To adjust for the effects of household composition, it is deemed appropriate to use nutritional scales in the following analysis. Each family member is indicated as a fraction of an adult equivalent consumption unit based on the calorie requirements for moderately active persons recommended by the Food and Agriculture Organization and the World Health Organization (Table 14).

These scales are similar to the "specific scales" proposed by Prais and Houthakker.[45] Although they may not reflect the actual food consumption patterns of each family member, they should do better than the alternative method of counting all members as identical consumption units.

A daily calorie intake of 2,500 calories per adult equivalent unit is adopted as a benchmark. According to the SES data, 52 percent of urban households and 48 percent of rural households—an average of 49 percent—have calorie intakes per adult equivalent unit that are less than this. These figures look high but certainly are not out of range, considering that NESDB estimates that 64.1 percent of households had incomes smaller than were necessary to meet minimum dietary requirements in 1968-69.[46]

Table 14—Adult equivalent consumption units according to age and sex

Age	Male	Female
(years)	(adult equivalent consumption units)	
Less than 1	0.27	0.27
1	0.39	0.39
2	0.45	0.45
3	0.52	0.51
4	0.57	0.56
5	0.62	0.60
6	0.67	0.63
7	0.71	0.67
8	0.75	0.70
9	0.79	0.74
10 - 12	0.87	0.78
13 - 15	0.97	0.83
16 - 19	1.02	0.77
Adult	1.00	0.73

Source: Computed from data in Food and Agriculture Organization of the United Nations, *Energy and Protein Requirements. Report of a Joint FAO-WHO Expert Group* (Rome: FAO, 1972).

Note: The adult equivalent consumption units are based on the recommended energy requirements of moderately active people.

Dietary Composition of Expenditure Classes

Table 15 shows the average calorie intake per adult equivalent unit from 13 food groups, the daily per capita calorie intake (PCCAL), and the daily per adult calorie intake (PACAL) of 10 expenditure groups. Since it is hard to find reliable information on household income and in some cases there is seasonality in household incomes (farmers, for example), household consumption expenditures are used as a proxy for household incomes.[47]

Rice is obviously a major source of calories for all households. It contributes about 91 percent of the total calorie intake for the lowest rural expenditure group, 56 percent for the highest rural expenditure group, 70

[45] S.J. Prais and H.S. Houthakker, *The Analysis of Family Budgets* (Cambridge: Cambridge University Press, 1971).

[46] Thailand, National Economic and Social Development Board, *Report on Food and Nutrition*, p. 125.

[47] The 13 food groups cover almost all the foods consumed by these households. The only item omitted is alcoholic drinks away from home, because their prices vary greatly and reliable calorie intake cannot be obtained from expenditure data when specific price data are not available in the original data set. Alcoholic drinks away from home constitute only a small portion of the budget.

Table 15—Average per adult calorie intake from 13 food groups, calorie intake per capita, and calorie cost distributed by 10 expenditure groups in urban and rural areas, 1975/76

Food Group	Urban Per Capita Expenditure Group									
	1	2	3	4	5	6	7	8	9	10
	(calories)									
All grains and cereal products	1,667	1,676	1,681	1,735	1,702	1,710	1,753	1,836	1,843	1,750
Rice[a]	1,446	1,437	1,384	1,416	1,398	1,403	1,362	1,446	1,424	1,378
Meat and poultry	108	178	185	216	231	250	279	298	339	375
Fish and seafood	36	43	45	56	50	52	55	64	68	80
Milk, cheese, and eggs	32	47	51	58	74	81	91	96	100	122
Oils and fats	63	90	97	97	119	109	123	147	147	163
Fruits and nuts	12	18	23	27	29	41	40	56	67	84
Vegetables	40	56	62	69	73	82	84	92	102	129
Sugar and sweets	54	70	71	86	80	92	87	100	113	119
Spices, coffee, and tea	8	11	12	13	13	14	20	19	21	25
Nonalcoholic beverages	2	4	5	6	8	11	11	13	17	23
Prepared food eaten at home	35	45	41	62	74	135	136	119	117	155
Prepared food eaten away from home	7	14	26	26	26	38	46	61	60	85
Alcoholic drinks consumed at home	2	4	5	6	6	7	6	9	11	21
Per capita calorie intake	1,596	1,767	1,814	1,939	1,980	2,092	2,167	2,317	2,425	2,557
Per adult calorie intake	2,065	2,257	2,305	2,453	2,487	2,623	2,734	2,910	3,007	3,133

Food Group	Rural Per Capita Expenditure Group									
	1	2	3	4	5	6	7	8	9	10
	(calories)									
All grains and cereal products	1,917	2,105	2,181	2,246	2,253	2,228	2,235	2,256	2,201	2,141
Rice[a]	1,872	2,033	2,060	2,092	2,062	1,969	1,962	1,941	1,872	1,768
Meat and poultry	27	48	67	82	104	132	149	168	210	282
Fish and seafood	48	56	62	71	68	69	71	81	81	91
Milk, cheese, and eggs	4	10	15	19	23	30	36	46	60	93
Oils and fats	12	23	36	45	58	66	87	94	113	145
Fruits and nuts	3	6	9	11	13	19	21	30	32	42
Vegetables	20	35	37	48	56	60	69	80	81	98
Sugar and sweets	17	30	38	62	72	86	97	95	126	117
Spices, coffee, and tea	3	4	6	8	9	11	13	13	16	21
Nonalcoholic beverages	0	0	0	1	1	1	2	3	5	10
Prepared food eaten at home	1	2	3	3	6	14	14	21	36	60
Prepared food eaten away from home	0	0	0	1	1	3	5	9	15	31
Alcoholic drinks consumed at home	1	2	3	3	3	6	6	7	9	22
Per capita calorie intake	1,557	1,757	1,889	2,019	2,086	2,150	2,229	2,311	2,406	2,560
Per adult calorie intake	2,053	2,322	2,458	2,600	2,667	2,727	2,860	2,904	2,984	3,154
	(baht/1,000 calories)									
Average urban calorie cost	2.90	3.45	3.76	4.06	4.28	4.58	4.81	5.07	5.43	6.55
Average rural calorie cost	1.90	2.17	2.32	2.50	2.60	2.83	3.02	3.27	3.71	4.70

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Note: The breakdown of the expenditure groups is based on per capita household consumption expenditures. Group 1 is the poorest, Group 10, the richest.

[a] Rice is part of the grains and cereal products food group and these numbers are included under those above. It is shown separately, however, because rice plays such a major role in the calorie intake of Thais.

percent for the lowest urban expenditure group, and 44 percent for the highest urban expenditure group. Consumption of meat, poultry, dairy products, and oils and fats by urban households is clearly higher than in rural households. The consumption of these food items increases with household expenditures. On the other hand, consumption of fish and seafood tends to be higher in the rural area.

Average calorie cost shows a positive relationship with household expenditures. Variation in the average calorie cost is caused by changes in dietary composition rather than by different qualities of the same food item because average monthly prices of food items are used in the calculations of the calorie figures, as explained in Appendix 3. Average costs of calories consumed by these expenditure groups correspond with their dietary composition and are substantiated by the average calorie prices of the 13 food groups, as shown in Table 16. Rice is the cheapest source of calories. Sugar and sweets are a close second. Oils and fats are the third. The most expensive source is nonalcoholic beverages.

Table 16—Average calorie prices of 13 food groups, 1975/76

Food Group	Price
	(baht/1,000 calories)
All grains and cereal products	1.17
Rice[a]	1.16
Meat and poultry	9.78
Fish and seafood	19.64
Milk, cheese, and eggs	7.36
Oils and fats	2.09
Fruits and nuts	12.43
Vegetables	16.59
Sugar and sweets	1.64
Spices, coffee, and tea	90.47
Nonalcoholic beverages	102.83
Prepared food eaten at home	5.33
Prepared food eaten away from home	16.59
Alcoholic drinks consumed at home	21.86

Source: Calculated by the method explained in Appendix 3.

[a] Rice is part of the grains and cereal products food group and these numbers are included under those above. It is shown separately, however, because rice plays such a major role in the calorie intake of Thais.

Poverty Incidence as Measured by Income Versus Calorie Intake

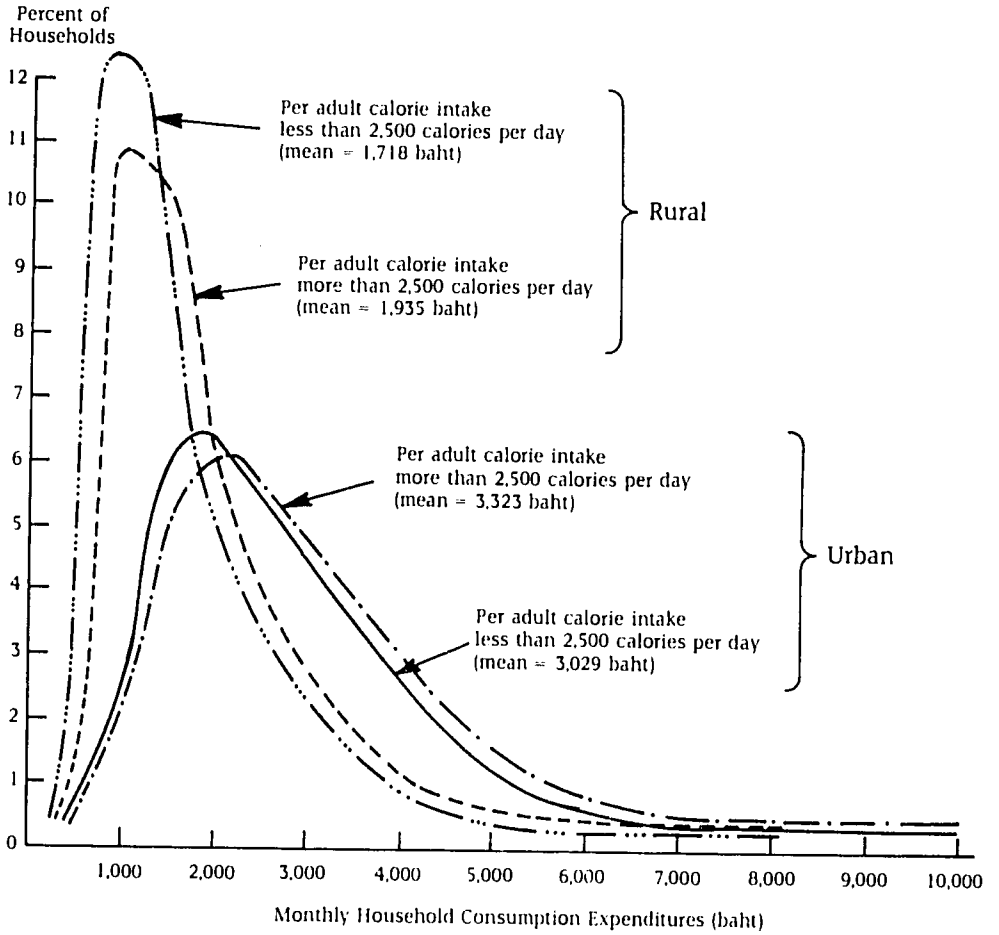
This study focuses on the behavior of the poor, but poverty can be defined in different ways. A relevant question here is whether the income of a household is a good indicator of its calorie intake. Figure 8 shows the frequency distribution of monthly household consumption expenditures (used to represent household incomes) of households whose PACAL is below 2,500 calories compared with those above 2,500 calories. It is striking to see how much the two curves overlap, especially in the urban areas, although the mean expenditures of the two calorie groups are statistically different from each other at a confidence level of 0.0097 for urban households and 0.0001 for rural households. In other words, there are calorie-deficient and nondeficient groups among both low- and high-income households. Using household income or expenditures alone does not represent the calorie intakes of these households well.

In Chapter 3, the absolute poverty line was computed based on a nutritionally adequate diet. If the price data of rice, pork, and bananas are corrected, the new poverty lines are 291.14 baht per capita per month for urban households and 205.15 baht per capita per month for rural households. The national incidence of poverty rises to 37.9 percent; 15.4 percent of those who live in urban areas and 41.3 percent of those who live in rural areas are poor.

When the income and calorie-intake methods are cross-classified, it is apparent that many households are classified differently under the two methods. In urban areas 1,221 households (or 41.4 percent of urban households) with per capita monthly incomes above the poverty line of 291.14 baht are found to have a PACAL of less than 2,500 calories. In rural areas the number is also high, 1,841 households (or 25.8 percent of rural households). The number of households with per capita incomes below the poverty line but with PACAL above 2,500 calories are 186 in the urban areas and 1,085 in the rural areas.

Four types of households are identified: low income and calorie deficient (LI&D); high income and calorie deficient (HI&D); low income and not deficient (LI&ND); and high income and not deficient (HI&ND).

Figure 8—Distribution of the monthly household consumption expenditures of the calorie-deficient and nondeficient groups in urban and rural areas, 1975/76



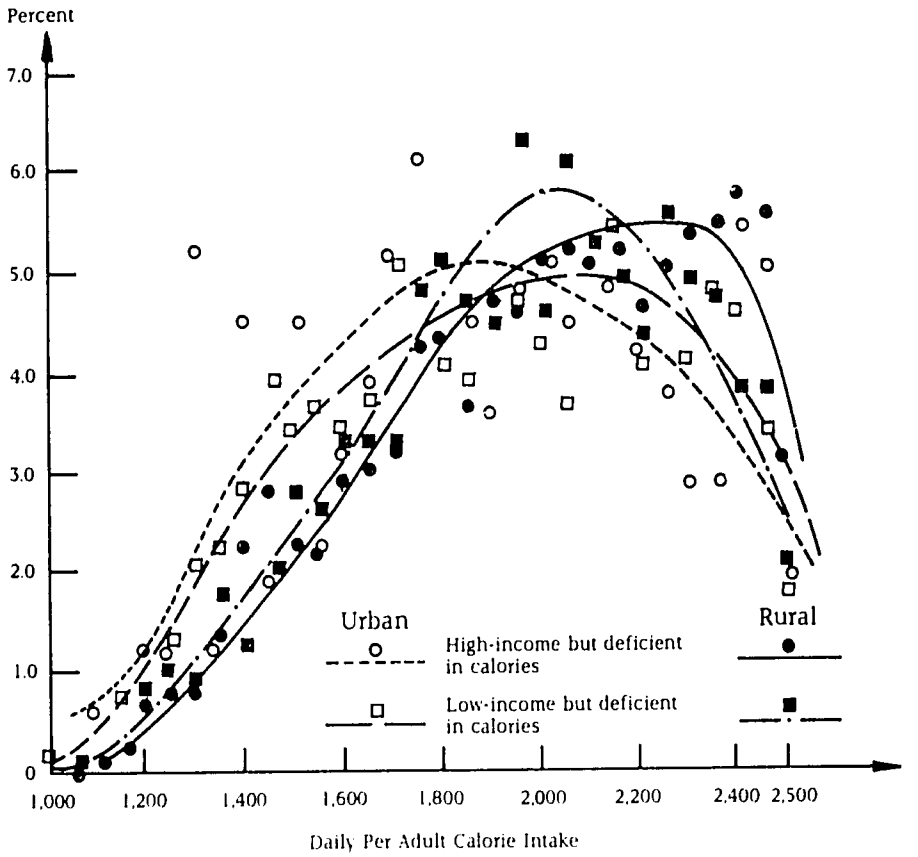
Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

High income here does not necessarily mean rich. It merely means that the income of the household places it above the poverty line.

One may suspect that the calorie intake of the HI&D groups, although less than 2,500 calories, may be quite close to what is required and that they should not be classified in the deficient group. Figure 9, which shows the distribution of calorie intake of the LI&D and HI&D groups for the urban and rural areas, dissolves these suspicions. Although the curves of the HI&D groups tend to be on the right-hand side of those of LI&D, they frequently overlap. The distributions of calorie intake for the LI&ND and HI&ND groups also frequently overlap.

The questions, of course, are why do some of those who are better off suffer from calorie deficiency, and how do some of the poor manage to meet their calorie requirements? Table 17 shows the average budget shares for the four types of consumers for 14 groups of food, including rice, and nonfood items. As expected, the HI&D consumers spend the smallest percentage of their household budget on food and beverages. They also spend less on grains and cereals, especially rice. On the other hand,

Figure 9—Distribution of the daily per adult calorie intake of high- and low-income groups deficient in calories in urban and rural areas, 1975/76



Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: The per adult calorie intake of both groups in this figure was less than 2,500 calories per day. Low-income consumers are those having per capita monthly incomes of less than 291.14 baht in urban areas and less than 205.15 baht in rural areas. High-income consumers are those having per capita monthly incomes of more than these amounts.

they spend the highest percentage of their budget shares on nonfood items.

Of the two low-income groups, the LI&ND consumers seem to allocate a higher proportion of their budget to food and beverages than the LI&D group. The opposite is true for nonfood items.

Table 18 shows the marginal budget shares of food and beverages of these four consumer groups. The HI&D group displays the lowest marginal propensity to consume (MPC) food and beverages with the exception of the rural LI&D group, which may be extremely poor.

The MPC of the urban LI group is higher than that of either the urban LI&D or the LI&ND groups. Because the LI group is a mixture of the LI&D and the LI&ND, one would expect its MPC to fall in between the MPCs of the other two. This phenomenon also occurs with the urban and rural HI groups. Table 19 shows that the D and ND groups tend to have different preferences in food consumption, particularly in the consumption of rice. Hence, when the two groups are combined, they are heterogeneous at least in preference for rice. Figure 10 is a hypothetical diagram showing how calorie intakes and incomes of consumers relate. The slope of the LI group is higher than that of either the LI&D or the LI&ND groups. In estimating disaggregated consumption parameters, the disaggregation usually occurs at the LI level, but this investigation shows that parameters obtained at the LI level may not precisely

Table 17—Average budget shares of urban and rural consumers, by calorie intake and income, 1975/76

Expenditure Item	Urban				Rural			
	Low-Income Deficient	High-Income Deficient	Low-Income Non-Deficient	High-Income Non-Deficient	Low-Income Deficient	High-Income Deficient	Low-Income Non-Deficient	High-Income Non-Deficient
	(percent)							
Total food and beverages	0.56	0.44	0.61	0.48	0.61	0.49	0.66	0.55
All grains and cereal products	0.16	0.08	0.21	0.10	0.28	0.15	0.32	0.19
Rice[a]	0.14	0.07	0.18	0.08	0.27	0.14	0.30	0.17
Meat and poultry	0.09	0.09	0.09	0.08	0.06	0.07	0.08	0.08
Fish and seafood	0.07	0.05	0.07	0.05	0.10	0.07	0.09	0.08
Milk, cheese, and eggs	0.03	0.02	0.03	0.02	0.01	0.02	0.01	0.02
Oils and fats	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01
Fruits and nuts	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.03
Vegetables	0.07	0.05	0.07	0.05	0.08	0.07	0.08	0.07
Sugar and sweets	0.01	0.05	0.02	0.01	0.01	0.01	0.01	0.01
Spices, coffee, and tea	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.02
Nonalcoholic beverages	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01
Prepared food eaten at home	0.02	0.03	0.03	0.04	0.00	0.01	0.00	0.01
Prepared food eaten away from home	0.03	0.06	0.02	0.05	0.01	0.03	0.01	0.02
Alcoholic drinks consumed away from home	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alcoholic drinks consumed at home	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total nonfood items	0.44	0.56	0.39	0.52	0.39	0.51	0.34	0.45
Tobacco products	0.03	0.04	0.04	0.03	0.03	0.03	0.03	0.03
Apparel	0.06	0.08	0.05	0.08	0.08	0.11	0.07	0.10
Housing	0.13	0.15	0.11	0.14	0.08	0.09	0.06	0.08
Medical care	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.04
Personal care	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.02
Transport and communications	0.03	0.06	0.03	0.06	0.03	0.05	0.09	0.04
Recreation and reading	0.02	0.03	0.02	0.03	0.01	0.02	0.01	0.02
Education	0.03	0.04	0.01	0.02	0.01	0.02	0.01	0.01
Ceremonies and miscellaneous	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Other purchases[b]	0.08	0.10	0.07	0.10	0.09	0.12	0.07	0.10
	(baht)							
Monthly consumption expenditures	1,893	3,220	2,024	3,521	1,220	2,149	1,360	2,173

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

[a] Rice is part of the grains and cereal products food group and these numbers are included under those above. It is shown separately, however, because rice plays such a major role in the calorie intake of Thais.

[b] Other purchases include major equipment, recreation equipment, and vehicle purchases.

Table 18—Marginal budget shares spent on food and beverages by urban and rural consumers, by calorie intake and income, 1975/76

Consumer Group	Urban	Rural
Low-income, deficient	0.283	0.126
High-income, deficient	0.110	0.150
Low-income, nondeficient	0.372	0.333
High-income, nondeficient	0.150	0.172
All low-income	0.380	0.215
All high-income	0.160	0.180
All deficient	0.130	0.160
All nondeficient	0.170	0.190

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: Low-income consumers are those having per capita monthly incomes of less than 291.14 baht in urban areas and less than 205.15 baht in rural areas. High-income consumers are those having per capita monthly incomes of more than these amounts. The calorie-deficient group consumes less than 2,500 calories per adult a day, whereas the nondeficient group consumes more than 2,500 calories.

reflect those of the LI&ND and LI&D groups.

There is also a statistical problem of sample selection bias. In regression analysis it is always inappropriate to select the sample on the basis of a dependent variable or something strongly influenced by a dependent variable.[48]

In absolute terms Table 19 shows the average amount of calories contributed by various groups of food in the diets of these four groups of consumers. Strikingly, the HI&D group consumes very little rice, about half of that consumed by the LI&ND group. The HI&D households consume more meat and poultry. The LI&ND group consumes large amounts of rice, but the consumption of oils and fats by the rural LI&ND households is quite low.

Although those in the LI&D group tend to consume more rice than those in the HI&D group, their consumption of all other food items is the lowest of all. This is undoubtedly caused by their low incomes. In comparing the two low-income groups, the amount of calories from rice seems to make the difference between deficiency and nondeficiency.

The average and marginal cost of calories consumed by those consumer groups is given in Table 20. The marginal cost of calories is estimated by regressing the expenditures on food and beverages on the amount of calorie intake. Again, the HI&D groups are found to have the highest average cost of calories. Their marginal cost is also quite high.

Profiles of the Four Population Groups

In light of the evidence above, it is useful to look at the four types of consumers in an attempt to identify who they are.

Although incomes of the LI&ND group are low, these consumers know how to manage their food expenditures to fulfill their calorie requirements. Because their incomes and calorie intake are high, those in the HI&ND group are of no concern here. The HI&D group, however, spends more on nonfood items than on food, and their calorie costs are high. These consumers are not eager to spend additional income on increasing their calorie intake. Strangely enough, they also show a higher negative response to an increase in the price of rice. Their calorie deficiency seems to be voluntary, but the reasons for it have not been determined. Finally, the LI&D is the group of people who are deficient in calorie intake because they cannot afford to acquire enough food.

The four types of consumers are disaggregated into the socioeconomic groups in Table 21. Because the sample sizes of the socioeconomic groups are different, as well

[48] To illustrate sample selection bias, suppose that for household i, consumption of food c_i is related to household income y_i via

$$c_i = \alpha + \beta y_i + \varepsilon_i,$$

and the sample is split into those with $c_i < \bar{c}$ and those with $c_i > \bar{c}$. When two regressions are run for each group, the sample split induces a negative correlation between y_i and ε_i in the low consumption group (if y_i is high, it can only move to the low group if ε_i is negative) and a positive correlation in the high consumption group. Income elasticities are then adjusted downward for the former and upward for the latter even if there is no genuine group heterogeneity. (James J. Heckman, "Sample Selection Bias as a Specification Error," *Econometrica* 47 [January 1979]: 153-161.)

Table 19—Average calorie intake of urban and rural consumers by calorie intake and income for 13 food groups, 1975/76

Food Group	Urban				Rural			
	Low-Income Deficient	High-Income Deficient	Low-Income Non-deficient	High-Income Non-deficient	Low-Income Deficient	High-Income Deficient	Low-Income Non-deficient	High-Income Non-deficient
	(calories/adult/day)							
All grains and cereal products	1,441.2	1,214.5	2,485.1	2,215.6	1,723.5	1,542.3	2,790.7	2,642.8
Rice[a]	1,246.1	1,064.5	2,030.0	1,700.6	1,652.1	1,417.2	2,606.7	2,269.8
Meat and poultry	128.9	215.2	174.3	317.3	54.7	117.9	91.3	192.8
Fish and seafood	39.1	45.3	55.4	67.9	55.0	60.1	74.7	84.0
Milk, cheese, and eggs	36.6	65.6	56.6	97.8	12.3	36.1	17.5	51.3
Oils and fats	71.7	96.4	113.8	145.9	28.3	64.5	44.4	104.3
Fruits and nuts	14.8	27.2	30.8	59.9	8.3	16.1	11.0	30.1
Vegetables	43.3	67.5	59.9	102.1	31.8	52.6	45.4	84.1
Sugar and sweets	56.7	59.9	120.6	117.1	36.1	62.6	55.4	112.7
Spices, coffee, and tea	9.1	12.6	15.3	21.2	5.8	10.7	7.3	14.5
Nonalcoholic beverages	2.7	8.7	4.6	14.0	0.3	2.7	0.3	3.9
Prepared food eaten at home	26.1	54.5	59.3	151.6	2.2	14.0	5.9	30.3
Prepared food eaten away from home	12.4	31.8	10.5	57.3	0.5	9.4	1.2	10.4
Alcoholic drinks consumed at home	3.9	6.1	6.4	10.6	2.2	5.9	3.3	9.8
Total calorie intake per adult	1,886.5	1,905.1	3,192.7	3,378.2	1,960.9	1,994.9	3,148.4	3,371.0

Source: Thailand, National Statistical Office, "1975-76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

[a] Rice is part of the grains and cereal products food group and these numbers are included under those above. It is shown separately, however, because rice plays such a major role in the calorie intake of Thais.

as the number of households in each cell, the percentage of each type of consumer in the sample size of the socioeconomic group is given.

In the rural areas, within the same socioeconomic class, there seem to be more farmers in the low-income groups than nonfarmers (see columns 5 and 7). Among the low-income farmers, those who can and cannot meet their calorie requirements appear to be almost equal in number.

For the rural HI&D group (column 6) there are more nonfarmers than farmers. Comparing column 2 with columns 1 and 3, and column 6 with columns 5 and 7, those in the HI&D group most often seem to belong to these socioeconomic groups: the self-employed who hire others to work for them; the self-employed professionals; and management, administrative and professional employees.

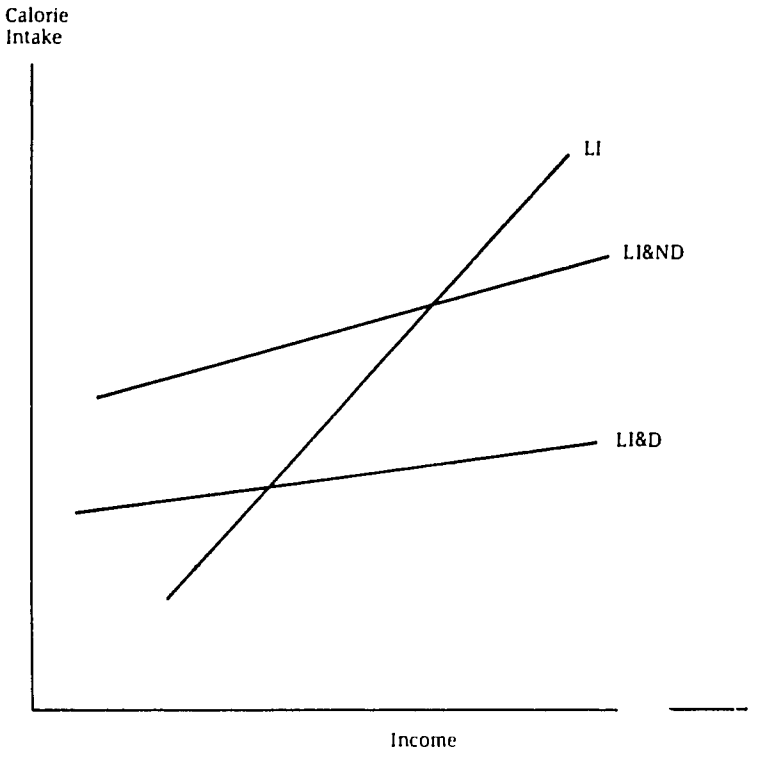
For the LI&D group (columns 1 and 5) these socioeconomic groups seem to be predominant: farmers (farmers with small holdings are more common than farmers with large holdings); those employed in fishing and forestry; the self-employed without paid workers; farm workers; clerical workers; production workers; general workers; and the economically inactive. The LI&D households are more heavily located in the rural North, Northeast, and South.

Table 22 compares the LI&D households with the urban and rural averages. The LI&D families tend to be large, but the number of income earners and the number of weeks worked in a month are similar to the sample averages. In fact, if the number of weeks worked by the family head represents the employment situation of the household, they are well employed. However, the income earned from their work is extremely low. These households already consume low-cost calories, yet their expenditures on nonglutinous rice, which is the cheapest source of calories, are below average.

Estimating Income and Price Elasticities

For many households, expenditures on rice constitute a large portion of their total

Figure 10—Hypothetical relationship of the calorie intake of low-income consumers to their incomes



Notes: The three groups in this figure are low-income consumers (LI), low-income but not calorie-deficient consumers (LI&ND), and low-income and calorie-deficient consumers (LI&D).

household consumption expenditures. Farm operators, for example, spend 22 percent on rice and industrial workers about 20 percent. The effects of changes in the price of rice on the calorie intake of various Thai consumer groups is measured by the income and price elasticities, which can be useful in tracing the consequences of policy measures.

The following income and price elasticities with respect to food consumption are estimated from a log-linear consumption equation.[49]

$$\log q_i = \alpha + \beta a + \theta \log y + \delta \log p_i + \sum_j \varepsilon_j \log p_j + \sum_k \gamma_k u_k + \sum_m \eta_m r_m + e_i; \quad (14)$$

where

q_i = weekly household consumption of commodity i (expenditure i divided by price i);

a = number of adult consumption equivalent units per household;

y = monthly household income (represented by total monthly expenditures);

p_i = price of commodity i;

p_j = prices of commodities j;

u_k = dummy variables for municipal areas and sanitary districts k;

r_m = dummy variables for regions m (North, Northeast, Central and East, and South); and

e_i = error term.

[49] The use of the exogenously introduced monthly data must be viewed as the best use of the existing data. However, if there is a measurement error on the price variable, the observed price may be correlated with the disturbance term.

Table 20—Average and marginal cost of calories consumed by urban and rural consumers, by calorie intake and income, 1975/76

Consumer Group	Average Cost	Marginal Cost
	(baht/1,000 calories)	
Urban		
Low-income, deficient	3.38	2.75
High-income, deficient	5.14	3.56
Low-income, nondeficient	2.95	2.45
High-income, nondeficient	4.36	3.58
Rural		
Low-income, deficient	2.39	1.95
High-income, deficient	3.59	2.65
Low-income, nondeficient	2.15	1.67
High-income, nondeficient	3.03	2.23

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Estimates from other forms of the models did not give appreciably better results. The double-log models also offer convenience in the interpretation of the coefficients. In addition, the elasticities are constant for all observations in the sample group.

In the estimation of the income and price elasticities, the dependent variable can be either the household's total calorie intake from all food items or just the amount of calories contributed by each food item, with consumption parameters obtained for specific food items and aggregated later on because of possible substitution between food items.[50] Since not all foods are likely substitutes for rice, it may not be necessary to obtain the price elasticities of all food items in order to obtain the calorie price elasticities.

The two major types of rice grown in Thailand, glutinous and nonglutinous, are quite different from one another. Including price variables for both types of rice in the consumption equation can create a problem of multicollinearity.[51] Nonglutinous rice is chosen for the subsequent analysis because it constitutes a larger portion of total rice production and consumption and because most of the rice exported is nonglutinous. It should be kept in mind, however, that both types are consumed in Thailand.

Estimating food consumption parameters by specific income groups has become a familiar technique, but disaggregation by calorie groups is quite new.[52] There is a question of whether basing the estimation on calorie groups will give consistent parameters. In this study, however, it has been shown that there are low- and high-income households in both the low- and high-calorie groups. The low- and high-income households that belong to the same calorie-consumption group, however, have significantly different food consumption and dietary patterns (Tables 17 and 19) and different marginal propensities to consume food (Table 18).

Food consumption parameters were estimated by income and calorie groups, but calorie grouping yielded inconsistent results, so only estimates by income groups are used. The sample sizes for some commodities are small, considering that this is a cross-sectional data set with price data introduced exogenously. Hence, the estimates reported are those from the pooled data set, including both the urban and rural households.[53] Such estimates, however, have at least one drawback: the different sampling fractions cannot be easily incorporated into the regression analysis. The results reported are obtained from the unweighted equations.

Table 23 gives the income and own-price elasticities of nonglutinous rice, pork, beef, and chicken consumption for all consumers, and the bottom 25 percent, the middle 50 percent, and the top 25 percent of the expenditure groups. It also shows the cross-price elasticities among these food items. For nonglutinous rice consumption, it is apparent that the income elasticity of the lowest 25 percent expenditure group (E_{IY} = 0.401) is significant and high when compared to those of the upper expenditure groups.

[50] Mark M. Pitt, "Food Preferences and Nutrition in Rural Bangladesh," *The Review of Economics and Statistics* 65 (February 1983): 105-114.

[51] See Prasarn Trairatvorakul, "Food Demand and the Structure of the Thai Food System" (D.B.A. dissertation, Harvard University, 1981).

[52] Cheryl Williamson Gray, *Food Consumption Parameters for Brazil and Their Application to Food Policy*, Research Report 32 (Washington, D.C.: International Food Policy Research Institute, 1982).

[53] Prasarn Trairatvorakul, "Food Demand and the Structure of the Thai Food System."

Table 21—Distribution by socioeconomic group of urban and rural consumers, by calorie intake and income, 1975/76

Socioeconomic Group	Urban								Rural							
	Low-Income Deficient (1)	Percent (1)	High-Income Deficient (2)	Percent (2)	Low-Income Non-deficient (3)	Percent (3)	High-Income Non-deficient (4)	Percent (4)	Low-Income Deficient (5)	Percent (5)	High-Income Deficient (6)	Percent (6)	Low-Income Non-deficient (7)	Percent (7)	High-Income Non-deficient (8)	Percent (8)
Farm operators owning land																
Less than 2 rai	...	...	...	...	...	...	...	...	13	25.5	9	17.6	13	25.5	16	31.4
2 - 4 rai	...	...	...	...	...	...	...	...	86	37.6	28	12.3	54	23.7	60	26.3
5 - 9 rai	...	...	...	...	...	...	...	...	195	37.9	68	13.2	133	25.8	119	23.1
10 - 19 rai	...	...	...	...	...	...	...	...	320	36.4	122	13.9	266	25.7	211	24.0
20 - 39 rai	...	...	...	...	...	...	...	...	238	28.4	153	18.2	181	21.6	267	31.8
More than 40 rai	...	...	...	...	...	...	...	...	67	14.0	141	29.4	57	11.9	214	44.7
Farm operators renting land																
Less than 5 rai	...	...	...	...	...	...	...	...	45	38.5	16	13.7	35	29.9	21	17.9
5 - 19 rai	...	...	...	...	...	...	...	...	122	33.0	52	14.0	96	25.9	100	27.0
More than 20 rai	...	...	...	...	...	...	...	...	85	20.5	118	28.4	44	10.6	168	40.5
Fishing and forestry	...	..	...	...	...	...	...	...	35	24.6	41	28.9	22	15.5	44	31.0
Self-employed, nonfarm																
With paid workers	1	0.7	56	38.1	0	0.0	90	61.2	1	1.6	27	43.5	2	3.2	32	51.6
Without paid workers	129	12.4	459	44.0	64	6.1	390	37.4	85	10.6	266	33.2	49	6.1	400	5.0
Professionals	0	0.0	6	37.5	0	0.0	10	62.5	0	0.0	3	33.3	0	0.0	6	66.7
Farm workers	10	38.5	6	23.1	7	26.9	3	11.5	93	25.5	108	29.6	41	11.2	123	33.7
Managers and administrators	5	1.5	144	41.3	3	0.9	173	53.2	1	0.4	97	42.7	1	0.4	128	56.4
Clerical	55	7.8	317	44.9	31	4.4	303	42.9	22	5.4	195	48.0	12	3.0	177	43.6
Production workers	42	13.7	127	41.4	23	7.5	115	37.5	42	9.8	187	43.6	17	4.0	183	42.7
General workers	26	28.6	27	29.7	12	13.2	26	28.6	97	19.9	134	27.5	64	13.1	193	40.0
Economically inactive																
Assistance and pensions	16	11.4	51	36.4	8	5.7	65	46.4	25	11.5	55	25.3	16	7.4	121	55.8
Property income	2	6.9	9	31.0	5	17.2	13	44.8	6	12.5	14	29.2	6	12.5	22	45.8
Total	313		1,221		186		1,226		1,591		1,841		1,085		2,618	

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).
Note: The columns marked "percent" are the percentage of each type of consumer in the sample size of the socioeconomic group. The figures represented by ellipses are available but insignificant.

Table 22—The low-income and calorie-deficient group compared with the averages for urban and rural consumers, 1975/76

Characteristic	Urban Consumers		Rural Consumers	
	Total	Low-Income Deficient	Total	Low-Income Deficient
Family size	5.5	7.0	5.5	6.5
Number of income receivers (from all sources)	1.7	1.8	1.5	1.3
Number of earners (economically active)	2.1	2.2	2.8	3.2
Current income (baht/month)	3,458	1,499	1,779	889
Consumption expenditure (baht/month)	3,170	1,893	1,831	1,220
Number of adult equivalent units	4.4	5.5	4.4	5.1
Number of weeks worked by head of household				
Primary occupation	3.9	3.8	3.5	3.4
Secondary occupation	0.2	0.2	0.8	0.8
Net profit of head of household (baht/month)	2,789	982	1,279	622
Wages and salaries of the head of household (baht/month)	1,770	967	845	339
Income from other sources	997	418	780	360
Average calorie price (baht/1,000 calories)	4.49	3.38	2.90	2.39
Expenditures (baht/adult/month)				
Food and beverages	341	187	229	139
Tobacco products	37	17	18	9
Other goods	425	150	212	94
Nonglutinous rice	43	36	43	33
Glutinous rice	7	8	25	24
Expenditures on food and beverages as a percentage of total consumption expenditures	47.3	54.3	55.0	58.1

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: The low-income and deficient groups consume less than 2,500 calories per adult per day. The urban low-income and deficient group earns less than 291.14 baht per capita per month and the rural low-income and deficient group earns less than 205.15 baht per capita per month.

The own-price elasticity for this group is also significant and high at -0.736. That of the middle expenditure group is slightly lower at -0.714. Both are statistically significant in contrast with that of the top expenditure group. This clearly supports the premise that a change in income or the price of rice affects the calorie intake of lower-income groups.

In Table 24 the total households in the sample are disaggregated into the same four consumer groups as before, and equation (14) is estimated for each group separately. The dependent variable is the logarithm of total household calorie intake. The price of nonglutinous rice is employed. The income elasticities are significant for all groups, but they are not high, ranging from 0.121 to 0.298. Consistent with the results on the marginal propensity to consume food, the income elasticities with respect to calorie intake of the HI&D group are low—about half those of the other groups.

The own-price elasticities are significant and have negative values for the urban LI&D, HI&D, HI&ND, and rural HI&D groups, but the response of HI&D groups to changes in the price of rice is much stronger than that of the other groups. The cross-price elasticities of meat prices that are statistically significant are all positive because households may substitute rice for meat when meat prices rise, which increases their calorie intake.

The data in Table 24 should be interpreted with caution. The degrees of freedom in the last row now indicate the approximate size of the samples in each equation. Note that some of these cross-sectional data are made up of only a few hundred observations, and the price data are monthly averages, which indicates that the estimated coefficients of price may not be very robust. It is also clear that there are a number of glutinous rice consumers within each consumer group, and problems of multicollinearity prevent

Table 23—Income, own-price, and cross-price elasticities of nonglutinous rice, pork, beef, and chicken for total households and for three income groups, 1975/76

Variable	Quantity Consumed (q_i)			
	Nonglutinous Rice	Pork	Beef	Chicken
All households				
Price (p_j)				
Nonglutinous rice	-0.636	0.420	-1.255	-0.540
	(-2.60)	(1.22)	(-2.66)	(-1.24)
Pork	0.926	-0.786	1.171	-0.003
	(4.17)	(-2.51)	(2.53)	(-0.01)
Beef	0.590	1.227	-1.230	-0.061
	(1.70)	(2.33)	(1.58)	(-0.08)
Chicken	0.552	0.431	0.588	-0.417
	(3.13)	(1.60)	(1.54)	(-1.17)
Income elasticity (N_i)	0.126	0.584	0.408	0.437
	(11.90)	(37.08)	(18.34)	(22.69)
Top 25 percent income group[a]				
Price (p_j)				
Nonglutinous rice	-0.460	-0.164	-1.728	-0.106
	(-0.90)	(-0.24)	(-1.74)	(-0.14)
Pork	0.966	-0.544	1.796	0.126
	(2.37)	(-0.97)	(2.19)	(0.20)
Beef	0.783	1.969	-2.250	-0.569
	(1.18)	(2.14)	(-1.57)	(0.50)
Chicken	0.664	0.287	0.236	-0.189
	(1.99)	(0.62)	(0.37)	(-0.36)
Income elasticity (N_i)	0.034	0.399	0.234	0.444
	(1.21)	(10.38)	(4.38)	(10.93)
Middle 50 percent income group[b]				
Price (p_j)				
Nonglutinous rice	-0.714	0.663	-2.375	-0.638
	(-2.09)	(1.41)	(-3.71)	(-1.06)
Pork	0.863	-0.373	1.646	-0.263
	(2.81)	(-0.85)	(2.51)	(-0.48)
Beef	0.557	1.242	0.822	0.900
	(1.15)	(1.74)	(0.79)	(0.85)
Chicken	0.672	0.526	1.044	-0.852
	(2.74)	(1.43)	(1.97)	(-1.63)
Income elasticity (N_i)	0.084	0.583	0.483	0.524
	(2.63)	(12.54)	(7.49)	(8.98)
Bottom 25 percent income group[c]				
Price (p_j)				
Nonglutinous rice	-0.736	0.386	2.020	-0.542
	(-1.69)	(0.51)	(2.05)	(-0.48)
Pork	0.601	-2.215	-1.173	-0.720
	(1.19)	(-2.94)	(-1.02)	(-0.59)
Beef	0.516	-0.850	-7.181	-2.524
	(0.76)	(-0.61)	(-3.55)	(-0.96)
Chicken	-0.044	0.526	0.257	0.252
	(-0.12)	(0.70)	(0.24)	(0.18)
Income elasticity (N_i)	0.401	0.704	0.422	0.295
	(10.59)	(9.07)	(3.93)	(2.35)

Source: Prasarn Trairatvorakul, "Food Demand and the Structure of the Thai Food System" (D.B.A. dissertation, Harvard University, 1981).

Note: t-statistics are in parentheses.

[a] The total household expenditures of this group are more than 2,723 baht per month.

[b] The total household expenditures of this group are between 1,121 baht and 2,723 baht per month.

[c] The total household expenditures of this group are less than 1,121 baht per month.

Table 24—Estimated equations of calorie intake of urban and rural household consumption groups, by calorie intake and income, 1975/76

Independent Variable	Urban				Rural			
	Low-Income Deficient	High-Income Deficient	Low-Income Non-deficient	High-Income Non-deficient	Low-Income Deficient	High-Income Deficient	Low-Income Non-deficient	High-Income Non-deficient
Intercept	0.437	-0.860	2.522	7.690	5.946	5.152	5.516	4.292
	(0.11)	(-0.41)	(0.50)	(3.51)	(3.57)	(3.07)	(2.88)	(3.13)
a	0.133	0.183	0.146	0.201	0.163	0.195	0.174	0.213
	(16.92)	(43.99)	(14.02)	(39.88)	(45.57)	(56.03)	(38.92)	(63.77)
Log y	0.222	0.140	0.298	0.230	0.167	0.121	0.261	0.212
	(6.20)	(8.94)	(7.05)	(15.08)	(12.74)	(10.56)	(15.50)	(20.99)
Log P_{rice}	-0.532	-0.653	0.469	-0.394	0.060	-0.299	-0.048	-0.100
	(-1.16)	(-1.95)	(0.85)	(-1.28)	(0.34)	(-1.43)	(-0.23)	(-0.53)
Log P_{pork}	0.711	0.807	0.423	-0.074	-0.093	0.171	-0.274	0.191
	(1.55)	(3.93)	(0.62)	(-0.26)	(-0.40)	(0.84)	(-1.00)	(1.05)
Log P_{beef}	1.312	1.654	0.775	0.130	0.107	0.156	0.744	0.478
	(1.38)	(3.06)	(0.77)	(0.26)	(0.28)	(0.42)	(1.91)	(1.82)
Log $P_{chicken}$	0.033	0.116	-0.279	-0.205	0.311	0.416	-0.131	0.130
	(0.08)	(0.51)	(-0.70)	(-0.90)	(1.72)	(2.31)	(-0.62)	(0.85)
SD	n.a.	n.a.	n.a.	n.a.	-0.000	-0.015	0.040	-0.042
					(-0.02)	(-1.32)	(2.97)	(-4.23)
N	0.302	0.255	0.179	0.070	0.068	0.122	0.183	0.151
	(3.06)	(4.54)	(1.59)	(1.30)	(1.41)	(2.94)	(2.93)	(4.38)
NE	0.236	0.220	0.167	0.027	0.071	0.110	0.213	0.174
	(2.78)	(4.41)	(1.55)	(0.54)	(1.57)	(2.90)	(3.52)	(5.20)
CE	0.232	0.227	0.232	0.046	0.090	0.171	0.197	0.149
	(1.97)	(3.70)	(1.86)	(0.79)	(1.72)	(3.80)	(3.15)	(4.40)
S	0.152	0.128	0.180	0.135	0.031	0.089	0.196	0.039
	(2.10)	(3.13)	(2.35)	(3.58)	(0.79)	(3.02)	(3.45)	(1.47)
R^2	0.774	0.778	0.855	0.802	0.766	0.794	0.833	0.804
F	103.50	422.94	103.17	491.48	470.45	642.52	486.59	968.87
df	302	1,210	175	1,215	1,579	1,829	1,073	2,606

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: The dependent variable is the log of total calorie intake. Independent variables used in estimating the equation include a, which is the number of adult equivalent consumption units in a household, and these logarithms: log y is monthly household consumption expenditures; log P_{rice} is the price of nonglutinous rice; and log P_{pork}, log P_{beef}, and log $P_{chicken}$ are the prices of pork, beef, and chicken. Dummy variables include SD for sanitary districts, N for the Northern Region, NE for the Northeastern Region, CE for the Central and Eastern Region, and S for the Southern Region. Each of these is 1 for that region (or sanitary district) and 0 if not.

Low-income consumers are those with per capita monthly incomes of less than 291.14 baht in urban areas and less than 205.15 baht in rural areas. High-income consumers are those with incomes greater than these amounts.

The calorie-deficient group consumes less than 2,500 calories per adult per day, whereas the nondeficient group consumes more than 2 500 calories per adult per day.

n.a. means not applicable. The numbers in parentheses are t-statistics.

the inclusion of both price variables in the equation.

Income and Price Elasticities by Socioeconomic Group

In addition to income and calorie intake, sample households are disaggregated into three socioeconomic groups. Groups 1 and 2 have average incomes lower than group 3. Table 25 shows the results of using equation (14) to estimate the income and price elasticities for these three socioeconomic groups with respect to their total calorie intake. (The notes to the table list the occupations in each group.) The income elasticities of all three groups are significant, and the magnitudes are quite similar. However, the price elasticities are significant only for groups 1 and 2 (-0.405 and -0.618 respectively). That of group 3 is not significantly different from zero.

Table 25—Income and price elasticity of the calorie intake of three socioeconomic groups, 1975/76

Elasticity	Socioeconomic Group		
	Group 1	Group 2	Group 3
Income elasticity	0.322 (31.36)	0.273 (25.65)	0.333 (19.90)
Price elasticity of nonglutinous rice	-0.405 (-2.37)	-0.618 (-2.79)	0.068 (0.17)

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: The sample is not weighted by the sampling fraction. t-statistics are in parentheses. Group 1 consists of farmers (sample size 3,967); group 2 consists of workers in fishing and forestry, self-employed nonfarmers without paid workers, farm workers, clerical workers, production workers, and general workers (sample size 4,843); and group 3 consists of self-employed nonfarmers with paid workers, professionals, managers and administrators, and those who are economically inactive but who receive property income, assistance, or pensions (sample size 1,220).

7

THE EFFECTS OF RICE PRICE CHANGES ON THE CALORIE INTAKE OF PADDY FARMERS

Because paddy farmers play a dual role as both producers and consumers, the interaction between their production and consumption decisions can be quite complex. The lack of household labor utilization data in particular may hamper attempts to model these interactions, as is evident in the discussion of the price-wage link in Chapter 5.[54] Therefore, the analysis focuses on farmers' decisions in allocating their production between home consumption and the cash market.[55]

On the average, only about 30-50 percent of total paddy production in Thailand is sold. The rest is consumed on-farm. Paddy farmers have a tendency to consume home-produced rice rather than to buy from the markets, and changes in the quantity marketed may not parallel changes in the amount produced.

Figure 11 schematically diagrams the linkages important to a study of the food consumption of farm households. In addition to direct effects from food prices and income, there are also consumption effects through farm production. The consumption analyses in the previous chapter are limited to those linkages shown in loop A. Link f—the effects of price on farm production—is discussed in Chapter 4. In this chapter each of these linkages is considered separately. Link a is the relationship between farm production and farm income, and link b is the relationship between farm production and home consumption. Link e shows that increases in the price of rice also increase the value of sales. Links a and b are combined to represent farmers' decisions on the allocation between home consumption and marketable supply, and links c and d represent estimation of the partial income and price elasticities of food consumption. In the end, all these linkages determine the effects of rice price changes on the calorie intake of the paddy farmers. The 1975/76 SES is the primary source of data.[56]

Crop Production and Family Incomes

The following analyses deal with farmers who are primarily rice producers. These households may produce other crops and livestock, however, and they may also obtain income from off-farm activities.[57] This section investigates the importance of rice and other farm production to the incomes earned by these households.

Table 26 compares the annual value of farm production and the value realized from the sale of farm products by different types of paddy farmers. Clearly, paddy farm households are involved in production of other crops and livestock besides rice. The value of livestock production is quite significant.[58]

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[54] Studies of such interactions include: Dale Jorgenson and Lawrence Lau, "An Economic Theory of Agricultural Household Behavior," a paper presented at the Far Eastern meeting of the Econometric Society, Tokyo, June 1969 (mimeographed); Lawrence Lau et al, "Microeconomics of Distribution: A Simulation of the Farm Economy," *Journal of Policy Modeling* 3 (February 1981): 175-206; and Howard Barnum and Lyn Squire, *A Model of an Agricultural Household Theory and Evidence*. World Bank Staff Occasional Paper 27 (Washington, D.C.: World Bank, 1979).

[55] On the average, the quantity bartered is only a small part of the total output.

[56] In examining the data on sizes of landholdings and on quantities of production, 121 observations have zero land area but significant farm production, and 6 observations have huge land areas of about 400 rai but very low production (1 hectare equals 6.25 rai). These 127 observations are excluded from this analysis.

[57] Rice farmers are classified under Enterprise 11 in the 1975/76 SES. Most of these farm households are located in the villages. Hence, the sample weighting (by sampling fractions of different community types) is considered unnecessary.

[58] The figures for livestock production must be interpreted carefully because of discrepancies in the definitions of stocks of animals and meat production. It is not a serious problem here because this variable does not enter directly into the analyses.

Figure 11—Schematic diagram of linkages contributing to the nutrition of farm households

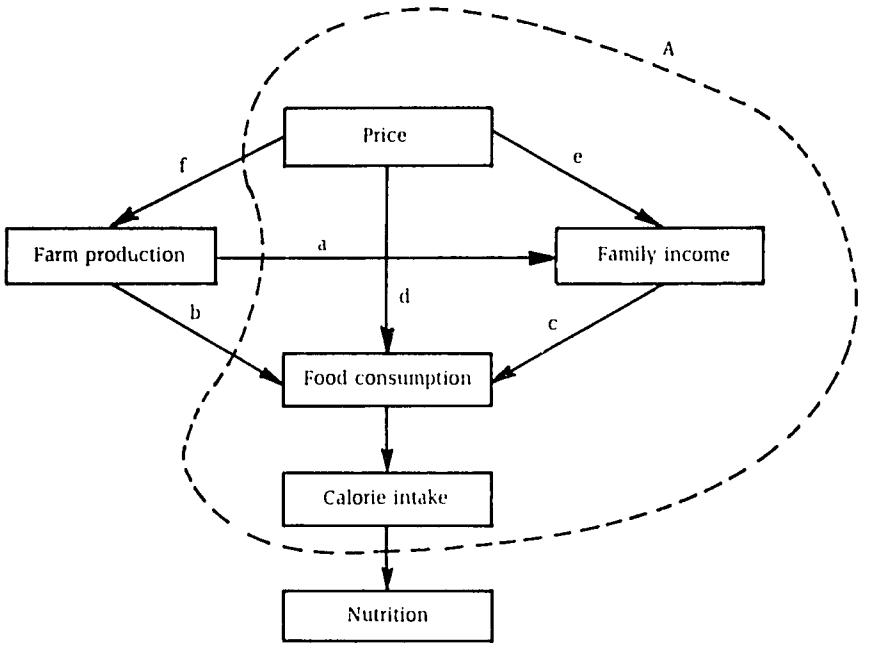


Table 26—Average annual value of farm products produced and sold by paddy farmers, by type of landholding, 1975/76

Farm Product	Paddy Farms		
	Irrigated Land Only	Nonirrigated Land Only	Both Irrigated and Non-irrigated Land
		(baht)	
Produced			
Rice	14,710	7,107	8,770
Cash crops	491	1,293	1,986
Vegetable crops	566	108	251
Tree crops	74	20	70
Livestock	4,118	5,505	5,779
Fishing and hunting	90	150	125
Other crops	61	186	159
Total	20,111	14,370	17,141
Sold			
Rice	7,823	2,274	2,864
Cash crops	466	1,207	1,715
Vegetable crops	495	82	188
Tree crops	70	18	62
Livestock	1,079	400	587
Fishing and hunting	39	47	53
Other crops	43	115	79
Total	10,015	4,144	5,548

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

The monthly current income and consumption expenditures for the household are regressed over the total values of farm production (all crops plus livestock plus fishing and hunting) to determine whether the total value of farm production can represent current monthly income. The monthly dummy variables are included because of possible seasonal variations in farm income. The coefficients of farm production are positive, but the correlation coefficients of the equations are low, which indicates that a large portion of the variances in current farm income and consumption expenditures are explained by factors or variables that are not included in the equations. The monthly current income and consumption expenditures of the households are also regressed over the net profit from farm operations, which is the value of farm production minus operating expenses. Results similar to those for total value of production are obtained.

When household income and consumption expenditures are regressed over farm size, the coefficients of the land variables are significantly positive, but the correlation coefficients are also low. In addition, the coefficients for the amount of irrigated land seem to be lower than the coefficients for the amount of nonirrigated land, indicating possible sources of income other than farming. Results suggest that paddy farm households also earn part of their income from nonfarm work. Therefore, Table 27 looks at the different sources of income.[59] On the average, farmers who are closer to urban areas earn a higher proportion of their income from nonfarm sources. The relative share of profits from farming and other farm activities in total current income ranges from 0.56 for farmers in municipal areas to 0.80 in village areas. Most of the farmers are located in village areas.

Farm Production and Home Consumption

A large portion of total paddy production is consumed at home, and many farmers must supplement the rice they grow by purchasing rice for home consumption. Table 28 shows the percentage of paddy farmers in each region who are producing a marketable surplus of rice. Most of the farmers with a large surplus (measured in terms of paddy sold) are in the Central and Eastern Region and the Greater Bangkok metropolitan area. Most of the paddy farmers in other regions have sales ratios of less than 0.1.

In disaggregating the total sample of paddy farmers by sales ratios, they are divided into two groups: those with sales ratios of less than 0.1, called semisubsistence paddy farmers, and those with ratios of more than 0.1, called commercial paddy farmers.[60] The semisubsistence paddy farmers include those who are net purchasers of rice from the market. Table 29 shows how the paddy produced by these two groups of farmers is used. Semisubsistence farmers produce much less than commercial farmers. The difference between the amounts consumed at home by semisubsistence farmers and by commercial farmers should partially reflect the amount bought from the market.

Because it will eventually be necessary to disaggregate the commercial paddy farmers according to the type of rice they consume—glutinous or nonglutinous—the statistics on the use of the paddy they produced (in Table 29) are broken down in this way.

It should be noted that although the semisubsistence paddy farmers grow only enough paddy for their own use, they may produce other crops on their farms as well. For them, the average relative share of paddy production in total farm production is only 0.41; other farm production accounts for the remaining 0.59. In contrast, the share of paddy production in the total farm production of commercial paddy farmers is 0.70.

The daily calorie intake of semisubsistence paddy farmers is not necessarily lower than that of commercial paddy farmers. The two distribution curves of calorie intake per adult equivalent unit (PACAL) almost coincide with one another. The estimates of mean calorie consumption (2,621 calories for semisubsistence farmers and 2,683 calories for commercial farmers), the percentage of households that are calorie-deficient (51 percent versus 46 percent), and the dietary

[59] This table includes all kinds of farm operators (paddy and nonpaddy). However, farms that raise no paddy constitute only 20 percent of the total farm households.

[60] The ratio of 0.1 is chosen because farmers who are on the borderline switch their positions between being net suppliers and net consumers depending on economic conditions.

Table 27—Average monthly income per household by source of income and by type of community of farm operators, 1975/76

Source of Income	Greater Bangkok		Municipal Areas		Sanitary Districts		Villages	
	Own Land	Rent Land	Own Land	Rent Land	Own Land	Rent Land	Own Land	Rent Land
				(baht)				
Total income	2,392	2,319	4,528	3,238	1,918	1,784	1,380	1,317
Current income[a]	2,379	2,278	2,354	3,230	1,903	1,743	1,359	1,299
Money income[b]	1,705	1,567	1,779	2,861	1,313	1,222	731	765
Earnings	1,625	1,525	1,685	2,855	1,249	1,177	704	739
Wages and salaries	140	206	310	566	120	171	83	111
Nonfarm profits	53	67	312	614	88	160	40	59
Profits from farming	1,432	1,252	1,063	1,675	1,041	846	581	569
Property income	41	7	67	1	17	8	6	4
Land rent	21	4	57	...	12	4	3	3
Interest and dividends	...	...	10	1	4	2	1	...
Current transfers	39	35	27	5	47	37	21	22
Assistance payments	39	35	25	5	39	37	20	22
Pensions and annuities	...	...	...	...	2	...	1	...
Scholarships and grants	...	...	2	...	6	...	...	...
Nonmoney income	674	711	575	369	590	521	628	534
Received as part of pay	...	...	5	27	5	1	...	2
Home produced[c]	277	372	274	149	388	346	501	403
Received free	56	97	44	37	26	27	17	29
Rental value of owned home	341	242	252	156	171	147	110	100
Other money receipts	13	41	2,174	8	15	41	21	18
Insurance proceeds	11	...	...	...	1	...	...	...
Lottery winnings	...	40	2,173[d]	8	5	1	3	3
Other receipts	2	1	4	...	9	40	18	15
Share of profits from farming and nonmoney income from home produced crops in current income	0.72	0.71	0.57	0.56	0.75	0.68	0.80	0.75

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Note: The average share of profits from farming and nonmoney income from home-produced crops in current income is 0.69.

[a] Current income is total income excluding insurance proceeds, lottery winnings, and other "windfall" receipts.

[b] Money income is current income excluding the nonmoney portion.

[c] Home-produced crops include crops received as rent.

[d] One sample household won first prize in a lottery.

patterns of the two groups of farmers are all similar.

The diets of nondeficient households are also close to each other, but on average the semisubsistence farmers pay slightly less for their calories than the commercial farmers. In all, rice remains the major source of calories: it provides 73-85 percent of total calorie intake. Therefore, using paddy sales ratios to divide paddy farmers into semisubsistence and commercial farmers does not give a good indication of calorie intake.

Is the MPC of food, rice in particular, different for paddy farmers than for other groups of consumers? To answer this question, the MPC of food and beverages and of rice is estimated for paddy farmers and for other groups of consumers (Table 30). A quadratic term is included for household monthly consumption expenditures. Both coefficients of the linear and quadratic terms of the expenditure variables (used to represent incomes of the households) are statistically significant—the linear term is positive and the square is negative, indicating that the MPC declines when incomes rise. The MPCs for the two groups are close to one another, indicating that the MPCs of food and bev-

Table 28—Percentage of paddy farmers producing a marketable surplus of rice by region, 1975/76

Ratio of Sales to Production	Region				
	Northern	Northeastern	Central and Eastern	Southern	Greater Bangkok
			(percent)		
Less than 0.1	60.8	69.0	26.6	83.1	7.8
0.1 - 0.2	4.5	8.4	4.7	4.4	1.6
0.2 - 0.3	4.2	7.0	6.8	1.8	5.8
0.3 - 0.4	4.5	5.0	5.8	2.7	7.3
0.4 - 0.5	5.7	2.7	7.5	3.1	7.8
0.5 - 0.6	6.8	4.3	9.9	2.7	14.7
0.6 - 0.7	5.1	2.0	11.7	0.9	12.0
0.7 - 0.8	3.8	0.7	7.2	0.9	9.4
0.8 - 0.9	3.2	0.1	10.4	0.4	19.4
More than 0.9	1.5	0.8	9.2	0.0	14.1
Total	100.0	100.0	100.0	100.0	100.0

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).
Note: Greater Bangkok includes the Bangkok metropolis and the provinces of Nonthaburi, Pathumthani, and Samut Prakan.

erages of paddy farmers and other groups of consumers are not significantly different from one another.

This is in contrast to the MPCs of rice consumption estimated in Table 31. As a result of the lesson learned in Chapter 6 about the problem of estimating the consumption parameters of a heterogeneous group of consumers, the two groups of consumers are further disaggregated to nonglutinous and glutinous rice consumers. As the bottom row of Table 31 shows, glutinous rice consumers tend to consume larger amounts of rice than nonglutinous rice consumers, so the combined group of paddy farmers may represent two different groups of consumers who have distinct preferences for rice. The MPC of the total paddy farmers is 0.082 and

Table 29—Utilization of paddy produced by the semisubsistence and commercial paddy farmers, 1975/76

Use	Semisubsistence Paddy Farmers	Commercial Paddy Farmers		
		Total	Nonglutinous Rice Consumers	Glutinous Rice Consumers
		(kilograms/household)		
Produced	2,555	7,562	8,259	5,200
Sold	32	4,314	5,148	1,929
Consumed at home	1,437	1,614	1,454	2,095
Bartered	290	562	634	298
Used for feed and seed	117	356	394	144
Held in storage	545	601	517	639
Residual[a]	134	115	112	95

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).
Notes: Of the 1,593 commercial paddy farmers in the sample, 873 were nonglutinous rice consumers, 408 were glutinous rice consumers, and the rest consumed both. There are 2,225 semisubsistence paddy farmers in the sample.

[a] The residual is the quantity produced less the amount used in all of the purposes above.

Table 30—Estimated equations of the marginal propensity for paddy farmers and other consumers to consume food and beverages, 1975/76

Category	Paddy Farmers	Other Consumers
Regression		
Intercept	265.55 (12.72)	306.70 (22.37)
MCEXP	0.43 (65.77)	0.39 (95.05)
$(MCEXP)^2$	-1.90×10^{-5} (-31.11)	-1.10×10^{-5} (-43.85)
N	-46.85 (-2.44)	-78.97 (-5.38)
NE	-29.80 (-1.59)	-54.82 (-3.83)
CE	-8.01 (-0.41)	-21.09 (-1.48)
S	-17.84 (-0.77)	-25.64 (-1.69)
R^2	0.63	0.66
F	1,129.6	2,334.0
df	4,035	7,162
Average MCEXP (baht)	1,591	2,610
MPC at average MCEXP	0.370	0.333
MPC from estimation by linear equation	0.265	0.242

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: The dependent variable is total household expenditures on food and beverages. MPC is the marginal propensity to consume food and beverages and MCEXP is monthly consumption expenditures per household. The average MCEXP was 1,591 baht for paddy farmers and 2,610 baht for other consumers. Dummy variables for the regions include N for Northern Region, NE for Northeastern Region, CE for Central and Eastern Region, and S for Southern Region. Each of these is 1 for that region, and 0 if not. t-statistics are in parentheses.

is higher than that of either the nonglutinous rice consumers (0.019) or the glutinous rice consumers (0.033). The same phenomenon also applies to other consumers who are not paddy farmers (see Figure 10 in Chapter 6).

When comparing the paddy farmers with other consumers, however, the marginal propensity to consume rice is two to three times higher for paddy farmers than for other consumers. That is, when incomes rise, paddy farmers and other consumers spend a similar share of their marginal income on food and beverages, but the paddy farmers tend to spend more on rice, whereas other consumers may spend more on other food items.

Among the paddy farmers, there are three sources of rice: purchased rice, home-produced rice, and rice received free as a gift. That more than half of total rice production is consumed at home is not surprising because the farmer can save about 20 percent by consuming home-produced rice, instead of buying rice on the market (Table 32).

This 20 percent difference is largely accounted for by the marketing costs, because there is no consistent evidence that abnormally high profits are collected in the Thai domestic rice marketing system.[61] A study of the rate of return on stockholding reveals that storage is not highly profitable, and indeed, that there is a high probability

[61] See Dan Usher, "The Thai Rice Trade," in *Thailand: Social and Economic Studies in Development*, ed. T. H. Silcock (Canberra: Australian National University Press, 1967), pp. 206-230; Chirmsak Pinthong, "A Price Analysis of the Thai Rice Marketing System" (Ph.D. dissertation, Stanford University, 1978); and Ammar Siamwalla, "Rice in the Thai Economy," Thammasat University, Bangkok, 1979 (in Thai).

Table 31—Estimated equations of the marginal propensity to consume rice of paddy farmers and other consumers, 1975/76

Category	Paddy Farmers			Other Consumers		
	Total	Nonglutinous Rice Consumers	Glutinous Rice Consumers	Total	Nonglutinous Rice Consumers	Glutinous Rice Consumers
Regression						
Intercept	77.08	19.40	37.15	97.36	24.72	30.36
	(6.88)	(6.22)	(17.71)	(19.98)	(24.05)	(10.95)
MCEXP	0.10	0.025	0.038	0.03	0.007	0.018
	(31.31)	(18.16)	(25.70)	(22.05)	(20.75)	(10.23)
$(MCEXP)^2$	$-5.11 \cdot 10^{-6}$	$-1.84 \cdot 10^{-6}$	$1.69 \cdot 10^{-6}$	$1.01 \cdot 10^{-6}$	$1.77 \cdot 10^{-7}$	$8.89 \cdot 10^{-7}$
	(-19.01)	(-12.28)	(-16.40)	(11.37)	(9.53)	(-3.76)
N	76.08	13.94	10.60	64.41	9.09	-1.30
	(7.24)	(5.33)	(-6.06)	(11.92)	(6.95)	(-0.63)
NE	147.76	31.18	...	120.90	25.53	...
	(14.37)	(12.04)		(23.61)	(20.68)	
CE	64.95	11.42	...	72.68	14.23	...
	(5.95)	(4.57)		(14.82)	(10.75)	
S	48.89	12.20	...	69.36	13.79	...
	(4.20)	(4.09)		(12.32)	(12.44)	
R^2	0.232	0.209	0.314	0.133	0.143	0.216
F	231	77	258	169	147	84
df	4,594	1,756	1,686	6,616	5,291	910
Average MCEXP (baht)	1,591	1,653	1,340	2,610	2,683	1,650
Rice consumption per adult per week (kilograms/adult/week)	...	3.63	4.73	...	2.87	4.25
MPC rice	0.082	0.019	0.033	0.027	0.006	0.015

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: The dependent variable is total household expenditures on rice. MPC is the marginal propensity to consume rice and MCEXP is monthly consumption expenditures per household. Dummy variables for the regions include N for Northern Region, NE for Northeastern Region, CE for Central and Eastern Region, and S for Southern Region. Each of these is 1 if the data are for that region, and 0 if not. t-statistics are in parentheses.

of incurring losses in a stockholding investment.[62] Thus, the advantage of consuming home-produced rice largely results from savings on transportation costs and other necessary marketing costs.

Partial Income and Price Effects

Equation (14) is used to estimate the partial income (E_{iy}) and the own-price elasticities (E_{ii}) with respect to rice consumption of the paddy farmers. The corresponding elasticities for the total, the semisubsistence, and the commercial paddy farm households are given in Table 33.[63]

The parameters estimated from cross-sectional data represent the long-run adjustment of consumers to changes in income and prices. Hence, they may be higher than the short-run adjustments.[64]

It is assumed here that the farmer's con-

[62] Somnuk Tubpun, "The Price Analysis and the Rate of Return on Holding Rice and Paddy in Thailand" (M. Econ. thesis, Thammasat University, 1974).

[63] The dependent variable in the regression analysis, the quantity of rice consumed, is not strongly influenced by the ratio of marketable surplus used in the sample selection. Hence, the sample selection bias discussed in Chapter 6 should not be a problem here.

[64] C. Peter Timmer and Harold Alderman, "Estimating Consumption Parameters for Food Policy Analysis," *American Journal of Agricultural Economics* 61 (December 1979): 982-987.

Table 32—Average selling price of paddy compared with buying prices of glutinous and nonglutinous milled rice, 1975/76

Product of Milling/Price	Milling Rate from 1 Kilogram of Paddy	Nonglutinous Rice		Glutinous Rice[a]	
		Market Price	Value	Market Price	Value
		(baht/ kilogram)	(baht)	(baht/ kilogram)	(baht)
Milled rice, 5 percent	0.45	4.40	1.98	3.80	1.71
A1 brokens	0.17	2.82	0.48	2.44	0.41
C1 brokens	0.04	2.71	0.11	2.34	0.09
C3 brokens	0.02	2.37	0.05	2.05	0.04
Fined brans	0.07	1.67	0.12	1.44	0.10
Coarse brans	0.03	0.83	0.02	0.72	0.02
Total	...	...	2.76	...	2.37
Equivalent buying price of 1 kilogram of paddy[b]	...	...	2.68	...	2.29
Average selling price of 1 kilogram of paddy	...	...	2.22	...	1.83
Marketing cost[c]	...	...	0.46	...	0.46
Marketing costs as a percentage of the selling price	...	...	21	...	25

Sources and notes: The milling rate and the milling fees are from Nopmanee Somboonsub, "Rice Milling Technology and Some Economic Implications: The Case of Nakorn Pathom, Thailand, 1974" (M.A. thesis, Thammasat University, 1975). The buying prices for 5 percent milled rice are from Thailand, Ministry of Commerce, Department of Business Economics, *Commodity Price Report* (Bangkok: MOC, 1976). Prices of other by-products of milling are proportional to Somboonsub's figures and are based on the prices of 5 percent milled rice. Selling prices are from Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976.

[a] Glutinous rice is primarily consumed in the Northern and Northeastern regions.

[b] The equivalent buying price is the value of the products of milled paddy minus milling fees (0.08 baht).

[c] The marketing cost is the difference between the equivalent buying and the average selling prices of paddy.

Table 33—Estimated partial income and own-price elasticities with respect to the rice consumption of semisubsistence and commercial paddy farmers, by type of rice consumed, 1975/76

Type of Consumer	Number of Households in Survey	Income Elasticity	Own-Price Elasticity
Nonglutinous rice consumers			
Paddy farm households			
Total	1,752	0.20[a]	-1.07[b]
		(10.01)	(-3.14)
Semisubsistence	874	0.20[a]	-0.66[b]
		(7.49)	(-1.55)
Commercial	867	0.20[a]	-2.03[b]
		(6.67)	(-3.57)
Glutinous rice consumers			
Paddy farm households			
Total	1,682	0.33[a]	-0.59[b]
		(14.68)	(-3.36)
Semisubsistence	1,262	0.39[a]	-0.81[a]
		(14.54)	(-3.98)
Commercial	412	0.21[a]	0.31
		(4.75)	(0.89)

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

[a] This is significant at $\alpha = 0.0001$.

[b] This is significant at $\alpha = 0.002$.

sumption decisions are influenced partly by the purchasing price of rice. For farmers who consume both home-produced and purchased rice, the consumption decision may be influenced by both the purchasing and the selling prices. Unfortunately, the derived selling prices in this data set are given as annual averages and cannot be used successfully to explain weekly consumption decisions. If the marketing system is efficient, these two prices should be highly correlated with one another.

Consumption Effects

Let consumption of rice (C_i) be a function of farm household current income (Y) and the rice price (P_i):

$$C_i = C_i(Y, P_i).$$

A total derivative of C_i with respect to P_i and a slight algebraic manipulation would yield the following equation:

$$dC_i/dP_i \times P_i/C_i = \partial C_i/\partial P_i \times P_i/C_i + (dY/dP_i \times P_i/Y)(\partial C_i/\partial Y \times Y/C_i). \quad (15)$$

Let

$dC_i^c/dP_i \times P_i/C_i$ = total elasticity of calorie intake with respect to price changes of rice;

c_i = the relative contribution of rice to total calorie intake;

r = the share of rice production in total farm production;[65]

k = the share of incomes from farm production in total household current incomes;

E_{ii} = the partial price elasticity of rice consumption; and

E_{iy} = the partial income elasticity of rice consumption.

Equation (15) can be written as:[66]

$$dC_i^c/dP_i \times P_i/C_i = c_i (E_{ii} + r \times k \times E_{iy}). \quad (16)$$

The term E_{ii} is the uncompensated price elasticity of rice consumption, which can be broken down into the pure substitution elasticity (E'_{ii}) and the income effect ($s_C E_{iy}$) according to the Slutsky equation:

$$E_{ii} = E'_{ii} - s_C E_{iy},$$

where s_C is the income share of rice consumption. If the income share of rice production ($r \times k$) is represented by s_Q, equation (16) can be written:

$$dC_i^c/dP_i \times P_i/C_i = c_i [E'_{ii} + (s_Q - s_C) E_{iy}]. \quad (17)$$

In equation (17) the income term indicates how the influence of price on the calorie intake of semisubsistence farmers differs from its influence on commercial farmers. For the semisubsistence farmers, s_Q is smaller than or equal to s_C; and vice versa for the commercial farmers.[67]

Estimates of the variables in equation (16) are summarized in Table 34. As shown earlier, the sample size of the commercial farmers who consume glutinous rice is quite

[65] The ratio r is measured based on the gross revenue (rather than net profits) of rice production and total farm production because no information is available on farm operating expenses by specific crops. An implicit assumption is made that the cost structure of rice production and other crops are the same. It is shown later that the influence of the income term on the calorie intake of paddy farmers is relatively small. Hence, this is not a serious assumption.

[66] The paddy production is assumed to be constant unless the production elasticity with respect to price will be incorporated into equation (16), which, however, gives only slightly different results.

[67] However, the pure substitution elasticity (E'_{ii}) is not possible to estimate. Only the uncompensated price elasticity (E_{ii}) is estimated from equation (14). Hence, the following calculation is based on equation (16). Using the farm marketable surplus model for a two-crop case along the lines developed by Bardhan, the price elasticities of marketable surplus are positive, ranging from 0.8 to 1.2 (Kalpana Bardhan, "Price and Output Response of Marketed Surplus of Foodgrains: A Cross-Sectional Study of Some North Indian Villages," *American Journal of Agricultural Economics* 52 [August 1970]: 50-61).

Table 34—Values of variables used to calculate the effects of changes in the price of rice on the calorie intake of rice farmers

Variable	Semisubsistence Farmers	Commercial Farmers
c_i	0.83	0.74
r	0.41	0.70
k	0.69	0.69
E_{iy}		
Nonglutinous rice	0.20	0.20
Glutinous rice	0.33	0.33
E_{ii}		
Nonglutinous rice	-1.07	-1.07
Glutinous rice	-0.59	-0.59

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: c_i = the relative contribution of rice to total calorie intake,
r = the relative share of rice production in total farm production,
k = the relative share of incomes from farm production in total household current income,
E_{iy} = the partial income elasticity of rice consumption, and
E_{ii} = the partial price elasticity of rice consumption.

The parameters for the total paddy farmers separated by type of rice consumed are used because the sample size for the commercial and paddy farmers who consume only glutinous rice is too small.

small and the estimated parameters are not explained well.[68] Thus, the estimates of the income elasticity and the own-price elasticity of the total paddy farmers separated by type of rice consumed are used.

Using equation (16) and the values of the variables given in Table 34, the price elasticities of the calorie intake are -0.84 for the semisubsistence farmers who consume nonglutinous rice and -0.41 for those who consume glutinous rice, and -0.72 for commercial farmers who consume nonglutinous rice and -0.32 for those who consume glutinous rice. The elasticities for glutinous rice consumers are about one half of those for nonglutinous rice consumers. This is because the estimates of the own-price elasticity are lower. Glutinous rice consumers are limited to the Northern and Northeastern regions. These consumers express a strong preference for glutinous rice and, on the average, consume more rice than the nonglutinous rice consumers. Many of these consumers are much less dependent on the market than the nonglutinous rice consumers; hence, they are less responsive to price changes. Again, these estimates are from cross-sectional data. The short-term responses of paddy farmers may be much lower than these values. To calculate the impact of a rice price increase on the calorie intake of paddy farmers, price elasticities of half of the values shown above may be used. (The ratio of half is used arbitrarily to represent the lower values of the short-run effect on consumption.)[69]

The average daily calorie intake per adult equivalent unit is derived for the cases where there is no change in the price of rice and where the rice price increases by 10 percent and 20 percent. The average figures for calorie intake and the percentage of households having a PACAL of less than 2,500 when half the values of the estimated price elasticities are used are given in Table 35. Since the var-

[68] One may attempt to explain the positive price elasticity of the commercial glutinous rice farmers as follows: glutinous paddy farmers are less commercial than the nonglutinous paddy farmers. They target the income they need. When the rice price increases, they can meet the targeted income by selling less rice and, hence, will have more for their own consumption. But this will be true under the condition of fixed output only when the income elasticity multiplied by the proportion of income from rice is greater than the price elasticity, which is not true in this case (if any of the significantly negative price elasticity is used).

[69] Little empirical evidence exists to determine the value of this ratio of short-run/long-run adjustment.

Table 35—Effects of a change in the price of rice on the calorie intake of semisubsistence and commercial paddy farmers, 1975/76

Rice Price Increase	Semisubsistence Farmers		Commercial Farmers	
	Nonglutinous Rice Consumers	Glutinous Rice Consumers	Nonglutinous Rice Consumers	Glutinous Rice Consumers
(percent)	(calories/adult/day)			
Average daily calorie intake per adult				
0	2,413	2,713	2,557	2,767
10	2,312	2,659	2,465	2,723
20	2,210	2,602	2,373	2,678
	(percent)			
Percentage of households with calorie intake less than 2,500				
0	62	46	54	41
10	68	49	57	42
20	72	52	61	43

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

iation of the data on the purchasing prices of rice used in the estimation of the consumption parameters has a range of only 20 percent, the simulation is conducted for the scenarios in which the rice price changes 10 percent and 20 percent. If the rice price were to increase more than 20 percent, the estimated parameters might differ.

The effects of rice price increases are much less pronounced for the glutinous rice consumers than for the nonglutinous rice consumers. For the latter, a 20 percent increase in the rice price decreases the average PACAL from 2,413 calories to only 2,210 calories for semisubsistence farmers and from 2,557 calories to only 2,373 calories for commercial farmers. And it increases the percentage of households having a PACAL lower than 2,500 calories from 62 percent to 72 percent for semisubsistence farmers and from 54 percent to 61 percent for commercial farmers.[70]

[70] When the rice price increases, commercial farmers gain more in real income, but they also respond to price increases by decreasing the amount of rice they consume and this effect is stronger than the income effect. Therefore, Table 35 shows a decline in calorie intake. The calculation is based on the assumption that rice is the single major source of calories for these consumers.

8

THE EFFECTS OF RICE PRICE CHANGES ON INCOMES AND FOOD CONSUMPTION OF LOW-INCOME PEOPLE

Real Incomes

This study of the effects on real income of an increase in the price of rice centers on the poor, because a rice price increase would be absorbed without much difficulty by the higher income groups. In Chapter 3, which analyzes the effects of such increases on the incidence of poverty and on income distribution, the assumption is made that supplies, wages, and consumption are constant. In the subsequent chapters each of these assumptions is examined in detail.

In Chapter 4 the weighted average response of supply to price changes is estimated to be 0.36 in the short run (one year), which is slightly higher than is generally estimated. Figure 12 shows how a change in the supply of rice affects the incremental incomes of the paddy farmers. If the supply elasticity were zero, the additional income to paddy farmers would equal area P_0e a P_1 (see equation [1] in Chapter 3). By increasing their production from Q_0 to Q_1 farmers incur an additional cost of Q_0 Q_1 b e, which can be divided into cash (out-of-pocket) cost and economic cost, such as the cost of family labor, which does not involve a cash payment.

If the total cost incurred must be paid by the farmer, the additional income—that not taken into account in Chapter 3—is equivalent to triangle a b e and is negligible. However, if the additional cost is an economic cost it represents additional income to the farmer. It is this income that is calculated here.

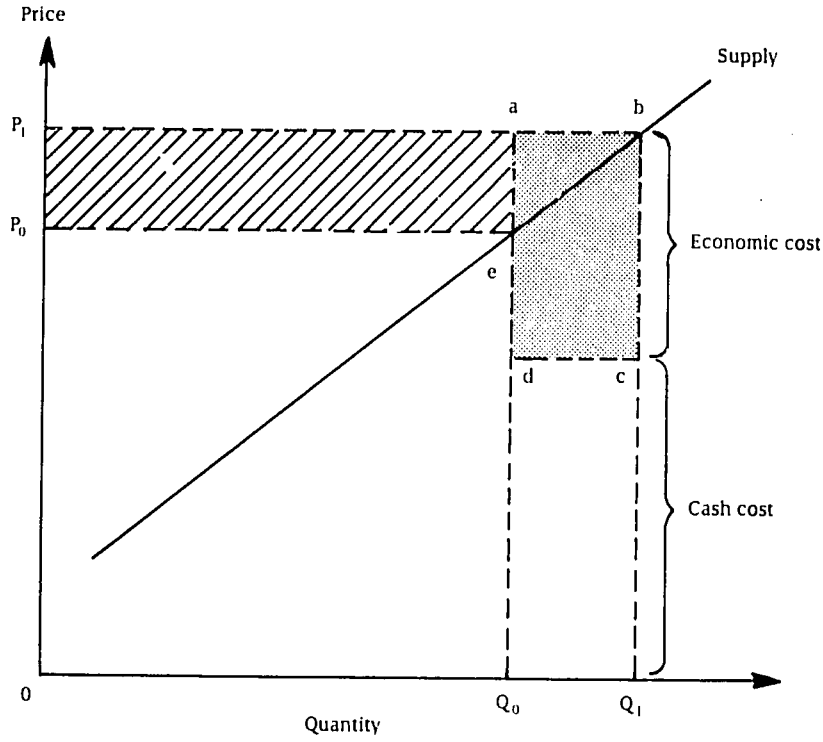
Data from the Thai Ministry of Agriculture and Cooperatives indicate that in the crop year 1975/76 the ratios of average economic cost to average total cost of paddy production by region were 0.80 in the North; 0.85 in the Northeast; 0.53 in the Central and Eastern Region; and 0.78 in the South.[71] When the supply response elasticity to price changes of 0.36 in the short run is adopted and the rice price is increased by 10 percent, the additional income to paddy farmers that has not already been accounted for (area a b c d in Figure 12) amounts to 2.9 percent in the North; 3.1 percent in the Northeast; 1.9 percent in the Central and Eastern Region; and 2.8 percent in the South.

The impact of rice price changes on the rural farm wage rate depends on the size of the supply elasticity of hired labor. As indicated in Chapter 5, this elasticity is difficult to estimate satisfactorily. However, if the supply elasticity of hired labor were high, as this analysis concludes, the impact on the rural wage rate would be minimal, but it must be stressed that this conclusion is only tentative. Because of data limitations, a more definitive estimate of the labor supply elasticity and its effects on the urban wage rate cannot be obtained. In this chapter a short-run adjustment in the wage rate is made based on the assumption that the nominal wage rates of workers will adjust fully to price changes of rice.

For the consumption analysis, the sample is disaggregated into different groups of consumers and the income and price elasticities are estimated for various food items but concentrating on rice. In general, the poor tend to be more price and income responsive than the higher income consumers. The decrease in the amount of rice consumed by

[71] The ratios of economic cost to total cost incurred by additional production at the margin are assumed to be equal to the ratios at the average level of production. The economic costs include family labor, payments for the use of animals, machinery, equipment, and land and seed; and opportunity costs of capital. The first three items constitute the largest share of costs that farmers do not have to pay. One may argue that some of these cost items should be removed from the economic costs because farmers may have to pay for them by other means than cash or because farmers may have forgone other opportunities to use them in paddy production. Chapter 3 presents one extreme where additional income from the production increase is not included, whereas this chapter shows another extreme where all possible additional income from the production increase is included. Hence, all these cost items are assumed to be costs that the farmers do not have to pay. A more realistic scenario would lie between these two extremes.

Figure 12—Effects of a change in the supply of rice on the incremental incomes of paddy farmers



the poor when the rice price increases should not be used to adjust for the effects on the poor's real income because the calculation of the poverty line in Chapter 3 is based on the minimum income necessary for individuals or households to meet their calorie requirements. A decrease in rice consumption in Thailand would affect the calorie intake of poor consumers because there is no substitute for rice in the Thai diet.

The findings on the supply response, the price-wage link, and the consumption effects are incorporated into the estimation of the effects from a rise in the price of rice on the incidence of poverty. The results obtained in Chapter 3 are revised and shown in Tables 36, 37, and 38.

In Table 36 the incidence of poverty among rice growers is greatly reduced, whereas that of other consumers is still rising but is not as severe as that shown in Chapter 3. For the population as a whole, poverty is not as prevalent. When the poor population is disaggregated by region and type of community in Table 37, the results show greater improvement than those in Chapter 3.

When the population is divided into socioeconomic groups, the vulnerable groups tend to be low-income households whose expenditures on rice account for a significant portion of their household budgets. Table 38 shows the percentage of households that fall below the poverty line when there is no change in the rice price and as the price increases from 10 to 50 percent.

Clearly, the improvement in the incidence of poverty occurs only among paddy farmers, especially large farmers. For other socioeconomic groups, the number of poor households increases. The net effect for the whole country indicates some improvement in the poverty incidence, with the rural sector improving and the urban sector worsening.

To highlight the distributional effects of a 10 percent rise in the price of rice, the urban and rural households are disaggregated into 10 decile expenditure groups based on their per capita household expenditure. The total gains and losses in real income from a 10

Table 36—Number and percentage of households in poverty in 1975/76 and changes in the percentage of poor households after rice production and wages have adjusted to rice price increases of 10 to 50 percent

Rice Price Increase	Rice Growers		Others		National Average	
	Number of Households	Percent of Poor Households	Number of Households	Percent of Poor Households	Number of Households	Percent of Poor Households
(percent)						
0						
Poor households	1,110,465	33.68	436,450	16.39	1,546,915	25.96
All households	3,296,895		2,662,770		5,959,665	
10						
In	8,400	31.03	14,645	16.94	23,045	24.74
Out	-95,690		0		-95,690	
20						
In	12,960	30.05	33,300	17.64	46,260	24.50
Out	-132,825		0		-132,825	
30						
In	15,480	28.30	47,885	18.19	63,365	23.78
Out	-193,055		0		-193,055	
40						
In	20,400	27.29	68,250	18.95	88,650	23.57
Out	-231,165		0		-231,165	
50						
In	28,320	26.53	93,730	19.91	122,050	23.57
Out	-264,125		0		-264,125	

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: In this table, paddy farmers have increased rice production and the nominal wage rate of wage earners has risen in response to rice price increases. The number of households in this table was obtained by weighting the number of sample households by the reciprocals of the sampling fractions. In and out mean the number of households moving into and out of poverty.

percent rise in the price of rice for each expenditure group are plotted for two scenarios. Under the first it is assumed that production of paddy, the money wage rate, and rice consumption are constant (Figure 13); under the second, it is assumed that paddy production adjusts in the short run and the money wage rate of wage earners is fully adjusted (Figure 14).

It is apparent that most of the net gains to the rural sector are received by the high expenditure groups. Net gains acquired by the top three decile expenditure groups account for about 48 percent of the total net gains to the rural sector in scenario 1 (Figure 13) and 37 percent in scenario 2 (Figure 14).

In the urban areas the absolute net losses are similar for all expenditure groups. However, when considering the relative incomes of these population groups, the burdens on the lower expenditure groups are higher.

As indicated in Chapter 3, the data set used in this analysis is quite representative of the Thai population. Hence, the bar charts in Figures 13 and 14 are compatible if drawn to the same scale. All urban expenditure groups contribute to the income transfer from the urban to the rural sector caused by the increase in the rice price, but the rural upper expenditure groups receive the majority of the transfer. There is little transfer to the rural poor. The net gains to the rural sector are higher than the net losses to the urban sector. The difference is the decrease in government revenues from the export tax (assuming that the increase in the domestic price of rice may be caused by the decrease in the export premium).[72]

[72] This is a short-run consideration. In fact, when the export premium is increased, the market price of Thai rice to foreign buyers is also increased, and, depending on the foreign demand elasticity for Thai rice, there may be a transfer of income from foreign buyers to the government's revenue. However, it is not the purpose of this study to quantify the welfare and transfer effects of the export premium. An example of studies along this line may be found in Wong, "A Model of the Rice Economy of Thailand."

Table 37—Percent of poor households by region and type of community at 1975/76 rice prices and after rice production and wages have adjusted to rice price increases of 10 to 50 percent

Rice Price Increase	Municipal Areas				Sanitary Districts			
	N	NE	CE	S	N	NE	CE	S
	(percent)							
0	13.5	16.9	9.1	16.4	15.7	21.4	6.1	14.2
10	13.7	17.3	9.9	17.4	15.5	20.5	5.7	14.7
20	13.9	18.0	10.1	17.8	15.7	20.6	5.9	14.2
30	13.5	19.5	10.7	16.8	15.5	19.9	5.7	14.7
40	13.9	20.1	11.1	19.0	15.5	20.1	5.5	15.2
50	13.9	20.6	11.3	20.2	15.3	20.6	5.5	15.7
	(1,000 households)							
Number of households	133	136	125	132	215	258	261	106

Rice Price Increase	Villages				Greater Bangkok			National Average
	N	NE	CE	S	Metropolis	Suburban	Fringe Areas	
	(percent)							
0	31.6	42.5	11.5	28.3	6.5	4.6	6.4	25.96
10	30.5	40.9	10.7	28.2	6.9	4.6	5.1	24.74
20	28.6	39.4	10.3	28.2	7.0	4.3	5.4	24.50
30	27.4	38.2	9.6	28.2	7.5	4.3	6.1	23.78
40	27.8	37.3	9.5	29.5	8.0	3.7	5.4	23.57
50	21.1	36.5	9.2	28.6	8.5	3.9	5.4	23.57
	(1,000 households)							
Number of households	1,473	2,176	1,139	774	973[a]	...[a]	...[a]	7,901

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Notes: N is the Northern Region, NE the Northeastern Region, CE the Central and Eastern Region, and S the Southern Region. Greater Bangkok includes the Bangkok metropolis and the provinces of Nonthaburi, Pathumthani, and Samut Prakan. The municipal areas and metropolis are urban, whereas the sanitary districts, villages, suburbs, and fringe areas are considered rural.

[a] The number of households in the Bangkok metropolis includes those in the suburban and fringe areas.

For the past 10 years, revenues from the collection of the rice premium have gone to the Farmers' Aid Fund. Because the Fund is separate from the main fiscal budget and is exempt from the scrutiny of the Budget Bureau and the House of Representatives, studies have shown that its original aim of helping Thai farmers is often unfulfilled. Decisions are often made to use the Fund for agricultural projects without carefully examining them to see if the proper groups of farmers will benefit from them.[73]

The effect on the incomes of high-income households, both urban and rural, may result in shifts in their consumption of other goods and services. Whether these shifts will have secondary effects on the poor through a change in employment in the production of these goods and services requires additional research.[74] If the high-income households spend less on other goods and services, the employment of the poor may be reduced, which reinforces the conclusion drawn in this study.

[73] Rangsan Thanapornpan, "The Roles of the Farmers' Aid Fund," report prepared for the National Economic and Social Development Board of Thailand, Thammasat University, Bangkok, 1980. (In Thai.)

[74] Mellor, "Food Price Policy and Income Distribution."

Table 38—Changes in the incidence of poverty at 1975/76 rice prices among low-income socioeconomic groups of urban and rural households after rice production and wages have adjusted to rice price increases of 10 to 50 percent

Socioeconomic Group	Rice Price Increase					
	0	10	20	30	40	50
	(percent)					
Paddy farmers						
Own land						
Small	47.9	45.8	44.3	41.6	40.2	39.2
Large	29.6	27.4	24.6	23.2	21.7	20.4
Rent land						
Small	42.5	39.5	37.3	36.2	36.2	35.4
Large	22.8	18.6	15.9	12.3	10.6	10.2
Other farmers						
Own land						
Small	41.4	43.4	45.0	46.3	48.9	49.3
Large	20.0	20.6	22.6	23.9	29.0	31.0
Rent land						
Small	44.4	45.1	47.6	47.6	50.8	50.8
Large	16.7	16.7	16.7	20.8	20.8	20.8
Fishing and forestry	26.4	27.2	28.8	28.8	29.6	31.2
Self-employed without paid workers	12.6	13.5	14.0	14.7	15.1	15.7
Farm workers[a]	26.6	26.6	26.6	26.6	26.6	26.6
Production workers[a]	10.5	10.5	10.5	10.5	10.5	10.5
General workers[a]	19.8	19.8	19.8	19.8	19.8	19.8
Total urban households	8.2	8.6	8.9	9.2	9.8	10.3
Total rural households	28.0	27.0	26.1	25.3	25.1	24.6
Total	25.96	24.74	24.50	23.78	23.57	23.57

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

Note: The incidence of poverty is measured by the percentage of households below the poverty line. A small farm is less than 20 rai; a large farm is more than 20 rai. One hectare equals 6.25 rai.

[a] If the nominal wage rate of workers is assumed to adjust fully to a rise in the price of rice, the poverty incidence does not change.

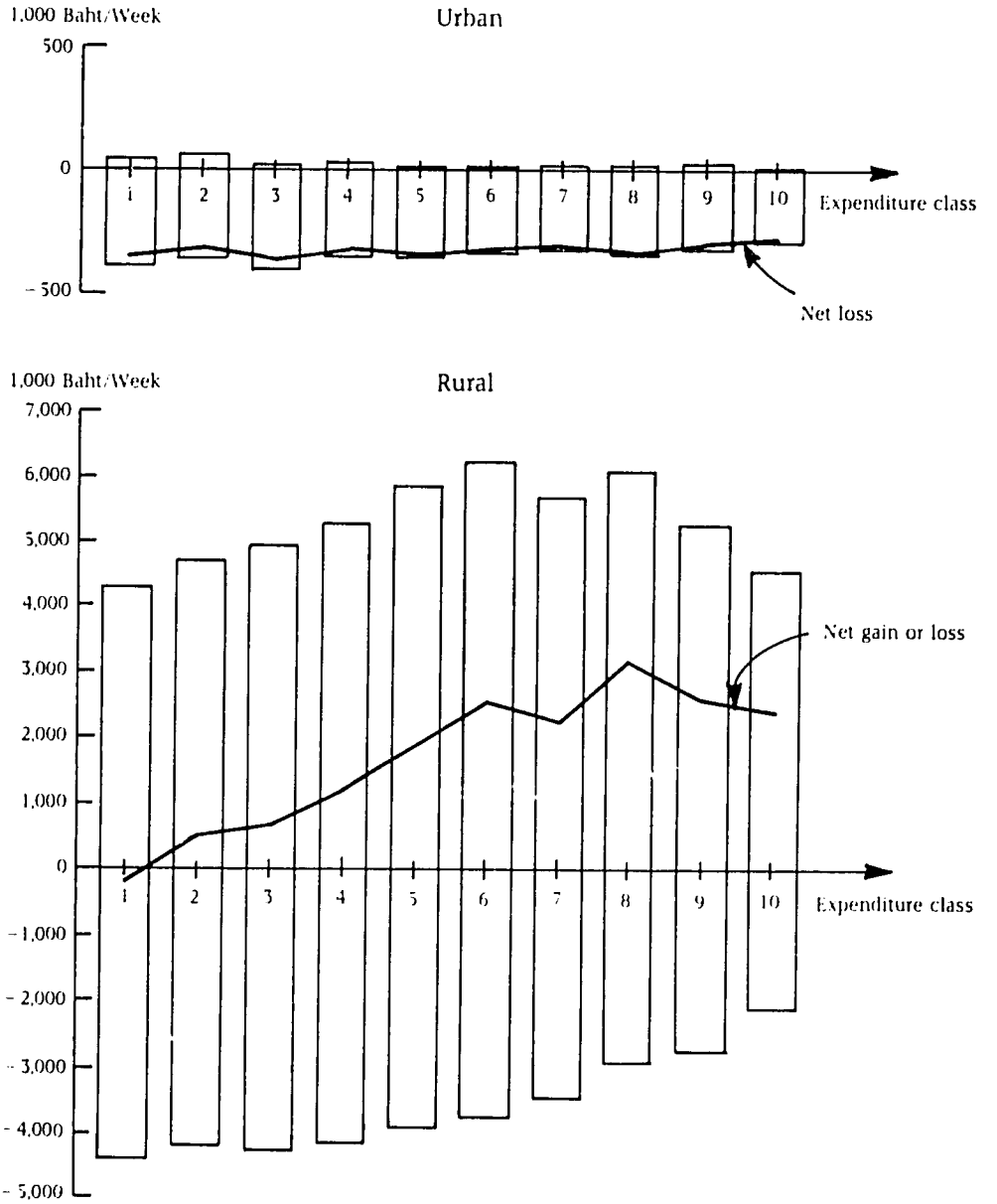
Another approach to the problem of calculating the effects from a rise in the price of rice is to use a computable general equilibrium model (CGE). A recent study by Amranand and Grais using a CGE model includes the macroeconomic and distributional implications of an increase in the price of rice.[75] The short-run results, although not as disaggregated as in this study, are similar. The long-run results largely depend on farmers' responses to price changes and the price elasticity of world demand for rice. Nevertheless, the results based on a few assumed values indicate that the long-run benefits to the economy from a rise in the price of rice may not be as high as might have been expected.

Calorie Intake

The consumption analysis has focused on the effects on the calorie intakes of different groups of consumers, partly because rice is the single major source of calories. There are many ways to disaggregate the sample households and estimate the consumption parameters for each group. They may be disaggregated, for example, by income, by socioeconomic group, by calorie intake, by type of rice consumed, or by a combination of these variables. Under each method the disaggregated sample group will possess a certain amount of heterogeneity with respect to other characteristics. For example, if the sample is grouped by calorie

[75] Piyasvasti Amranand and Wafik Grais, *Macro-economic and Distributional Implications of Sectoral Policy Interventions: An Application to Thailand*, World Bank Staff Working Paper 627 (Washington, D.C.: World Bank, 1984).

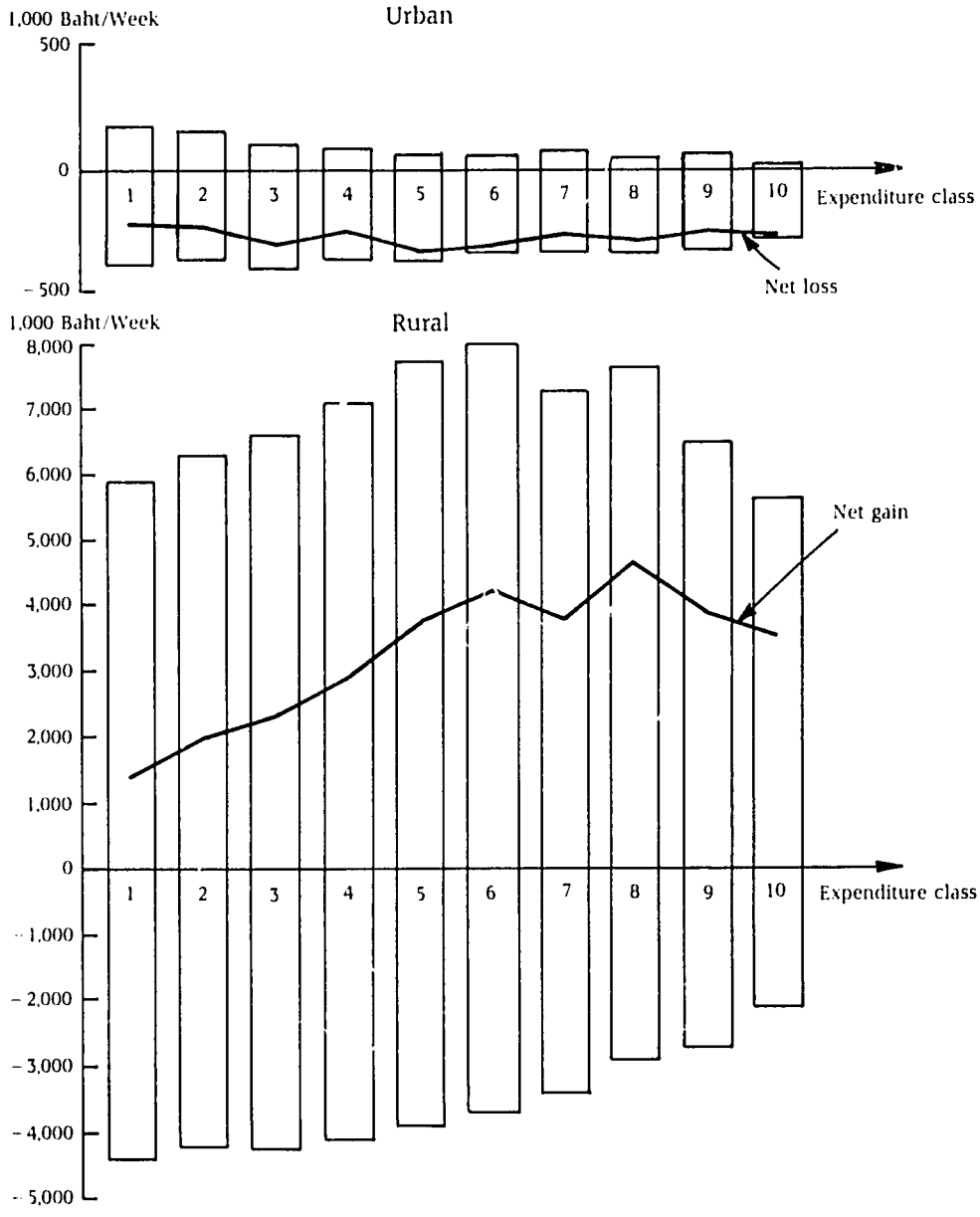
Figure 13—Distributional effects of a 10 percent rise in the price of rice on the real incomes of urban and rural households, assuming that supply, the wage rate, and rice consumption are constant



Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976.

Notes: Each box represents the sum of gains and losses in 1,000 baht per week resulting from a 10 percent increase in the price of rice of each expenditure class in the urban and rural areas. (Group 1 is the poorest, group 10, the richest.) The lines drawn across the boxes represent the corresponding net gains and losses. In the rural areas the net gain of the bottom four deciles is 13 percent, whereas the top three deciles gain by 48 percent. In urban areas there is a net loss.

Figure 14—Distributional effects of a 10 percent rise in the price of rice on the real incomes of urban and rural households with adjustments in production and the wage rate



Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976.

Notes: Each box represents the sum of gains and losses in 1,000 baht per week resulting from a 10 percent increase in the price of rice of each expenditure class in the urban and rural areas. (Group 1 is the poorest; group 10, the richest.) The lines drawn across the boxes represent the corresponding net gains and losses. In the rural areas the net gain of the bottom four deciles is 27 percent, whereas the top three deciles gain by 37 percent. In urban areas there is a net loss.

Table 39—Income and own-price elasticities of rice consumption by expenditure class

Expenditure Class	Nonglutinous Rice Consumers		Glutinous Rice Consumers	
	Income Elasticity	Own-Price Elasticity	Income Elasticity	Own-Price Elasticity
Bottom 25 percent	0.401	-0.736	0.592	n.s.
Middle 50 percent	0.084	0.714	0.276	-0.578
Top 25 percent	n.s.	n.s.	n.s.	n.s.
Total	0.126	-0.636	0.286	-0.431

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).
Note: Where n.s. appears, the figure was not significantly different from zero.

intake, in each calorie group there are both low- and high-income consumers. Hence, the estimated consumption parameters may not be consistent with those of their constituencies. One example is discussed in Chapter 6 when the sample is disaggregated by calorie intake and the estimated consumption parameters are shown to be inconsistent. In addition, by using the dependent variable of the regression equation to select the sample, the estimated parameters can be biased. Thus, the method used to disaggregate the sample will partly depend on its purpose and whether differences in tastes and preferences or other characteristics in the sample subgroups will render the parameters inconsistent.

A summary of some of the important parameters of rice consumption and calorie intake with respect to changes in incomes and prices of rice for various groups of consumers is given in Tables 39-41. In all cases where the own-price elasticities are statistically significant they are negative, indicating that when the rice price increases, these consumers will probably decrease the amount of rice they consume and hence decrease their calorie intake. The short-run response may be lower than that indicated because these parameters are estimated from a cross-

Table 40—Income and own-price elasticities of calorie intake by socioeconomic group

Socioeconomic Group	Income Elasticity	Own-Price Elasticity
Group 1	0.322	-0.405
Group 2	0.273	0.618
Group 3	0.333	n.s.

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).
Notes: Group 1 consists of farmers. Group 2 consists of workers in fishing and forestry, the self-employed nonfarmers without paid workers, farm workers, clerical workers, production workers, and general workers. Group 3 consists of the self-employed nonfarmers with paid workers, professionals, managers and administrators, and those who are economically inactive but who receive property income, assistance, or pensions. Where n.s. appears, the figure was not significantly different from zero.

Table 41—Price elasticities of calorie intake of paddy farmers

Type of Farmer	Price Elasticity
Semisubsistence farmers	
Nonglutinous rice consumers	0.84
Glutinous rice consumers	0.41
Commercial farmers	
Nonglutinous rice consumers	0.72
Glutinous rice consumers	0.32

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976 (computer printout).

sectional data set. Yet, a fraction of, say, one half still leaves substantial magnitudes for many of these parameters.

In each consumer group disaggregated, calorie consumption varies widely except when the samples are already disaggregated by calorie intake. The effects on the calorie-deficient groups of consumers are of primary interest. Unfortunately, the consumption parameters estimated from the calorie grouping can be quite inconsistent. Parameters estimated from other methods of disaggregation such as income, are used.

In conclusion, a rise in the domestic price of rice in Thailand would be much less favorable to the rural poor than is widely believed. Floating the price of rice is unlikely to solve the problem of poverty in rural areas. As this report shows, about one fourth of the paddy farmers are net purchasers of rice. A rice price increase would create short-run hardships for many of the rural poor. Thus, if the rice price is increased, compensatory measures may be needed in both rural and urban areas, at least during the transition period.

APPENDIX 1: SUPPLEMENTARY TABLES

Table 42—Summary of the estimated price elasticities of area of selected crops and their sources

Crop and Region	Period	Elasticity	
		Short Run	Long Run
Rice			
Thailand[a]	1940-63	0.18	0.32
Northeast[b]	1940-63	0.0-0.57	0.0-1.04
Central[b]	1940-63	0.0-0.62	0.0-3.12
Thailand, whole kingdom[c]	1951-71	0.07	...
Thailand, whole kingdom[d] (supply elasticity)	1955-72	0.36	...
Thailand, whole kingdom[e] (supply elasticity)	1951-72	0.41	0.91
Thailand, whole kingdom[f]	1951-75	0.04	...
Thailand, whole kingdom[g]	1964-75	0.09	0.51
Thailand, whole kingdom[h]	1951-73	0.19	0.39
	1951-64	0.29	0.48
	1965-73	0.04	0.04
Northeast[h]	1951-73	0.33	0.38
	1951-64	0.34	...
	1965-73	0.03	...
Central[h]	1951-73	0.14	0.90
	1951-64	0.18	...
	1965-73	0.08	0.10
Thailand, whole kingdom[i]	1969-77	0.10	...
Zone 1	1969-77	0.39	...
Zone 2	1969-77	0.11	...
Zone 3	1969-77	0.22	...
Zone 4	1969-77	0.14	...
Zone 5	1969-77	0.45	...
Zone 6	1969-77	0.17	...
Zone 8	1969-77	0.27	...
Zone 11	1969-77	0.08	...
Maize			
Thailand, Central and Northeast[a]	1937-68	1.03	2.29
Thailand, whole kingdom[j]	1950-70	0.52	...
Maize center	1950-70	0.65	...
Thailand, whole kingdom[i]	1969-77	0.32	...
Zone 1	1969-77	1.50	...
Zone 5	1969-77	0.97	...
Zone 6	1969-77	0.53	...
Zone 7	1969-77	0.17	...
Sugarcane			
Thailand, whole kingdom[i]	1969-77	1.76	...
Zone 1	1969-77	0.65	
Zone 11	1969-77	0.76	...
Zone 12	1969-77	0.66	...
Zone 15	1969-77	0.74	...
Cassava			
Thailand, Rayong province[a]	1954-63	1.09	1.09
Thailand, whole kingdom[i]	1969-77	0.26	...
Zone 1	1969-77	1.50	...
Zone 3	1969-77	2.92	...
Zone 5	1969-77	1.49	...
Zone 15	1969-77	1.18	...
Kenaf			
Thailand, 8 provinces in Northeast[a]	1954-63	2.70	5.75
Thailand, whole kingdom[i]	1969-77	0.46	...
Zone 1	1969-77	0.92	...
Zone 2	1969-77	0.64	...
Zone 3	1969-77	1.08	...
Zone 4	1969-77	0.91	...
Zone 5	1969-77	0.70	...

Table 42—Continued

Note: Zones 1 to 5 represent the Northeastern Region, Zones 6 and 8 through 10 represent the Northern Region, Zones 7 and 11 through 16 represent the Central and Eastern Region, and Zones 17 through 19 represent the Southern Region.

[a] Jere R. Behrman, *Supply Response in Underdeveloped Agriculture: A Case Study of Four Major Annual Crops in Thailand, 1937-63* (Amsterdam: North-Holland, 1968).

[b] Estimated by province. The Northeastern Region is composed of 15 provinces for which the mean of short-run and long-run elasticities are 0.23 and 0.30 respectively. The Central Region is composed of 35 provinces with 0.18 the mean of short-run and 0.32 the mean of long-run elasticities.

[c] Olarn Chaipravat, "Aggregate Production Structure of Paddy Cultivation in Thailand: A Time Series Analysis, 1951-73," in *Finance, Trade and Economics Development in Thailand, Essays in Honour of Khunying Suparb Yossundara*, p. 196.

[d] Chesada Loohawenchit, "A Dynamic Multicrop Model of Thai Agriculture: With Special Reference to the Rice Premium and Agricultural Diversification" (Ph.D. dissertation, Cornell University, 1978).

[e] Chung Ming Wong, "A Model for Evaluating the Effects of Thai Government Taxation of Rice Export on Trade and Welfare," *American Journal of Agricultural Economics* 60 (February 1978): 66-73.

[f] Saran Wattanutchariya, "Demand and Supply Analysis of Rice Production in Thailand (With Reference to Government Policies on Prices)" (Ph.D. dissertation, Texas A&M University, 1978).

[g] J. Malcolm Dowling and Medhi Krongkaew, *Agricultural Supply Response of Some Major Crops in Thailand*, Research Report 41 (Bangkok: Thammasat University, 1983).

[h] Somsak Prakongtanapan, "Changes in the Supply Response of Aggregate Rice Output in Thailand" (M.A. thesis, University of the Philippines, 1976).

[i] Apichart Pongsrihadulchai, "Supply Analysis of Important Crops in Thailand" (Ph.D. dissertation, Iowa State University, 1981).

[j] Dasri Tumnong, "An Economic Analysis of Maize Supply Response in Thailand, 1950-70" (M.A. thesis, Thammasat University), pp. 66-67.

Table 43—Basic data on paddy production and area, wet- and dry-season crops, 1955-79

Year	Wet-Season Crops			Dry-Season Crops		
	Cultivated Area	Harvested Area	Paddy Production	Cultivated Area	Harvested Area	Paddy Production
	(1,000 hectares)		(1,000 metric tons)	(1,000 hectares)		(1,000 metric tons)
1955	5,760	5,364	9,055	20	20	31
1956	6,003	5,739	9,621	11	11	17
1957	5,063	4,267	6,456	12	12	23
1958	5,746	5,158	8,186	10	10	17
1959	6,057	5,256	7,776	7	7	11
1960	5,911	5,623	9,094	10	10	17
1961	6,178	5,652	9,582	11	11	19
1962	6,659	6,191	9,974	12	11	20
1963	6,588	6,341	10,007	13	13	22
1964	6,520	5,952	9,522	19	19	36
1965	6,531	5,937	9,153	23	22	45
1966	7,433	7,001	11,947	35	34	64
1967	6,658	5,807	9,625	52	51	122
1968	7,138	6,251	10,160	91	...	569
1969	7,584	7,258	13,410	107	100	235
1970	7,568	6,848	13,576	99	...	278
1971	7,527	7,091	13,744	103	97	284
1972	7,139	6,571	11,669	210	209	743
1973	7,959	7,357	13,748	326	322	1,012
1974	7,647	7,187	12,477	410	408	1,372
1975	8,519	7,856	14,090	459	448	1,469
1976	8,137	7,735	13,676	490	487	1,806
1977	8,554	8,279	12,335	490	489	1,662
1978	9,210	8,192	14,908	644	638	2,131
1979	9,031	8,269	14,482	408	408	1,308

Source: Thammasat University, "Faculty of Economics Data Bank," 1982 (computer printout).

Table 44—Basic data on rice production, 1950-80

Year	Paddy Producer Price	Wholesale Price Index (1963-100)	Percentage of Rice Area Planted with HYVs	Irrigated Area	Average Annual Rainfall	Fertilizer Price Index (1965-100)	Percentage of Rice Area Planted with HYVs Adjusted for Wet-Season Crops Only
	(baht/kilogram)		(percent)	(1,000 hectares)	(millimeters)		(percent)
1950	0.75	83	0.09	...	...	...	0.01
1951	0.79	89	0.09	693	1,661	182	0.01
1952	0.87	95	0.09	829	1,568	162	0.01
1953	0.80	88	0.09	909	1,701	187	0.01
1954	0.71	86	0.09	980	1,420	157	0.01
1955	0.92	100	0.09	1,140	1,581	176	0.01
1956	1.00	103	0.09	1,251	1,682	178	0.01
1957	0.97	104	0.09	1,305	1,374	150	0.01
1958	1.10	108	0.09	1,332	1,415	151	0.01
1959	0.94	99	0.09	1,505	1,561	134	0.01
1960	0.90	108	0.09	1,531	1,522	123	0.01
1961	0.98	114	0.09	1,568	1,624	112	0.01
1962	1.17	107	0.09	1,645	1,530	114	0.01
1963	1.03	100	0.09	1,676	1,479	122	0.01
1964	0.87	94	0.09	1,726	1,456	102	0.01
1965	0.91	95	0.09	1,806	1,569	100	0.01
1966	1.28	111	0.09	1,872	1,877	107	0.01
1967	1.34	119	0.09	1,900	1,463	123	0.01
1968	1.24	114	0.09	1,960	1,412	103	0.01
1969	1.21	118	0.10	1,992	1,560	109	0.01
1970	1.16	117	0.40	2,032	1,813	109	0.01
1971	0.95	118	1.40	2,126	1,581	114	0.05
1972	1.17	127	4.10	2,197	1,418	100	1.30
1973	1.69	156	5.00	2,297	1,550	153	1.10
1974	2.43	201	5.50	2,162	1,551	188	0.40
1975	2.53	208	7.10	2,252	1,552	208	3.00
1976	2.38	216	11.30	2,322	1,407	135	6.00
1977	2.42	233	11.20	2,348	1,203	134	5.10
1978	2.60	251	11.80	2,600	1,895	134	5.60
1979	2.61	279	8.80	...	1,101	...	4.70
1980	...	335	...	...	...	...	...

Sources: Producer prices are taken from Adelita C. Palacpac, *World Rice Statistics* (Los Banos: International Rice Research Institute, 1980), Table 42, Average wholesale price of paddy No. 1, Bangkok metropolis.

The wholesale and consumer price indexes come from the International Monetary Fund, *International Financial Statistics*, Washington, D.C.: IMF, 1981. The proportion of total rice area planted with modern varieties is from Palacpac, *World Rice Statistics, 1982*, Table 15. The area planted with modern varieties before 1969 was believed to be negligible. It is given as 0.09, which is close to 0.1, the value in 1969. This is believed to have little effect on the dependent variable.

Irrigated area for 1951-73 is taken from Somsak Prakongtanapan, "Changes in the Supply Response of Aggregate Rice Output in Thailand" (M.A. thesis, University of the Philippines, 1976), Appendix Table B-1, 1 hectare = 6.25 rai; 1974-78 is taken from Dow Mongkolsmai, *Status and Performance of Irrigation in Thailand*, International Food Policy Research Institute Rice Working Paper 8 (Washington, D.C.: IFPRI, 1983), Tables 14 and 15, dry season in 1975 is in crop year 1974-75.

Average annual rainfall, 1951-73, is from Prakongtanapan, "Changes in the Supply Response of Aggregate Rice Output in Thailand," Appendix Table B-1; that for 1975-79 is from Thailand, Ministry of Agriculture and Cooperatives, *Agricultural Statistics, 1979/80* (Bangkok: MOAC, 1981), Table 74, average for the Northern, Northeastern, and Central and Eastern Regions; the figure for 1974 is interpolated between 1973 and 1975.

The fertilizer price index deflated by the wholesale price index is from Prakongtanapan, "Changes in the Supply Response of Aggregate Rice Output in Thailand," column 5 in Appendix Table B-1 divided by column 3 in Table B-4. The fertilizer price index, 1951-72, is derived from the fertilizer price index deflated by the wholesale price index, multiplied by the wholesale price index, that for 1973-78 uses prices paid by farmers per kilogram of nitrogen (urea) in Palacpac, *World Rice Statistics, 1982*, Table 51.

APPENDIX 2:
ESTIMATION OF THE LABOR SUPPLY FUNCTION

Labor used in rice production consists of family labor and hired labor. The structural model used to estimate the supply elasticity of labor is a system of two equations.[76]

$$S_t = m + nW_t, \text{ and} \quad (18)$$

$$W_t = a + bS_t + cD_t, \quad (19)$$

where

S_t = supply of labor in month t,

W_t = wage of hired labor in month t, and

D_t = total demand for labor in month t (family and hired labor).

Equation (18) is the labor supply function. It is hypothesized that the supply is affected by the wage rate in the current month. In equation (19) the wage rate is in turn determined by the labor supply and demand. Here, labor supply is defined as the supply of hired labor. The difference between the demand and supply of labor is family labor. The total demand for labor in month t is predetermined by the production decisions made at the beginning of the crop season, so that the amount of hired labor used in each month is determined by the supply of family labor and the cost of hired labor.

All prices are anticipatory in the beginning of the crop season, and the total demand for labor in month t is predetermined at the beginning of the crop season. But total labor demand can vary for different months. Suppose there is higher demand for labor in month 2 than in month 1. The total labor demand curve is shifted to the right. The demand curve of hired labor is the residual between total labor demand and the family labor supply. The supply curve of family labor and the supply curve of hired labor are fixed throughout the year. Hence, the wage rate increases.

Given that the following estimation is done over a period of one year and the production technology is fairly constant during the year, the assumption that D_t is exogenously determined is plausible. Statistically, if D_t is endogenous (rather than exogenous), there will be simultaneity in the wage equation. The error term, however, will not be randomly distributed. Any improvement that can be made here to obtain a more consistent and unbiased estimate is relatively minor compared with other problems that will be encountered later on.

The reduced forms of equations (18) and (19) are:

$$S_t = (m + an/1 - bn) + (cn/1 - bn)D_t, \quad (20)$$

and

$$W_t = (a + mb/1 - bn) + (c/1 - bn)D_t. \quad (21)$$

The system has only one exogenous variable, D_t. The supply equation is just identified, but the wage equation is underidentified. However, estimating the structural parameter of the supply function is the only interest here. Given the estimated reduced forms $S_t = \hat{A} + \hat{B}D_t$, and $W_t = \hat{E} + \hat{F}D_t$, the parameters of the supply function equation (18) can be obtained from $m = \hat{A} - n\hat{E}$ and $n = \hat{B}/\hat{F}$.

Data Sources

Although this model looks simple, the necessary data required to estimate it are less so. There seems to be no single data set adequate for its estimation. The most comprehensive labor force survey by the National Statistical Office (NSO) is limited to only two periods in a year—the peak and the off-peak seasons. Hence, the following estimation has to make use of data from various sources. The necessary variables are family labor use, wage rate, and hired labor. Labor supply is the difference between the amount of labor hired in and the total amount of family labor

[76] The model is the same as the one used in Bell, Hazell, and Slade, *Project Evaluation in Regional Perspective*.

hired out to other paddy farms. According to the 1975/76 SES data, farm households that engage in home production and hire out family labor are rare. Therefore, the total amount of hired-in labor in each period is assumed to be the labor supply within that period.

To prevent differences in geographical conditions and cultures from influencing the variation in wage rates and labor utilization, the model is estimated separately for five different regions: the Northern, Northeastern, Central and Eastern, Southern, and Greater Bangkok (which includes the Bangkok metropolis, Nonthaburi, Pathumthani, and Samut Prakan). Although Greater Bangkok belongs to the Central and Eastern Region, the areas are treated separately here to compare them with the results obtained from the Central and Eastern Region.

The basic time period is a month, which is the time period used in the sample specification in the 1975/76 SES data set. A month is also short enough to capture the variation in the cropping seasons.

Family Labor

Only sample households that are primarily engaged in rice farming are selected from the SES data. Any substantial labor use in the production of other crops is excluded. In all farm households in the survey, each family member was asked about his or her occupation, type of work, and the number of weeks worked in the previous month (a month before the interview month). Each family member in a household who was engaged in rice farming as employer, self-employed worker, or unpaid family worker is counted, with the number of weeks worked. The weighted sums of family labor used by each household are divided by the corresponding planted areas to obtain the family-labor intensity in number of person-weeks per rai. In each region, the average family-labor intensity is calculated from all of the farm households that were interviewed in the same month.

These figures for family-labor intensity are then multiplied by the total planted area in each region. The total planted area is obtained by adding together the planted area of all sample farm households that primarily engaged in rice farming in each region in 1975/76.

Region	Rai
Northern	17,972
Northeastern	38,944
Central and Eastern	21,140
Southern	2,857
Greater Bangkok	7,285

To be compatible with data on hired labor to be used later, the amount of family labor use must also be transformed into person-days. But how many working days should there be in a week? The labor force survey data collected by the NSO indicate that farm households have longer work weeks in the rainy season than in the dry season. There are two ways to transform family labor in person-weeks to person-days. One way is to use variable lengths of work weeks from month to month. But this could introduce artificial family-labor responses to seasonal demand. The second way is to use a constant work week for all months, which is the option selected.

From the specification of labor supply and wage functions shown in equations (18) and (19), the total labor demand (D_t) in month t is predetermined at the beginning of the crop season. Thus, the higher the family-labor responses are in the peak seasons, the lower the required hired labor will be. Therefore, if varying lengths of work weeks are used, the coefficient n of the labor supply function would be slightly lower than with constant work weeks. In practice, however, the total labor demand used in this analysis is derived from the summation of the family labor demand and the hired labor. Therefore, when the variable work week is used, changes in the amount of family labor will already be included in the total labor demanded, and the adjustment described theoretically will not take place. Hence, using the constant work week to calculate the amount of family labor used is the best alternative.

Wage Rate

In the economic literature it is often difficult to find an appropriate farm wage rate.[77] In the model wage rate can be a controversial variable for two reasons.

[77] This problem is discussed, for example, in Pranab Bardhan, "Labor Supply Functions in a Poor Agrarian Economy," pp. 73-83.

The proponents of a dual labor market hypothesize that the supply price of labor from the traditional sector—rural Thailand—exceeded its marginal product. And this phenomenon was caused by a substantial pool of unemployed or underemployed labor in rural Thailand, especially during the off-peak season. Notwithstanding the widespread adherence to a "labor surplus" description of the rural Thai economy, a recent empirical study indicates that evidence for this hypothesis is weak and that the rural Thai labor market is reasonably efficient and well integrated.[78]

Second, a reliable data source for the rural wage rate is quite hard to find. Few family members who were hired in rice farming reported their wage incomes in the 1975/76 SES. The labor force survey contains only data from 1977 onward and for only two periods of time in a year.

Under these circumstances, an exogenous source of wage data must be found. The surveys on manual wage rates by operations carried out by the Ministry of Agriculture and Cooperatives since 1975 seem to be the most appropriate.[79] The raw data for wages in paddy farming are given by region in Table 45. With knowledge of the regular cropping season in each region, these wage data can be allocated to appropriate time periods of the year.

Figure 15 shows a typical rice calendar for the main crops in Thailand, which appears to be appropriate for this analysis.[80] On a national basis, in crop years 1975/76 and 1976/77 the second crops accounted for only about 5 percent of the total planted area. In the Southern Region the monsoon seasons normally arrive two months later than in the other regions, and the calendar must be adjusted accordingly.

The wage rate for "caring" is the average of the wage rates for weeding, fertilizer application, and draining. The wage rate for spraying is excluded because it is much higher than the others, and spraying is not carried out extensively by most of the farmers. During the off-peak season, especially during the months of February, March, and April for most regions, and April, May, and June for the South, an arbitrary wage rate that is a little lower than the lowest wage rate in the previous crop year is assigned.

Wage rates in the off-peak seasons should not decline much because studies have found that during these periods farm workers can still find some nonfarm work.[81]

Farm households included in the 1975/76 SES were interviewed between November 1975 and October 1976. Because they were asked about their occupations during the previous months, the time frame in the analysis is October 1975 to September 1976.

Hired Labor

As might be expected, it is hard to find complete and accurate data on the amount of hired labor used by each farm household from a secondary data set like the 1975/76 SES. The 1975/76 SES data tape contains information on total expenditures of hired labor by household for the entire previous year. Because the objective is to obtain information on the total amount of hired labor by month, the expenditure data are divided by the appropriate wage rates to obtain the amount of hired labor in person-days; then the data are divided by the corresponding planted land area to get the level of hired labor intensity in person-days per rai. The hired labor intensity is averaged by region, and the average hired labor intensities are then used to extrapolate for the total amount of hired labor in each region by multiplying them by the total planted area in each region. These total figures are then allocated over a 12-month period according to the labor intensity required by different farm activities performed during different months of the year and according to the information on monthly hired labor from a separate spot survey. The step-by-step calculations are as follows.

First, the weights of labor intensity of four major activities—land preparation, planting, caring, and harvesting—are ob-

[78] Bertrand and Squire, "The Relevance of the Dual Economy Model."

[79] Unpublished data supplied by the Ministry of Agriculture and Cooperatives, Thailand.

[80] Figure 5 shows family labor used in different months in the Northeastern and Central and Eastern Regions and Greater Bangkok. The amounts of family labor used would partly depend on the availability of hired labor in specific months. On the other hand, Figure 15 shows only the major wet-season crops.

[81] Bertrand and Squire, "The Relevance of the Dual Economy Model."

Table 45—Manual wage rate by region and operation, 1975 and 1976

Operation	Northern		Northeastern		Central and Eastern		Southern	
	1975	1976	1975	1976	1975	1976	1975	1976
	(baht/day)							
Land preparation	20.00	21.04	15.00	15.04	22.30	24.80	20.00	20.00
Planting	20.18	23.28	15.00	14.96	20.00	20.60	20.00	22.00
Weeding	15.00	17.60	10.05	13.52	15.00	17.28	20.00	20.00
Spraying	25.00	30.72	20.00	20.88	29.36	29.36	25.00	27.56
Fertilizer application	15.00	17.60	10.05	14.32	15.00	16.08	20.00	20.08
Draining	15.00	20.08	15.00	15.04	20.00	24.16	20.00	20.00
Harvesting	15.00	18.00	15.00	15.84	20.00	20.00	20.00	22.00
Threshing	14.55	15.84	15.00	15.84	20.00	20.32	20.00	22.44

Source: Data supplied to the author by Thailand, Ministry of Agriculture and Cooperatives.

tained. The starting point is the information on labor use per rai by stages of cultivation from a separate but smaller survey.[82] The labor use data were collected by the Ministry of Agriculture and Cooperatives from six provinces in the Northeastern Region and in the Central and Eastern Region. The data are broken down by wet- and dry-season crops, and by different techniques of cropping, transplanting, and broadcasting. The figures for the same crop and the same technique are averaged. In 1975/76 the percentage of area planted by transplanting was 77 percent of the total area planted on a national average, and the amount of area planted in the dry season was only 5 percent of the total planted area. Then, these figures for labor intensity are averaged to obtain the distributional weights of the four major activities: 0.01 for land preparation, 0.35 for planting, 0.10 for caring, and 0.54 for harvesting.

Second, in conjunction with the wage rates by activities for different regions given in Table 45, the weighted average wage rates are calculated for different regions. Two sets of weighted average wage rates are calculated. For households that were interviewed before June 1976, wage rates of all four activities in 1975 are used. For households that were interviewed in June 1976 and afterward, wage rates for caring and harvesting in 1975 are used, but those for land preparation and planting are from 1976. The two sets of wage rates are given under categories A and B below.

Region	A	B
	(baht/person-day)	
Northern	16.99	18.09
Northeastern	14.88	14.86
Central and Eastern	20.01	20.03
Southern	20.12	20.90

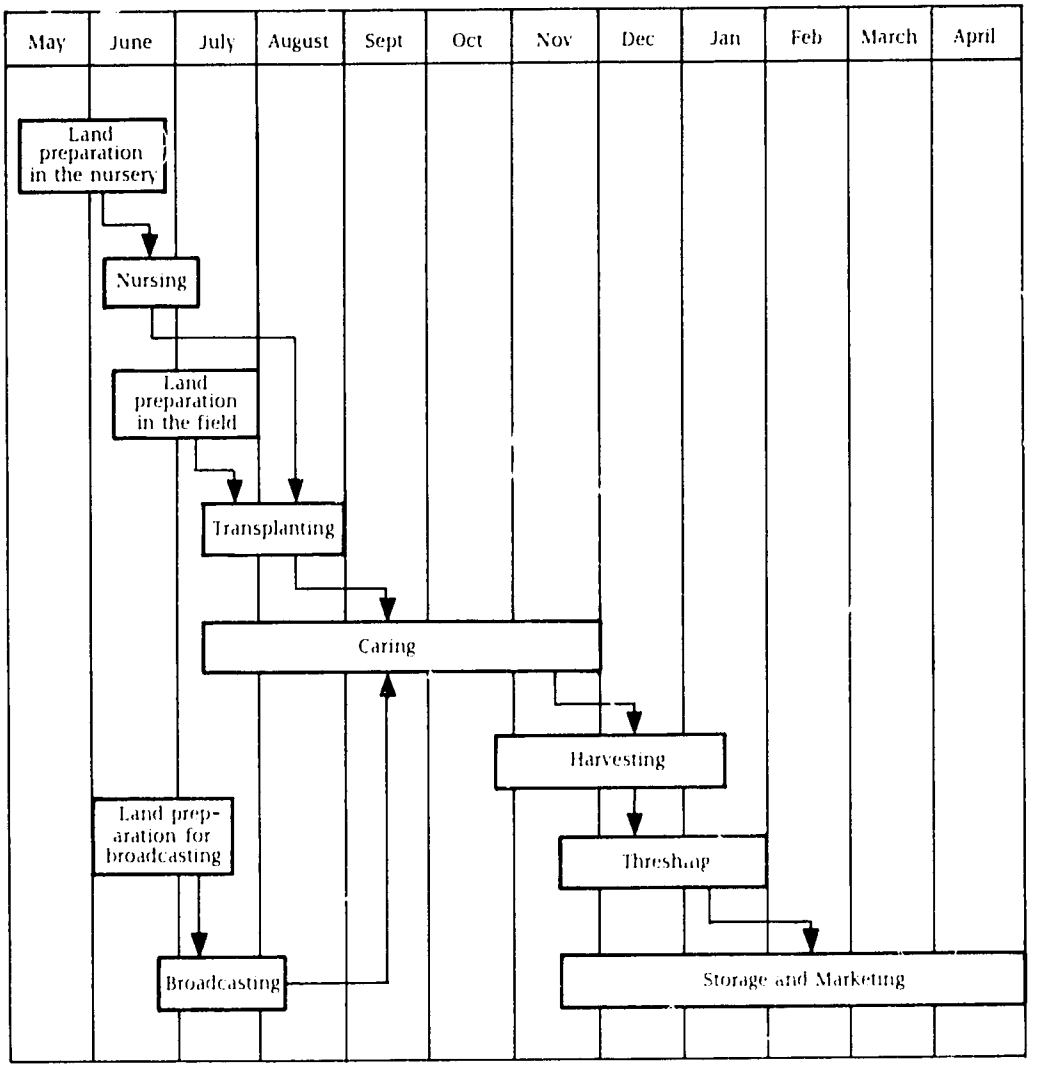
Third, the annual household expenditures on hired labor are divided by the corresponding wage rates and divided further by the corresponding planted land area to obtain hired labor intensity by household. In doing so, farm households that used tractors in their cultivation are excluded because the exogenous wage rates and the required labor intensity used in the calculations were for manual work only. (The total sample is reduced by about 25 percent by this exclusion, but it did not pose any problem in the calculations.)

It is appropriate at this point to check to see if the figures make sense. The labor intensity figures from two sources—family labor and hired labor—are summarized in Table 46 in person-days. They are compared with a required labor intensity for rice cultivation of about 11.20 person-days per rai per year, derived from a survey conducted in six provinces in the Northeastern and the Central and Eastern regions by the Ministry of Agriculture and Cooperatives.[83] Thus, it seems reasonable that the average required

[82] Tinprapha, "Employment and Agricultural Products in Thailand."

[83] Ibid.

Figure 15—Typical Thailand rice production calendar



Source: Thailand, Office of the National Economic and Social Development Board, Department of National Account, *Rice*, Report 1-20 (Bangkok: NESDB, 1977) (In Thai.)

labor intensity falls in between that of the Northeastern Region and that of the Central and Eastern Region from the data used in this report (11.20 compared with 13.44 and 8.48).

The figures for derived labor intensity are by and large sensible. In regions where farms are more commercialized (Central and Eastern Region and Greater Bangkok), hired labor takes a proportionately larger share in comparison with family labor. The figures for the Central and Eastern Region and Greater Bangkok are very close to each other. In the South, hired labor represents an exceptionally small share, which agrees with the background information that hired labor in this region is normally scarce and expensive and that farmers there use more household labor. But the figure for total labor intensity for the Northern Region seems quite high because utilization of family labor there is high, as will be discussed later on.

Fourth, the figures for hired labor intensity are used to extrapolate total hired labor use in each region by the sample households.

Table 46—Quantity of household family labor and hired labor compared with required labor per rai

Region	Family Labor	Hired Labor	Total Labor Intensity
		(person-day/rai/year)	
Northern	16.45	1.76	18.21
Northeastern	12.05	1.39	13.44
Central and Eastern	7.05	1.43	8.48
Southern	13.25	0.82	14.07
Greater Bangkok	7.30	1.72	9.02

Source: Calculations by the author.
Notes: The number of person-days is the product of the number of persons and the number of days involved in the work. It is based on a five-day work week. The labor intensity required for rice cultivation is 11.2 person-days per rai per year. Greater Bangkok includes the Bangkok metropolis and the provinces of Nonthaburi, Pathumthani, and Samut Prakan.

Hired labor intensities are multiplied by the total area planted by these households. The total hired labor used is then allocated over 12 months according to cultivation activities in different months and their corresponding labor requirements. These figures are shown in Table 47.

One may argue that this process of allocating the total hired labor over 12 months according to cultivation activities may render labor figures that do not correspond with the actual hired labor. In defense, this should be viewed as the best use of the data available despite the limitations. Considering the limited quantity of hired labor compared with family labor, this allocation process should not have an undesirable effect on the seasonal pattern of total labor demand. As for the labor supply, empirical evidence indicates that farm households tend to use hired labor in peak seasons when family labor has been fully utilized. Thus, this allocation process should not create figures that are too far from reality.

Nevertheless, in the labor supply equation hired labor is the marginal portion of total labor demand. The estimated elasticity of labor supply can be quite sensitive to how these monthly amounts of hired labor are allocated. To double check, a separate set of relative weights of monthly hired labor in farm activities is used. The data are from the Rural Off-Farm Employment Assessment Project in Thailand.[84] The monthly percentage of work hours allocated by different labor forces in the province of Khonkaen is used for the Northeastern Region; and that in Supanburi is used for the Central and Eastern Region and Greater Bangkok.[85] (Other regions are not included in the analyses.) The average number of hours worked by hired labor in each month and their relative weights are shown in Table 48.

As discussed in the beginning, the total hired labor used in each month represents the total labor supply (for the rice sector) in that month. And the total labor demand is the sum of family labor and hired labor. Hence, the data for wage rates and the corresponding labor demand and supply for the 12-month period are now available. They are summarized in Table 49.[86]

The numbers for total labor demand indicate clear differences during the 12-month period. The seasonal variation of total labor demand for the Northeastern and the Central and Eastern regions and Greater Bangkok corresponds well with the cropping season. For the North, total labor demand indicates unexpectedly high peaks in the months of January and April. These two months are considered to be in the off-peak season. The

[84] See Yasuo Banno, "Farm Household Labor Supply."

[85] Ibid. These sample villages are not representative of all the villages in the provinces, however.

[86] One potential problem of this estimation is that the off-peak wage often includes off-farm work. However, the wage rate here is specifically for rice cultivation. The wage rate for off-farm work tends to be on a different scale, and not everyone has access to it.

Table 47—Monthly allocation of hired labor by cultivation activity, 1975/76

Region	Caring		Harvesting			No Activity		
	October	November	November	December	January	February	March	April
	(person-days/household)							
Northern	1,055	1,055	5,699	5,699	5,699	...	...	...
Northeastern	1,808	1,808	9,761	9,761	9,761	...	...	...
Central and Eastern	1,005	1,005	5,430	5,430	5,430	...	...	...
Southern[a]	78	78	420	420	420	...	...	...
Greater Bangkok	418	418	2,256	2,256	2,256	...	...	...

Region	Land Preparation		Planting		Caring	Total
	May	June	July	August	September	
	(person-days/household)					
Northern	158	158	5,541	5,541	1,055	31,661
Northeastern	271	271	9,490	9,490	1,808	54,226
Central and Eastern	151	151	5,279	5,279	1,005	30,164
Southern[a]	12	12	408	408	78	2,332
Greater Bangkok	63	63	2,193	2,193	418	12,531

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976.

Notes: Greater Bangkok includes the Bangkok metropolis and the provinces of Nonthaburi, Pathumthani, and Samut Prakan. The weights of labor intensity are 0.10 for caring, 0.54 for harvesting, 0.01 for land preparation, and 0.35 for planting.

[a] Activities in the Southern Region take place two months later than in the other regions, but the figures have been advanced in this table. So, for example, the 78 person-days/household figure that is in the column for caring in October is actually for December (when caring really occurs in the South).

Table 48—Hours of hired farm labor used and their relative weights, by month, in two provinces, 1980/81

Month	Khonkaen		Supanburi	
	Number of Hours	Relative Weight	Number of Hours	Relative Weight
March	1.49	0.01	3.39	0.00
April	0.00	0.00	4.81	0.01
May	4.12	0.03	7.08	0.01
June	5.82	0.04	8.36	0.01
July	38.24	0.27	6.38	0.01
August	7.04	0.05	137.40	0.17
September	3.14	0.02	188.12	0.23
October	2.68	0.02	16.42	0.02
November	19.79	0.14	48.11	0.06
December	10.64	0.08	356.57	0.44
January	33.10	0.24	21.06	0.03
February	13.41	0.10	7.41	0.01
Total	...	1.00	...	1.00

Source: Yasuo Banno, "Farm Household Labor Supply in Non- and Off-Farm Work in Rural Thailand" (M.A. thesis, Thammasat University, 1982), Tables 4.10 and 4.13.

Note: The province of Khonkaen represents the Northeastern Region and the province of Supanburi represents the Central and Eastern Region and Greater Bangkok, which includes the Bangkok metropolis and the provinces of Nonthaburi, Pathumthani, and Samut Prakan.

Table 49—Wage rates and supply and demand of labor, by month and region, 1975/76

Month	Northern			Northeastern			Central and Eastern		
	Wage Rate	Supply of Hired Labor	Total Labor Demand	Wage Rate	Supply of Hired Labor	Total Labor Demand	Wage Rate	Supply of Hired Labor	Total Labor Demand
	(baht)	(person-days)		(baht)	(person-days)		(baht)	(person-days)	
October	15.00	1,055	21,992	11.70	1,808	44,646	16.67	1,005	14,429
November	14.78	6,754	38,025	15.00	11,569	62,975	20.00	6,435	20,916
December	14.78	5,699	24,570	15.00	9,761	52,989	20.00	5,430	22,236
January	14.78	5,699	29,871	15.00	9,761	43,337	20.00	5,430	19,171
February	14.00	0	26,599	11.50	0	37,192	16.50	0	15,327
March	14.00	0	21,926	11.50	0	26,482	16.50	0	11,944
April	14.00	0	28,665	11.50	0	29,208	16.50	0	5,496
May	21.04	158	16,333	15.04	271	50,898	24.80	151	9,664
June	21.04	158	22,533	15.04	271	39,215	24.80	151	10,721
July	23.28	5,541	33,038	14.96	9,490	46,487	20.00	5,279	23,565
August	23.28	5,541	25,490	14.96	9,490	45,513	20.00	5,279	16,060
September	18.40	1,055	37,272	14.29	1,808	45,425	19.17	1,005	11,047

Month	Southern			Greater Bangkok		
	Wage Rate	Supply of Hired Labor	Total Labor Demand	Wage Rate	Supply of Hired Labor	Total Labor Demand
	(baht)	(person-days)		(baht)	(person-days)	
October	20.00	408	4,836	16.67	418	5,445
November	20.00	78	7,649	20.00	2,674	13,419
December	20.00	78	978	20.00	2,256	7,428
January	20.00	498	2,212	20.00	2,256	6,445
February	20.00	420	5,177	16.50	0	4,808
March	20.00	420	3,848	16.50	0	4,116
April	19.50	0	2,066	16.50	0	2,477
May	19.50	0	1,663	24.80	63	2,613
June	19.50	0	1,843	24.80	63	3,924
July	20.00	12	198	20.00	2,193	5,216
August	20.00	12	298	20.00	2,193	6,710
September	22.00	408	3,236	19.17	418	2,968

Source: Calculated from data in Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976, and other sources explained in the text.
Note: Greater Bangkok includes the Bangkok metropolis and the provinces of Nonthaburi, Pathumthani, and Samut Prakan.

major cause of these two peaks is the high values of family labor computed from the 1975/76 SES data set. The low value of total labor demand in December is also caused by this data. The data on the amount of family labor and landholding are examined to detect any outliers, but none are suspected. Moreover, the total labor intensity required for the Northern Region is extraordinarily high (Table 46), which indicates that the data on family labor use in the Northern Region has some problems. Thus, it is excluded from the estimation.

In the Southern Region, the planting season is normally two months later than in the other regions. In general, the numbers for total labor demand do not violate the background knowledge of seasonal variations except for the high value in November. Estimations excluding and including November are carried out.

The wage rates in the Central and Eastern Region and Greater Bangkok need some explanation. During May and June, before the planting season, the only labor needed is for land preparation. The labor intensity required in these months is not exceptionally high, but the wage rates are. In Table 45, the wage rate for land preparation in the Central and Eastern Region in 1976, which was 24.80

baht per person-day, was high compared with wage rates for other activities (except spraying) in 1975 and 1976. Between 1977 and 1979 land preparation did not command an exceptionally high wage rate, compared with those for other activities in the same years. Therefore, the May and June observations are excluded from the estimation of the Central and Eastern Region and Greater Bangkok.

Estimation of the Labor Supply Function

The estimations of equations (20) and (21) are given in Table 50. The $\hat{B}$'s are statistically different from zero for the Northeastern, Central and Eastern, and Southern regions, and Greater Bangkok. (The November observation is excluded for the South.) The $\hat{F}$'s are significant only for the Northeastern and Central and Eastern Regions and Greater Bangkok. For the Southern Region, the wage rate is almost constant. Wage rates in the Southern Region varied little because most cultivation in this region is in tree crops, and labor flow is quite stable. Hence, the estimate of $\hat{F}$ in the wage equation is not significant. The calculation of the n's of equation (18) and the labor supply elasticities are shown in Table 51.

The labor supply elasticity for the Central and Eastern Region is very close to that of Greater Bangkok, which is mainly caused by the identical allocation pattern of hired labor and the identical set of wage rates. These two elasticities are both higher than the one for the Northeast Region although the average wage rates ($\overline{W}$) are higher. This can be explained by the more commercialized nature of the labor market in the Central and Eastern Region. Competition for labor in this region is probably higher, which causes wages to be higher, but the pool of hired labor may also be larger.

All of the three labor supply elasticities are high. One suspects that they may be caused by the allocation of hired labor. Therefore, a new set of relative weights of monthly hired labor is used (Table 48). The same estimation procedure also results in high labor supply elasticities (7.63 for Northeastern Region, 20.78 for Central and Eastern Region, and 19.07 for Greater Bangkok). This highly elastic labor supply is supported by the response of the rural labor market to the higher returns during the peak agricultural seasons and by the response of Thai farm families to more attractive employment opportunities in the more commercialized areas of the country.[87] However, in the estimation of the effects of rice price changes on the rural wage rate, shown in Chapter 5, lower values of the labor supply elasticities are also tested.

[87] Bertrand, *Thailand: Case Study of Agricultural Input and Output Pricing*, p. 18.

Table 50—Reduced forms of the labor supply function

Region	Labor Supply	Wage Rate
General	$S_t = \hat{A} + \hat{B}D_t$	$W_t = \hat{E} + \hat{F}D_t$
Northeastern	$S = -9.96 + 0.33D;$	$W = 8.59 + 0.12D;$
	$(-1.92)\quad(2.86)$	$(5.15)\quad(3.19)$
	$R^2 = 0.45,\quad df = 10.$	$R^2 = 0.50,\quad df = 10.$
Central and Eastern[a]	$S = -3.53 + 0.41D_3;$	$W = 14.99 + 0.22D;$
	$(-2.14)\quad(4.16)$	$(11.70)\quad(2.91)$
	$R^2 = 0.68,\quad df = 8.$	$R^2 = 0.51,\quad df = 8.$
Greater Bangkok[a]	$S = -0.39 + 0.28D_5;$	$W = 16.73 + 0.31D;$
	$(-0.68)\quad(3.12)$	$(15.18)\quad(1.83)$
	$R^2 = 0.55,\quad df = 8.$	$R^2 = 0.29,\quad df = 8.$
Southern[b]		
Including observations for November	$S = 0.765 + 0.042D;$	$W = 19.923 + 0.004D;$
	$(0.80)\quad(1.53)$	$(60.77)\quad(0.45)$
	$R^2 = 0.19,\quad df = 10.$	$R^2 = 0.02,\quad df = 10.$
Excluding observations for November	$S = 0.336 + 0.100D_4;$	$W = 19.838 + 0.009D;$
	$(0.43)\quad(3.65)$	$(51.97)\quad(0.66)$
	$R^2 = 0.60,\quad df = 9.$	$R^2 = 0.046,\quad df = 9.$

Source: Calculated from Table 49 based on data from Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976, and other sources described in the text.
Notes: Numbers in parentheses are t-statistics. Greater Bangkok includes the Bangkok metropolis and the provinces of Nonthaburi, Pathumthani, and Samut Prakan.

[a] Observations for May and June are excluded.

[b] The planting season occurs two months later in the Southern Region than in the others.

Table 51—Estimations of labor supply elasticities

Region	Parameters					Labor Supply Elasticity
	n	m	$S = m + nW$	$\overline{W}$	$\overline{S}$	
Northeastern	2.75	-33.58	$S = -33.58 + 2.75W$	13.79	4.52	8.39
Central and Eastern	1.86	31.41	$S = 31.41 + 1.86W$	18.53	2.99	11.53
Greater Bangkok	0.90	-15.06	$S = -15.06 + 0.90W$	18.53	1.24	13.50

Source: Calculated from Table 50, based on data from Thailand, National Statistical Office, "1975/76 Socioeconomic Survey Data Tape," Bangkok, 1976, and other sources described in the text.
Notes: The parameter n equals $\hat{B}/\hat{F}$, m equals $\hat{A}$ minus $n\hat{E}$, and the labor supply elasticity equals n times $\overline{W}/\overline{S}$. Greater Bangkok includes the Bangkok metropolis and the provinces of Nonthaburi, Pathumthani, and Samut Prakan.

APPENDIX 3:
CALCULATION OF THE CALORIE INTAKE FIGURES

The 1975/76 SES data set contains information on weekly household expenditures for 157 food items, which are expected to cover most of the food consumed by the households in the data set. They can be grouped into 13 food categories. The data set, however, does not contain information on food prices or quantities of food consumed. Price data from the Ministry of Commerce were introduced exogenously into the data set. They are monthly averages by five regions. As only prices of major food items are available, about 40 food items are selected, which are common in the Thai diet and are well distributed among the 13 food groups.

Expenditure data are divided by price data to obtain the quantities of food consumed. To determine the calorie intake from each food item, the quantities are multiplied by calorie conversion factors.[88]

The SES data set also contains information on total food expenditures by the 13 food groups (T_i; i = 1, . . . , 13).

Let

E_i = the sum of expenditures for the selected food items in food group i, and

C_i = the sum of calorie intake of the selected food items in food group i.

Assuming that calorie prices of food items that were not selected (because prices were unavailable) are the same as average calorie prices of the selected food items in the same food group, one can extrapolate the amount of calorie intake from each of the 13 food groups (K_i):

$$K_i = (T_i/E_i) \times C_i. \qquad (22)$$

Hence, the total household calorie intake in the survey week can be derived as

$$\sum_{i=1}^{13} K_i.$$

[88] The calorie conversion factors were obtained from these sources: Thailand, Office of the National Economic and Social Development Board, Subcommittee on Food and Nutrition, *Report for the National Plan on Food and Nutrition, 1977-81* (Bangkok: NESDB, 1977), pp. 97-102 (in Thai); Food and Agriculture Organization of the United Nations, *Food Composition Table for Use in East Asia* (Rome: FAO, 1972); and U.S. Department of Agriculture, Agricultural Research Service, *Composition of Foods--Raw, Processed, Prepared*, Agriculture Handbook 8 (Washington, D.C.: USDA, 1975); and U.S. Department of Agriculture, Agricultural Research Service, *Nutritive Value of American Foods, in Common Units*, Agriculture Handbook 456 (Washington, D.C.: USDA, 1975).

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