AN ABSTRACT OF THE THESIS OF

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Title DEMAND ANALYSIS OF RICE IN THAILAND

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Rice has been an important integral part of the economy of Thailand for centuries. Not only is rice the staple diet of the people but it also provides the major part of export earnings as well. Since economic development is stressed in Thailand, a demand study of rice is appropriate, especially domestic demand, in order to aid in determining a sound agricultural development plan.

The purposes of this study were: (1) to examine the trend in rice production, (2) to investigate the factors affecting the domestic demand for rice, (3) to consider the relative importance of rice to economic growth, and (4) to project future domestic demand for rice.

In the past decade the trend in annual rice consumption per capita has varied from 108 to 137 kilograms with no apparent trend although there has been some decline in the past three years. Change in the price of rice and income of consumers do not have a significant effect on quantity of rice consumed. The very significant

factor that does affect the change in aggregate demand for rice is the growth of population which is at the rate of 3.2 percent. It is estimated that a change in one million population is associated with a change in the same direction of 170,000 tons for rice consumed. As for demand for other purposes in the country, demand for seed should remain stable because the farm land area is not expected to increase, while demand for miscellaneous uses will be an increasing trend.

Demand for export has varied from 1.0 to about 1.6 million metric tons during the last ten years. The major factor affecting the rice export volume is the production of the previous year. Price of rice in the world market and income of the importing countries seems to be next in importance.

The projected domestic demand in 1970, which is estimated at 8.80 million metric tons, combined with the amount of the average export in the last decade, which is 1.30 million metric tons (2.00 million metric tons on a paddy basis), means total requirement of 10.80 million metric tons. If production is maintained at the 1961 level which was 7.85 million metric tons, the supply of rice will fall short of total requirements by 2.95 million metric tons or 27.3 percent.

In the past several years rice production has not increased in proportion to the increase in the farm area. Therefore, ways and means must be found to meet increasing requirements by

increasing both production and productivity at the same time. Only in this way will there be enough rice for domestic use and for export which is essential to continued growth of the country.

An economic development plan needs to emphasize an increase in rice production which will help increase the growth rate of the GNP and, of course, increase the income to farmers.

DEMAND ANALYSIS OF RICE IN THAILAND

by

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DEMAND ANALYSIS OF RICE IN THAILAND

CHAPTER I

INTRODUCTION

Rice is characterized as a grain that has world-wide acceptance as a staple food, especially in the Far East where rice is the preferred cereal. Because of suitable climatic conditions, rice has been grown in Thailand for centuries, and has become the main diet of the people. Even though Thailand might have had a surplus of rice in earlier years, it was not until about 1855 that rice started to be exported and since then has become the leading export (10, p. 41). At the present, rice plays two important roles, one as the main diet for a rapidly increasing population and the other as the major source of foreign exchange earnings.

Problems

The study of demand for food or any specific major crop is important for agricultural countries, especially the developing countries. Demand studies will provide a better idea for setting agricultural policies to suit economic development plans. Since rice is the most important crop in Thailand, from all aspects, the plan for rapid economic growth would not have been possible without

considering rice. Many programs and plans have been set for rice such as in production, yield, planting areas, and goals for export. A multi-purpose dam is in construction in the Central Region which is the major rice growing area. Irrigation and flood control is one of the purposes in building this dam. After completion of the dam, it is hoped that the irrigated land will be able to produce two crops per year. Hence, rice production will increase greatly.

It is felt that an attempt should be made to study the domestic demand for rice and use this information in arriving at probable solutions. The surplus of rice can then be estimated so that policies for exportation and for alternate crops can be established. This study will try to explain the nature of demand for rice, especially domestic demand. It is hoped that this study will be of some use as a supplement to other information used in development plans. Also, it is hoped that the study might stimulate the same type of study with some other major crops. Planning programs in Thailand will become more operative as more facts become available to use in designing programs.

Purpose of Study

1. To examine the trend in rice production.
2. To investigate the factors affecting the domestic demand for rice.

3. To consider the relative importance of rice to economic growth.

4. To project future domestic demand for rice.

Scope and Limitations

In many publications the term "rice" and "paddy" are used in rather confusing ways. Sometimes the term "rice" is used both for the producer and the consumer levels; sometimes the term "paddy" is used for the producer level and "rice" or "milled rice" for the consumer level. In this study both terms will be used. It should be kept in mind that when "rice" is mentioned at the producer level, it means on a paddy basis and when referred to at the marketing or consumer level, it will mean "milled rice."

There are two major kinds of rice, ordinary and glutinous. While ordinary rice is grown mostly in the Central Region, the main parts of the North and North Eastern Regions are devoted to glutinous rice production. In 1959, it was found that out of total rice production, 65 percent was ordinary rice, and the remaining 35 percent was glutinous. If the different regions are examined it is found that, three-fourth of the total ordinary rice production was in the Central Region. As for glutinous rice, 60 percent was produced in the North Eastern Region, and 30 percent was produced in the North (23, p. 23-24). In this study the term "rice" is used for both ordinary

and glutinous rice. This is so because of the lack of separate data for glutinous rice and also because price fluctuations have no effect on the change in growing patterns in the above two mentioned regions, since the main purpose for growing glutinous rice is largely for home consumption. (A map showing the different regions of rice production in Thailand is shown in Appendix Figure 1.)

For better understanding, the different terms used in this study are now summarized in some detail (8, p. 410-411).

> Rough Rice or Paddy, defined as rice in the husk after threshing. At present the term "paddy" is used in Burma, India, Ceylon, Thailand and Indo-China; "padi" in Japan, Korea and most of the Western Hemisphere; "gabah" in Indo-China and "kwo" in China.
>
> Milled Rice, defined as rice from which the husk germs and bran layers have been substantially removed by power machinery. This is known as "polished rice" in the Western Hemisphere. Rice is milled to various degrees, if milled to a high degree it is generally called "white rice."
>
> Glutinous Rice, a type of rice which, after cooking, has a peculiar stickiness regardless of how it is cooked. It can be milled to various degrees or home pounded in the same way as ordinary rice and will then be called glutinous milled, glutinous home-pounded rice, etc.

Since rain fall is still the main source of water supply rather than irrigation, the planting season starts in May and lasts until June. The harvesting period begins in November or December. The difference in planting time depends on the varieties of rice

used.[1] The new crop is usually purchased sometime in the first three months of the next year. Therefore, when referring to the crop year, two calendar years will be used.

In one study concerning the demand for rice, the demand equation is set up so that price is the dependent variable. It was found that price of rice in general is highly associated with change in production and income.[2] Even though this study is based on 1922 to 1938 data, it still gives some idea as to the characteristics of demand. In this study only the demand for rice in Thailand will be emphasized both on a per capita and aggregate basis. Obviously, since rice is the main diet, consumption will be set as the dependent variable, rather than price.

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[1] From the survey in the Central Region, it is found that there are more than 450 varieties of rice grown, but there are only about 37 varieties that are commonly used (16, p. 114, 122-128).

[2] (14, p. 7-9) Mehren and Thuroezy found that this analysis for demand equation from 1922 to 1938 is:

$$X_1 = 607.85 - \underset{(4.21)}{0.66X_2} + \underset{(3.12)}{1.18X_3}$$

Where $\overline{R} = 0.81$

X_1 = Actual price (pence per pound--London price).

X_2 = World supply (1,000,000 quintals).

X_3 = Income index based on three largest rice consuming countries in Asia. (1925-1929 = 100)

The numbers in parenthesis are t-ratios.

CHAPTER II

RICE PRODUCTION

Before considering the demand for rice in Thailand, it is of some value to examine rice production in general. Therefore, this chapter will briefly examine the trend in rice production, with emphasis mostly on planted area, production and yield. Table 1 shows the rice farm area, planted area, production and yield from 1907 to 1961. By observing the past production to some extent, it is possible to determine the trend in the future.

Area of Production

Rice Farm Area

With total area of about 321 million rai,[1] Thailand has almost one-fifth or about 64 million rai in land holdings. Of total land holdings, about 56 million rai or 88 percent is under cultivation; about 5 million rai, or about eight percent, under farm woodland, the remaining 3 million rai, or six percent, is miscellaneous. From the total cultivated land of 56 million rai, about 38 million rai, or

[1] One rai is equal to 0.395 acres.

Table 1. Rice farm area, planted area, production and yield, Thailand, 1907 to 1961. [1]

Year	Farm area	Planted area	Production	Yield
	---1,000 rai---		1,000 tons	kg/rai
1907-16	-[2]	11,389	3,047	279
1917-26	-	15,953	4,024	289
1927-36	24,716	19,697	4,404	261
1937-46	28,880	24,031	4,602	224
1947-48	34,914	30,156	5,506	205
1948-49	36,454	32,573	6,835	222
1949-50	37,782	32,926	6,684	215
1950-51	38,507	34,625	6,782	205
1951-52	39,183	37,245	7,325	204
1952-53	39,645	33,551	6,602	206
1953-54	40,480	38,575	8,239	222
1954-55	41,377	34,732	5,709	202
1955-56	40,215	36,060	7,334	218
1956-57	40,968	37,648	8,297	230
1957-58	41,765	37,717	5,570	208
1958-59	41,954	36,329	7,186	221
1959-60	42,694	38,217	7,035	213
1960-61	43,694	37,107	7,789	220
1961-62	43,738	37,948	7,845	222

[1]Preliminary.

[2]Not available.

Source: (24, p. 37).

67 percent, in 1961, was planted to rice, while the remaining area was devoted to rubber, coconut, fruit trees and other upland crops (24, p. 153-154).

As rice is the staple food of the Thai people, rice farm area predominated the total land use from the early days. Not until the beginning of the Twentieth Century did the farming area show a rapid increase (10, p. 44). Such considerable increase stemmed from the need of rice for domestic consumption and export as well as from the availability of fertile land. After the 1949-1950 period, rice farm area still increased, but at a decreasing rate. The area expanded from about 39 million rai in 1950-1951 to nearly 44 million rai in 1961-1962. In the other words, the area increased only 5 million rai within 12 years (24, p. 37; 2, p. 37-39).

Applying simple regression analysis to compare the expansion of rice farm area between the above two periods, the annual increase in rice farm area is easily determined.

(1) $\hat{Y} = 22.95 + .97X^{1}$

$r = .98$

$r^2 = .97$

$S_y = .79$

---

[1] Significant at the one percent level.

where X = years from 1927-36 to 1949-50.

$\hat{Y}$ = total amount of rice farm area in millions of rai.

(2) $\hat{Y} = 38.26 + .45X$[1]

$r = .96$

$r^2 = .93$

$S_y = .46$

where X = years from 1950-51 to 1961-62.

$\hat{Y}$ = total amount of rice farm area in millions of rai.

From the above two equations, it can be seen that the rice farm area has increased all through both periods, but the annual increase is less in 1950-51 to 1961-62. The rice farm area is shown in Figure 1 (page 12).

Planted Area

With regard to the trend in planting area of rice, it is separated into two periods and compared. The two periods are from 1907-16 to 1949-50, and 1950-51 to 1961-62. During the first period, planting area increased rather rapidly from 11 million rai in average of 1907-16 to nearly 33 million rai in 1949-50. Such a rapid increase is due to the availability of arable land, and the increase in demand for rice both for domestic consumption and for export. Even in this

[1] Significant at the one percent level.

early period rice was one of the main sources of export earnings (10, p. 36-37). In the second period, the planting area had expanded and reached a maximum of nearly 39 million rai in 1953-54. After that year there is no evidence to show that the planting area has increased.

From a regional point of view, the expansion in rice farm area before 1948-49, was largely confined in the Central Region. After 1949-50, the expansion has occurred mostly in the North Eastern Region (24, p. 39; 2, p. 48).

The increase of planting area between these two periods is shown by means of simple regression analysis in the following equations:

(1) $\hat{Y} = 14.85 + 1.07X$[1]

$r = .91$

$r^2 = .83$

$S_y = 2.41$

where X = years from average 1907-16 to 1949-50.

$\hat{Y}$ = total number of rice planting area in millions of rai.

(2) $\hat{Y} = 35.02 + .17X$[2]

$r = .30$

$r^2 = .09$

---

[1]Significant at the one percent level.

[2]Not significant.

$S_y = 2.10$

where X = years from 1950-51 to 1961-62.

$\hat{Y}$ = total number of rice planting area in millions of rai.

The above equations show that the rice planting area significantly expanded before 1949-50. During the period 1949-50 to 1961-62 there is no significant increase in planting area. Equation (2) shows a slightly increasing trend, but it is not statistically significant. The rice planting area during 1950-51 to 1961-62 is also shown in Figure 1.

Figure 1 shows the comparison between rice farm area and rice planting area, which indicates that planted area is not increasing although total farming area shows an upward trend. This is due largely to one factor, which is that the expanded farm area which has occurred mostly in the past decade was not suitable for continuous rice growing. This land can be cultivated for one or two seasons and then starts to deteriorate. It was estimated that such land, which lies unproductive, constitutes a large portion of the rice farm area. During the 1950's, this kind of land accounted for nearly 5 million rai annually. The waste land tends to increase as rice farm area expands; especially in the North-Eastern Region, where about 75 percent of total waste rice farm area of the kingdom exists (23, p. 18-19).

Figure 1. Rice farm area and planted area, Thailand, 1950-51 to 1961-62.

Source: (24, p. 37-38).

Rice Production

Rice production depends on area of production and yield per rai. This section will briefly analyze the trend of rice production in the past. Rice production has increased as the planting area increased. During the average 1907-16 to 1949-50 period, rice production increased substantially, from about 3 million metric tons to 7 million metric tons. The annual production fluctuated according to weather conditions, but in general, the production trend was increasing during this period. After 1949-50, rice production seems to be relatively stable. It did not increase, even though the planted area has expanded slightly.

The following simple regression analysis indicates the increase in rice production between 1907-16 to 1949-50 and 1950-51 to 1961-62.

(1) $\hat{Y} = 3.59 + .14X$[1]

$r = .67$

$r^2 = .46$

$S_y = .77$

where X = years from average 1907-16 to 1949-50.

$\hat{Y}$ = annual rice production in million metric tons.

---

[1] Significant at the one percent level.

(2) $\hat{Y} = 6.82 + .05X^{1}$

$r = .20$

$r^2 = .04$

$S_y = .90$

where X = years from 1950-51 to 1961-62.

$\hat{Y}$ = annual rice production in million metric tons.

The above two equations place in focus the increasing trend in rice production before and after 1949-50. From the beginning of this century up to 1949-50, rice production increased substantially, due to the fact that there was the great expansion in planting area. This increase averaged .14 million metric tons per year. The other important factor is that the yield per rai was rather high during those early years. An expansion in area coupled with favorable yield per rai, gave significant annual production increases. After 1949-50 up to date, rice production increased slightly (.05 million metric tons per year) or tended to be stable. Even though the rice planting area increased over the period this change was offset by a decline in yield per rai.

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[1] Not significant.

Yield Per Rai

Finally, for a better understanding of rice production it is appropriate to consider yield of rice per rai. The available data show the annual average yield during 1907 to 1916 was 279 kilograms[1] per rai, and 289 kilograms during 1917 to 1926. After this period yield per rai showed a substantial decline; that is 243 kilograms in 1940-41 and dropped to 201 kilograms in 1945-46. After 1949-50, yield per rai declined slightly but the trend was a little upward after 1955-56. The following two simple regression equations show the change in yield per rai between the period of 1907-16 to 1949-50, and 1950-51 to 1961-62.

(1) $\hat{Y} = 272.59 - 4.78X^{2}$

$r = -.86$

$r^{2} = .73$

$S_{y} = 14.19$

where X = years from average 1907-16 to 1949-50.

$\hat{Y}$ = annual average yeild per rai in kilograms.

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[1] One kilogram is equal to 2.2046 pounds.

[2] Significant at the one percent level.

(2) $\hat{Y} = 205.05 + 1.41X^{1}$

$r = .56$

$r^2 = .32$

$S_y = 7.9$

where X = years from 1950-51 to 1961-62.

$\hat{Y}$ = annual average yield per rai in kilograms.

The above equations show that during the first period, the yield per rai decrease significantly. On the other hand, in the latter period, the analysis showed a slight increase, but was not statistically significant. In short, the yield in the last period can be considered as stable, the differences existing can be classified as random and thus are of no real significance.

The fluctuations in some years were mainly due to natural causes. During the 1943-44 to 1944-45 and 1956-57 to 1957-58 periods when the yield dropped from 222 kilograms to 202 and from 230 kilograms to 208 respectively, were the result of drought (23, p. 13). The general declining trend of yield on the other hand, was largely due to the lack of fertility of the soil. The present level of fertility of rice farm soil is comparatively low because of the continuous exploitation of land for a long period of time resulting in loss of nearly all fertility in some cases. The lack of soil nutrients year

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[1] Not significant.

after year is sure to have considerable effect on the yield of rice. The other factor that effects the yield per rai, is an expansion of rice planting area bringing under cultivation the relatively unproductive land of the country. This was especially true in the North-Eastern Region which experienced much expansion in planting area during that last ten years. The nature of the soil in this region is porous and sandy, being unsuited for planting rice which needs a sticky clay soil. The yield per rai in this region is the lowest in the kingdom. In 1959, yield per rai in the Northern, Central and Southern Regions were 318, 234, and 242 kilograms respectively, but in the North-Eastern Region the yield was only 149 kilograms (23, p. 30).

Compared to other Asian rice producing countries, the yield of Thailand rice producers has been exceedingly low. A scarcity of suitable land and primitive methods of cultivation, (using little technological development such as better seed, fertilization, insecticide, pesticide) account to a large measure for low yields (16, p. 112). Yields in Thailand have been only about one-third of the yield in Japan, about one-half of the yield in Taiwan, and less than those of Burma, Pakistan, and India (2, p. 40). Even though yield of rice per rai is rather low, statistics available show that Thailand has always had surplus to export.

Summary

Figure 2 summarizes the trend in area of production, production and yield per rai. The principle conclusions are:

(1) Even though the rice farm area showed a slight increase, the planting area has been relatively stable since 1950-51, mainly because of a lack of fertile land suitable for rice growing.

(2) Rice production, apart from the highest peak in 1953-54 and 1956-59, was relatively stable, and did not show a significant increase.

(3) Yield per rai has been declining through the entire period, the rate of decline decreasing and becoming insignificant during the last few years.

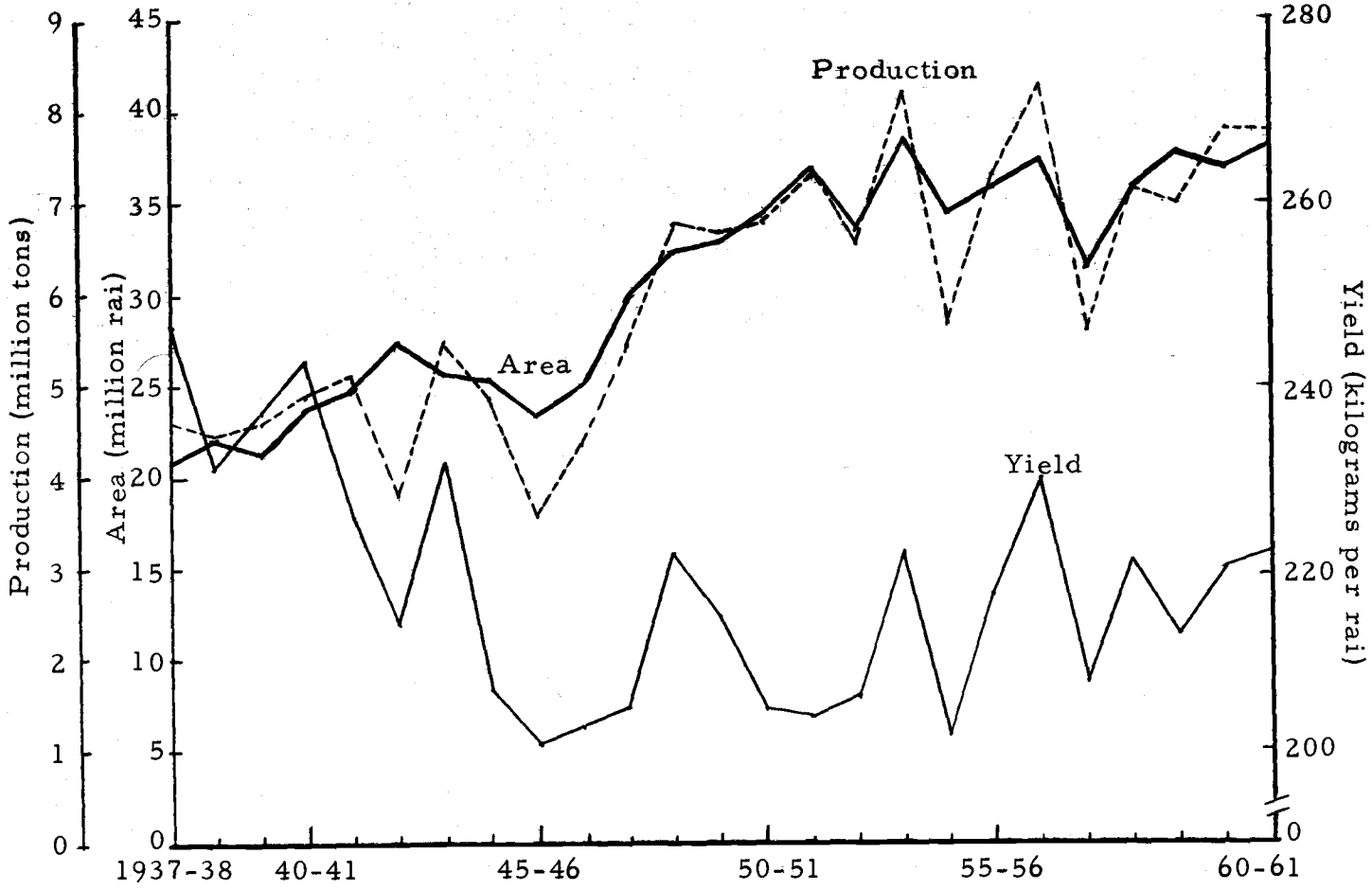

Figure 2. Area production and yield of rice, Thailand, 1937-38 to 1961-62.

Source: (24, p. 37).

CHAPTER III

DEMAND FOR RICE

This chapter will deal with the demand for rice in Thailand. The main emphasis will be on domestic demand which includes both consumption and the demand for other uses. Factors affecting domestic demand will be identified and discussed in detail. Also this chapter will briefly deal with the trend in demand for export. Before considering the various aspects of demand, it is appropriate to define the term "disappearance."

Total Domestic Disappearance

"Rice" and "meal" in Thai language are synonymous because rice is the only stable food in Thailand. Besides human food, rice is used for animal feed and for manufacturing. Rice or paddy used for seed is also a major outlet in Thailand as well as in other rice producing countries. The other disappearance was loss and waste. Since there is no exact data concerning this, only an approximation could be made.[1]

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[1] FAO estimated that the use of rice for seed loss and waste accounted for between five to ten percent of the crop on a paddy basis (4, p. 28).

Rice for consumption, seed, industrial use, animal feed, and loss and waste constitute the total domestic disappearance in Thailand. Domestic disappearance accounts for a large percentage of annual total production and becomes larger and larger from year to year. The average domestic disappearance was 54 percent during 1947-48 to 1951-52, 70 percent in 1952-53 to 1956-57, and rose to 77 percent during 1957-58 to 1961-62. The total amount was 4 million metric tons (paddy) in 1947-48 and increased to 5 million metric tons in 1954-55 and was above 6 million metric tons in 1959-60. Total domestic disappearance of rice (paddy basis) from 1947-48 to 1961-62 is shown in Figure 3.

Demand for Consumption

Theoretically, demand for a particular commodity can be defined as "the various quantities of it which consumers will take off the market at all possible alternative prices, other things equal" (12, p. 27). If the amount of the commodity demanded in the market is denoted by x, and the price of commodity is denoted by p; we can express in the form of a functional relationship the dependence of x upon p. It can be written:

$$x = d(p)$$

Actually, the quantity demand that the consumers will take

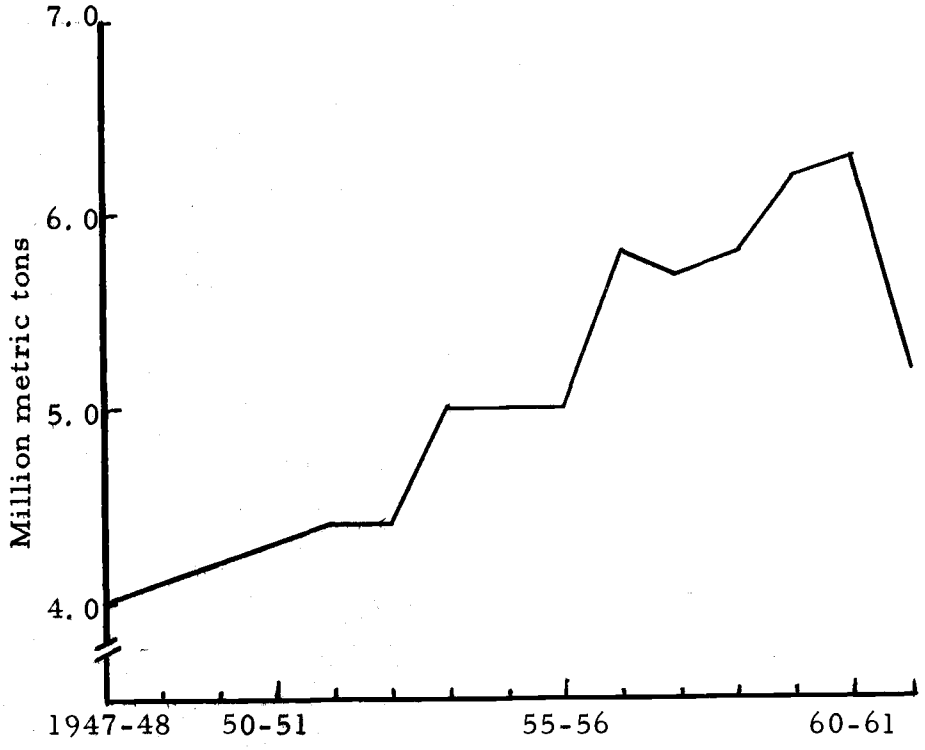

Figure 3. Total domestic disappearance of rice (paddy basis), Thailand, 1947-48 to 1961-62.

Source: Division of Agricultural Economics, Office of Secretary, Ministry of Agriculture.

off the market will be affected by a number of factors under different circumstances. Therefore, demand for a particular product can be represented as a function of several variables. Such variables include price of product, consumer's income, price of related goods, price of substitutes, and tastes and preferences. From the definition of demand, demand for a commodity at the per capita level can be expressed in the form of functional relationship as: (17, p. 55)

$$x_i = F(y_1, y_2 \ldots, y_n, R, t)$$

Where x_i is the quantity of the commodity demanded, y_1 is its price, $y_2 \ldots y_n$ are the other prices or influential factors. R is the size and distribution of income, and t is the time period.

In considering domestic demand for rice, two main topics will be discussed: (1) the demand for consumption, and (2) the demand for other uses. Domestic consumption will be examined on the basis of both per capita demand and aggregate demand for rice. The factors influencing demand will be evaluated in some detail.

Trend in Rice Consumption Per Capita

Since there have been no regular surveys conducted on rice consumption in Thailand, the available data concerning rice consumption has been obtained by calculating the difference between production and the adjusted data for quantities exported, the amount used for

seed, and the amount of losses. This method provides approximate data of total rice consumption in Thailand. Although this is a rough estimate it still indicates the general trend in rice consumption. Hence, the data in Table 2 show the gross supply of rice available for consumption rather than the quantities actually consumed.

Table 2. Total rice consumption and rice consumed per capita, Thailand, 1948 to 1961. [1]

Year	Total[2]	Per capita[3]
	1,000 metric tons	kilograms
1948	2,315	129.1
1949	2,359	128.8
1950	2,403	121.5
1951	2,449	120.3
1952	2,495	119.2
1953	2,798	130.0
1954	2,850	128.8
1955	2,904	129.4
1956	3,203	136.8
1957	3,287	136.5
1958	3,380	136.5
1959	2,909	114.0
1960	3,016	114.9
1961	2,933	107.9

[1]Preliminary.

Source: [2]Division of Agricultural Economics, Office of Secretary, Ministry of Agriculture.

[3]Column 2 divided by total population.

From this table it is shown that the annual disappearance may be considered as the demand for consumption from 1948 to 1961. The trend of rice consumption was observed as a steady increase, that is from 2.32 million metric tons in 1948 to 3.38 million metric tons in 1958.

The total consumption declined slightly to 2.91 million metric tons between 1958 and 1959 and was 2.93 million metric tons in 1961. Considering the entire period from 1948 to 1961, the rate of increase in annual consumption can be expressed in the form of the simple regression equation which follows:

$$\hat{Y} = 2.28 + .07X^{1}$$

$$r = .82$$

$$r^2 = .67$$

$$S_y = .20$$

Where X = years from 1948 to 1961.

$\hat{Y}$ = annual demand for consumption of milled rice in millions of metric tons.

The above equation shows that the trend of the total demand for consumption in the whole country increased significantly during the period 1948 to 1961. This trend is shown in graphic form in Figure 4.

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[1] Significant at the one percent level.

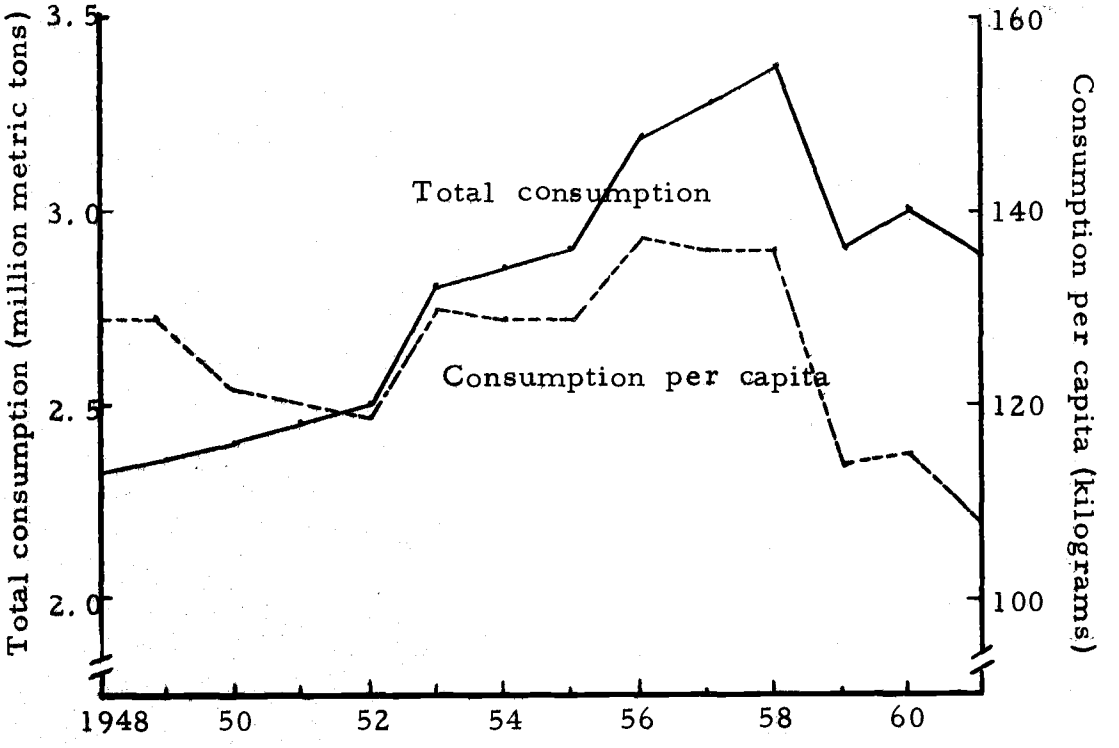

Figure 4. Total rice consumption and rice consumed per capita, Thailand, 1948 to 1961.

Source: Table 2.

The quantity of rice consumed per capita is calculated by dividing total rice available for consumption by total population. This gives a rough idea of the quantity consumed per capita. Since there has been no actual survey, the available data shows a discrepancy in amount consumed per capita. The Ministry of Agriculture has estimated that about 132 kilograms were consumed per capita annually in Thailand (19, p. 8). The FAO has estimated about 146 kilograms per capita per year for the Far East (6, p. 27), and as for Thailand it was estimated that per capita consumption was 101 kilograms on the average in 1934-38, 134 kilograms in 1948-52, and the highest, 176 kilograms in 1956-57 (4, p. 29). All these data and the data in Table 2 give some estimation of rice consumption per capita of the Thai people. It can be seen that there is considerable variation.

According to Table 2, rice consumption per capita was about 129 kilograms in 1948, and showed a slight increase year after year, reaching the highest amount in 1959 of nearly 137 kilograms. After 1956, the trend showed a slight decline. The over-all trend during this later period can be illustrated by the simple regression analysis which follows:

$\hat{Y} = 129.79 - .60X^1$

$r = -.27$

$r^2 = .07$

$S_y = 9.11$

Where X = years from 1948 to 1961.

$\hat{Y}$ = rice consumption per capita in kilograms.

The equation shows that during the period 1948 to 1961, there was a slight decline in trend of rice consumption per capita, but such a decline was not of statistical significance. We can conclude that the amount of rice consumption per capita was relatively stable during 1948 to 1961. This trend is also shown in Figure 4.

Factors Affecting Rice Consumption Per Capita

In most studies of demand, price and disposable income are almost invariably included as factors influencing consumption of a commodity. In addition to price and income, however, there are other factors that affect consumption of a particular product, such as price of substitutes and complementary products, and tastes and preferences. For the analysis of rice consumption per capita, a single demand equation was derived based on the assumption that the per capita consumption of rice in Thailand was a function of the

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[1] Not significant.

change in relative price for rice and the real income of consumers. The relationship can be shown in the functional equation as follows:

(1) $$\left[\frac{Q_t}{N_t}\right] = f\left[(P_t)\left(\frac{Y_t}{N_t}\right)\right]$$

Where $\frac{Q_t}{N_t}$ = rice consumption per capita.

P_t = retail price of rice.

$\frac{Y_t}{N_t}$ = per capita disposable income.

(2) $$\left[\frac{Q_t}{N_t}\right] = f\left[\left(\frac{P_t}{P_{o_t}}\right)\left(\frac{Y_t}{N_t P_{y_t}}\right)\right]$$

Where $\frac{Q_t}{N_t}$ = rice consumption per capita.

$\frac{P_t}{P_{o_t}}$ = deflated retail price of rice.

$\frac{Y_t}{N_t, P_{y_t}}$ = deflated per capita disposable income.

The above derived demand function shows the relative or proportionate relationship among the variables. The data to be used covers the years 1948 to 1961. The original multiple regression equations are described as:

$$Y = a_1 + a_2 X_{1_t} + a_3 X_{2_t} + U_t$$

Where Y = rice consumption per capita during 1948 to 1961.

a_1 = constant term

X_{1_t} = price of rice in specific year from 1948 to 1961.

X_{2_t} = disposable income in specific year from 1948 to 1961.

a_2, a_3 = parameters to be estimated by the partial regression coefficients.

U_t = error term.

From the above multiple regression model, the following regression equation and statistical coefficients were obtained. Numbers in parenthesis beneath the regression coefficients are the values of the t-ratios:

(1) $$\hat{Y} = 117.846 + \underset{(1.00)^1}{.391X_{1_t}} - \underset{(-1.66)^1}{.019X_{2_t}}$$

$R = .45$

$R^2 = .20$

$Sy.x = 8.84$

The regression equation in deflated price terms was:

(2) $$\hat{Y} = 115.237 + \underset{(1.29)^1}{.374X_{1_t}} - \underset{(-1.58)^1}{.016X_{2_t}}$$

$R = .44$

$R^2 = .19$

$Sy.x = 8.93$

The results of the equations can be explained as follows:

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[1]Not significant.

(1) There is no significant relationship between price and income variable and the per capita consumption of rice in Thailand when data for the 1948-61 period were used. The fluctuations in rice consumption or declining trend from 1948 to 1961 can not be explained by these two variables. Increases in prices or income have no significant effect on rice consumption per capita. (The wholesale price of rice, paddy and per capita income is shown in Appendix Table 1.) Therefore, the rice consumption trend, which is declining slightly must be caused by other factors.

(2) Even through the variables included in the equations had no significant effect on rice consumption, the positive or negative sign of the regression coefficients give some idea of rice consumption. The positive sign of the price variable, even though not significant, points out that a slight change in price will not have any effect on the quantity consumed since rice is the stable food of the Thai people. In considering the income variable as it relates to rice consumption, the negative sign indicates that when income increases, consumers will tend to decrease their consumption of rice. In short, rice may be an inferior product in Thailand.

Price and Rice Consumption: The above two equations indicate that price has no significant relationship with rice consumption per capita. In other words, change in price of rice will not affect the quantity consumed. FAO's Commodity Report (4, p. 31) states that in the low income countries where the level of rice consumption per capita is not yet satisfied, even relatively small changes in price can be an important influence on consumption. A fall in price, however, has a more direct effect on the quantity purchased than a price increase. This statement is not really applicable to Thailand, even though it is a low income country, because rice is always abundant. Therefore, the only effect caused by a price change is on quality of the rice purchased.

Income and Rice Consumption: Theoretically, when incomes increase, consumers will spend more money for consumption on the assumption that other conditions remain unchanged. When incomes rise, consumption can be expected to rise more or less in proportion to such increase (7, p. 90-94). There is a rather constant relationship between the size of consumers' incomes and the amount they spend for food. From household budget studies it is revealed that in the consumption-income patterns of most families,

consumption functions were different among different income levels (7, p. 96-97).[1]

There is no study on food expenditure in Thailand such as those made in the United States. From the study of Rice Farmers in Nakorn Pathom Province,[2] it was found that about 37 percent of total income was spent for food (19, p. 9). Also the percentage of expenditure to income was different among different income levels.

The income elasticity, which we can define as the "percentage change in expenditure divided by the percentage change in income assuming no change in prices" (9, p. 83), is different from country to country, and from product to product. The most important implication arising out of the analysis of income elasticity is that (9, p. 84):

> When there are increases in real income, the demand for meats, some dairy products, and more expensive fruits and vegetables will increase more than the demand for cereals and some of the cheaper fruits and vegetables.

The above statement is true in many countries, that is, the income elasticities of rice or other cereal products are relatively

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[1] In the United States the percentage of food expenditure to total income amounts to about 40 percent in the lowest income group and about 20 percent is spent for food in the highest income group. For the population as a whole in the United States, about 25 percent of the total income is spent on food (9, p. 82).

[2] One of the 35 provinces in the Central Region which is primarily a rice planting area.

low or even become negative when compared to meat and diary products. That is, when income increases, consumption in cereal products tends to decline. From the surveys on food expenditures in Japan during 1951 to 1955, it was shown that income elasticities for wheat and barley were negative and about zero for rice (19, p. 10).

Income elasticities of demand for rice are different even in those countries where rice is a stable food. From FAO's study, it was revealed that among rice consumption countries, income elasticity of demand can be divided into three groups: (1) those with an income elasticity of demand estimated at approximately 0. 5 (Ceylon, Hong Kong, India, Indonesia, Pakistan, and the Latin American Region); (2) an income elasticity of 0. 75 (Africa and the Near East Region); and (3) an income elasticity of zero (all other countries including Thailand) (5, p. 32).

In some rice importing countries where rice is a stable food, it was estimated that every two percent improvement in real income per capita is probably accompanied by an additional one percent in the expenditure for rice. On the other hand among Asian exporters (excluding mainland China) as well as in Japan, Malaya, Singapore, and the Philippines, demand for rice is believed to be generally satisfied already. An increase in expenditure on rice

would probably be associated with the purchase of better grades (5, p. 32-33).

With regard to income elasticity of rice in Thailand, it seems reasonable to expect that it is about zero or even slightly negative. As a consumer's income increases from very low levels his consumption may increase considerably at first. However, as his income continues to increase, the increase in consumption becomes less in proportion to the increase in income. This type of consumption is known as Engel's consumer curve for a commodity (12, p. 83-86).

Change in Pattern of Consumption: Even though rice is still maintaining the role of stable food and there has been no rapid change in the consumption pattern in Thailand, we can expect some change in consumption patterns in the future. It is evident that diets of poor nutritional quality are common in most of the less developed areas as indicated by the high percentage of calories derived from foods rich in carbohydrate and the small consumption of animal protein. This is due to an excessive dependence on cereals and starchy foods and to a low consumption of animal foods. In addition, consumption of other protective food such as fresh green and yellow vegetables and fruits are inadequate. These factors, together with the poor methods of food preparation, religious taboos, and traditional prejudices, are

responsible for the deficiency of good quality protein and of essential vitamins. It was estimated that the calorie supplies per capita in Thailand fall short of the requirements by about ten percent. Calorie intake in Thailand per day is about 2,050 and should be 2,300 (6, p. 37). Calorie supplies from vegetables and fruits, eggs, dairy products fall short about 50 percent of calorie requirements (11, p. 64). It is evident that there is serious and wide-spread malnutrition in Thailand.

Changes in dietary habits in Thailand can be expected but perhaps not rapidly. Such changes will take place as the result of education on nutritional improvement and the availability of sources of purchasing power. Therefore, with an improvement in income and education, the consumer will tend to use more animal products, vegetables and fruits, and less rice. Even though such changes can not be expected immediately, they will steadily occur in the future.

It is noticeable that during the last few years, there has been a significant change in consumption habits among the higher-income groups in the large cities in Thailand. More people tend to consume increasing quantities of breads or padies as substitutes for rice in some meals (especially for breakfast). This fact is supported by a noticeable increase in the numbers of bakeries and the

considerable increase in the import of wheat flour.[1] This change will, undoubtedly, affect rice consumption per capita in the future.

Factors Affecting Aggregate Demand

Aggregate demand at the consumption level is derived from the product of the estimated demand per capita and the corresponding population in any specific period. With reference to rice consumption per capita it has been shown that there is no statistical relationship between rice consumption and price or per capita income. Therefore, the only important factor which should be emphasized concerning aggregate demand for rice consumption is population.

In this section, the aspects of population which will be considered are growth rate and birth rate to death rate, both of which will effect population trends in the future.

Population Growth: The population of Thailand in the middle of 1947 was estimated to be 17.9 million, and had increased to 18.3 million in 1950, 22.1 million in 1955, and from the last census in 1960, the total population was up to 26.3 million. It was estimated that in the middle of 1961, Thailand had about 27.1 million people (24, p. 155; 10, p. 1). The rapid increase in population in Thailand can be easily

[1]The import of wheat flour increased from 10,946 tons in 1950 to 25,384 tons in 1961 (24, p. 124).

observed when considering the past. For example in 1911, the total population was only 8.3 million, and increased to 9.2, 11.5, and 14.5 million in 1919, 1929, and 1937 respectively (22, p. 46). Such increases can be readily observed when the annual growth rate of population is computed.[1] The following results were obtained:

Period	Annual Growth Rate (percent)
1919-1929	2.2
1929-1937	2.9
1937-1947	1.9
1947-1960	3.2

The above figures indicate that the annual growth rate increased considerably from period to period. During the period 1919 to 1929, when the population increased from 9.2 to 11.5 million, the annual growth rate was 2.2 percent. From 1929 to 1937 the annual

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[1] Barclay (1, p. 31) gave the method for calculated annual growth rate by:

$$\frac{P_2}{P_1} = (1 + r)^n$$

where P_1 = the number of people in the population census at the initial date.

P_2 = number of people at the later date.

r = the annual rate of growth.

n = the exact number of years between P_1 and P_2.

growth rate was 2. 9 percent but dropped to 1. 9 percent during 1937 to 1947 which was the period covering World War II. From 1947 to 1960, population increased from 17. 4 to 26. 3 million with the annual growth rate being 3. 2 percent.

Factors Affecting Population Growth: The rising rate of population growth in Thailand is not at all unusual. Such an increase is the general characteristic in underdeveloped countries, especially in Asia (except Japan) (31, p. 15). The two most important factors responsible for such increases are the differences between birth rates and death rates and immigration of aliens into the country.

Normally the population in any country will increase when the number of new-borns is greater than the number of deaths. Therefore, high birth rates and rapidly falling death rates account for the increasing rate of population increase. This is also true in Thailand. The birth rate increased rather steadily from 24 per 1, 000 in 1948 to about 34 and nearly 37 per 1, 000 in 1954 and 1958 respecitvely. The death rate trend also shows a steady decline from 11 per 1, 000 in 1948 to 9. 7 per 1, 000 in 1954 and still maintained this level in 1958. Therefore, the gap between the birth and death rates become larger and larger as shown in Table 3.

The cause of the rapid increase in birth rates and the rapid decline in death rates, is due to rapid improvement of the public

Table 3. Birth rate and death rate of population in Thailand, 1948 to 1958.

Year	Birth rate	Death rate
	--per thousand--	
1948	23.9	10.7
1949	27.8	10.5
1950	28.4	10.0
1951	29.3	10.3
1952	29.9	9.9
1953	31.1	9.4
1954	34.2	9.7
1955	34.2	9.2
1956	37.4	9.8
1957	36.9	10.4
1958	36.8	9.7

Source: (21, p. 74).

health, medical, and general health services, especially in the control of contagious diseases. However, it is not easy to say what the birth and death rate will be in the future, since there are economic and social problems involved. It is reasonable to believe that the trend of birth rate will increase at a decreasing rate. From studies in other Asian countries, it was found that the birth rate is related to living conditions, level of education attained, religion, occupation, and work status (31, p. 13-14). Therefore in the future, while it is hoped that the above mentioned situations will be improved, the birth rate will tend to decrease. From the FAO study, it was estimated that the birth rate in Thailand will be

relatively stable from 1960 to 1965, and will decline after this period (30, p. 11).

With regard to the death rate, although it has been gradually declining, it is believed that the rate will show a marked tendency to decline still further in the future. This is due to the increasing promotion of public health and medical development. It is believed that the death rate in Thailand will continue to decline considerably until 1970 and, after this period, the rate of decrease in the death rate will decline slowly (30, p. 9).

The other factor which increases population is immigration of aliens. With regard to Thailand, the strict limitation on immigrants quota has been in force since 1947 (30, p. 3). It can be concluded that the increasing rate of population growth after 1947 is largely the result of the birth rate being greater than the death rate. The number of immigrants is very small compared to the total increase in population.

Population Projection: To better estimate the demand for rice in the future, a population projection is necessary. First, the trend in population and the factors affecting the growth of population will be considered and then a population projection will be made.

According to Barclay (1, p. 231-232) the study of population growth has one specific practical application, which is to calculate

population trends of the future. These calculations are called by various names--future population, forecasts, extrapolations, estimates or projections. Any calculations of future population are by their nature hypothetical. In order to make a reliable estimate of the future, we need to predict future conditions affecting all the vital processes in population. At present this is not possible. Population projections, consist merely of extending some plausible growth pattern from the past into the future based upon certain assumptions.

There are three principal ways to proceed: (a) projecting the total amount of growth of a given period, (b) projecting on an observed rate of growth and (c) projecting the size of age and sex groups of the population independently. Since various sources of information are needed, which are not available for calculating methods (a) and (c), method (b) will be employed.

Barclay (7, p. 30-31) gave the procedures in projecting population which involve the following steps:

(1) Find the rate of growth for some known period or between two census period which can be found by the formula:

$$\frac{P_2}{P_1} = (1 + r)^n$$

(2) After we know values of r, P_1, and P_2, the estimated population, $\overline{P}$, is found either as:

$$\overline{P} = P_1 (1 + r)^{n_i}$$

or $$\overline{P} = P_1 e^{rn_i}$$

where P_1 = population of the latest census.

r = annual growth rate.

n_i = the exact number of years between the latest census and the project period.

From the above method, the population projection was calculated from 1963 to 1970, as shown in Table 4.

Table 4. Population projection, Thailand 1963 to 1970.

Year	Population projection
	--thousand--
1963	29,020
1964	29,902
1965	30,814
1966	31,751
1967	32,720
1968	34,054
1969	35,091
1970	36,160

Note: a) The n for calculating r was the period from May 23, 1947 to April 25, 1960.

b) The calculated r = 3.2.

The above population projection will only extend to some plausible growth figure since there are several factors affecting population growth in the future. These projection procedures must be based on various assumptions concerning birth and death rate; that is,

no major unexpected factors whether favorable or unfavorable upset the foreseeable trend of population growth.

Demand Predictive Model

This section will deal with the factors affecting aggregate demand for consumption in Thailand during a specific period. From the demand function of per capita consumption for rice, it was previously determined that price of rice and consumer's income have no effect on rice consumption. Therefore, to derive a demand function at the aggregate level, a population factor should be included. The demand function at the aggregate level can be expressed in the following function:

$$Q_t^D = f\left[(N_t)(P_t)\left(\frac{Y_t}{N_t}\right)\right]$$

where Q_t^D = total rice demand for consumption.

N_t = population.

P_t = retail price of rice.

$\frac{Y_t}{N_t}$ = per capita disposable income.

Multiple regression analysis was employed in order to show the relationship among variables. The original multiple regression model was:

$$\hat{Y} = a_1 + a_2X_{1_t} + a_3X_{2_t} + a_4X_{3_t} + U_t$$

where $\hat{Y}$ = Total consumption of rice in Thailand, from 1948 to 1961.

a_1 = constant term.

X_{1_t} = population in Thailand in specific year from 1948 to 1961.

X_{2_t} = price of rice in specific year from 1948 to 1961.

X_{3_t} = disposable income per capita from 1948 to 1961.

a_2, a_3, a_4 = parameters to be estimated by the partial regression coefficient.

U_t = error term.

Using the abbreviated Doolittle method for the simultaneous solution of linear equations, the following values were determined. Numbers in parenthesis beneath the regression coefficient were their value of t-ratio.

$$\hat{Y} = \underset{}{-.68} + \underset{(4.27)^1}{.17X_{1_t}} + \underset{(.22)^2}{.0013X_{2_t}} - \underset{(-.31)^2}{.00015X_{3_t}}$$

$R = .97$

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[1]Significant at the one percent level.

[2]Not significant.

$R^2 = .94$

$Sy.x = .132$

This equation indicates that about 94 percent of the change in annual rice consumption in Thailand is explained by these variables. Population is the only variable which has significant effect on domestic consumption demand within the country. That is, a change of one million population, considered by itself, is on the average accompanied by a change in the same direction of about 170,000 tons of rice for consumption demand in Thailand.

Price and income variables have no significant affect on total rice consumption. During the period covered, 1948 to 1961, a change in price or income was rather insensitive to the consumption pattern. Still the coefficient signs make it possible to arrive at some interesting conclusions. The plus sign for the price coefficient indicates that the price and quantity consumed tend to move in the same direction. That is, when the price of rice increases, people will buy more rice and vice versa. This can be explained according to the Giffen Paradox (20, p. 152-156). Since rice is the stable food, people compare their real income to the price of rice. Whenever the price of rice starts to increase, people believe their real income has dropped, and therefore, they need to buy more rice in order to compensate for other food products that they can not afford to buy. This

behavior is reversed when the price of rice declines. The minus sign attached to the disposable income coefficient indicates that rice is an inferior good and people would buy less rice if their income increased. However, both price and income variables are not statistically significant.

Demand for Rice for Other Purposes

This section will consider the trend in demand for rice which has been utilized for purposes other than human consumption. The major outlet for utilization of rice other than consumption is for seed, which was estimated to be about 13.6 to 14.8 kilograms per rai (16, p. 131). Therefore, the amount used for seeding depends upon the area of rice production and the amount of damaged area which required replanting. From 1948 to 1961 the trend of rice used for seeding was rather stable. The annual uses ranged from 304 thousand tons in 1957-58 to 562 thousand tons in 1961-62. The average annual use during the entire period was 436 thousand tons. These figures are shown in Table 5.

Utilization of rice for industrial uses, animal feed, and waste in Thailand show an increase through 1956, although the data are not available in all periods for each category. The utilization for animal feeds has increased considerably during the last decade

Table 5. Rice utilization for seed, and industry, animal feed and waste, Thailand, 1948 to 1961.[1]

Year	Total	Seed	Industry, animal feed and waste
		--thousand tons (paddy)--	
1948	589.0	482.1	106.9
1949	596.2	487.3	108.9
1950	623.4	512.5	110.9
1951	619.5	506.5	113.0
1952	571.5	456.3	115.2
1953	652.0	522.9	129.1
1954	621.2	489.6	131.6
1955	497.3	363.2	134.1
1956	858.0	358.9	499.1
1957	653.0	304.0	349.0
1958	611.0	344.0	267.0
1959	726.0	364.0	362.0
1960	667.0	349.0	318.0
1961	705.9	561.6	144.3

[1]Preliminary

Source: Division of Agricultural Economics, Office of Secretary, Ministry of Agriculture.

with the rapid increase in the poultry industry and other livestock. Only broken rice is used for feeding animals and poultry. The trend of feeding rice will show an increase as these industries expand. It is reasonable to believe that these industries will be developed further in the near future. As long as animal feed is not yet developed from other crops, the demand for rice for this purpose can be expected to increase.

No exact data of the rice used in industry are available, but a considerable amount is likely consumed annually. The major industries using rice are brewing, distilling, and starch manufacturing. It can be expected that rice consumption in distillery industries will be relatively stable, while starch manufacturing industries will show a slight increase in the future.

With regard to rice that has been lost and wasted annually, it can be predicted that these amounts will decline some in the future. The declining trend will be due to improvement in harvesting, drying, and handling methods used by the farmers and the rice dealers.

From this brief survey on demand of rice for other purposes, the following conclusions can be drawn:

(1) Utilization for seed will be relatively stable, unless there is an expansion in the area of production.

(2) Demand for animal feeds and industries will show a slight increase.

and (3) Losses and damage is expected to decline.

Demand for Export

Rice is not only the basic food in Thailand, but is also the largest source of foreign exchange earnings. Rice has had the

largest export value since it started to become an export commodity in the middle of the 19th century. Sometimes, Thailand has been referred to as a monoculture country because the growing of rice is so important and the economy has depended mainly upon this crop.

The volume of rice exported has increased rapidly since it became the major export commodity. From the available statistics it is shown that during 1857 to 1859 the volume of export was about 59 thousand metric tons. This amount had risen to 110 and 112 thousand metric tons in 1860-64 and 1870-74 respectively. The trend was doubled in 1875-79, when the amount of export jumped to 213 thousand metric tons, and again in 1890-94 when the average export reached the level of 435 thousand metric tons. In other words, the volume of rice export had quadrupled within 20 years. Rice exports increased to 668 and 886 thousand metric tons in the periods 1900-04 and 1905-09 respectively. The amount of rice export during the period 1920-24 reached one million metric tons (10, p. 38).

A major factor in the rapid increase in rice exports was a steady increase in demand for foreign exchange needed for the importation of other products. This rapid trend toward an exchange economy stimulated an expansion of rice production and changed rice production from the level of subsistence to a commercial activity of great importance.

During 1927 to 1948 the average annual export for the entire period was 1.47 million metric tons, ranging from a low of one million metric tons in 1930 to a high of two million metric tons in 1934 (2, p. 193-194). The export trend in this period was relatively stable with no significant changes occurring.

Three factors are responsible for export fluctuations: the annual production, demand from importing countries, and the price level in the world market. During World War II, rice exports dropped from a normal level of 1.2 million metric tons in 1940 to 1.1 million metric tons in 1941. Rice exports declined still further to 752, 310, and 195 thousand metric tons in 1942, 1944, and 1945 respectively. The export volume then increased to 803 thousand metric tons in 1948 and reached the normal level in 1949 which was after the end of the war (2, p. 196-202). The difficulties of shipping to the importing countries was not the only problem facing the rice exporter during the war. The decrease in rice production affected it as well.

Rice exports during 1949 to 1961, showed a slightly declining trend but it was not significant. The annual average export was 1.31 million metric tons and ranged from a low of one million metric tons in 1954, to a high of 1.58 million metric tons in 1961 (see Figure 5).

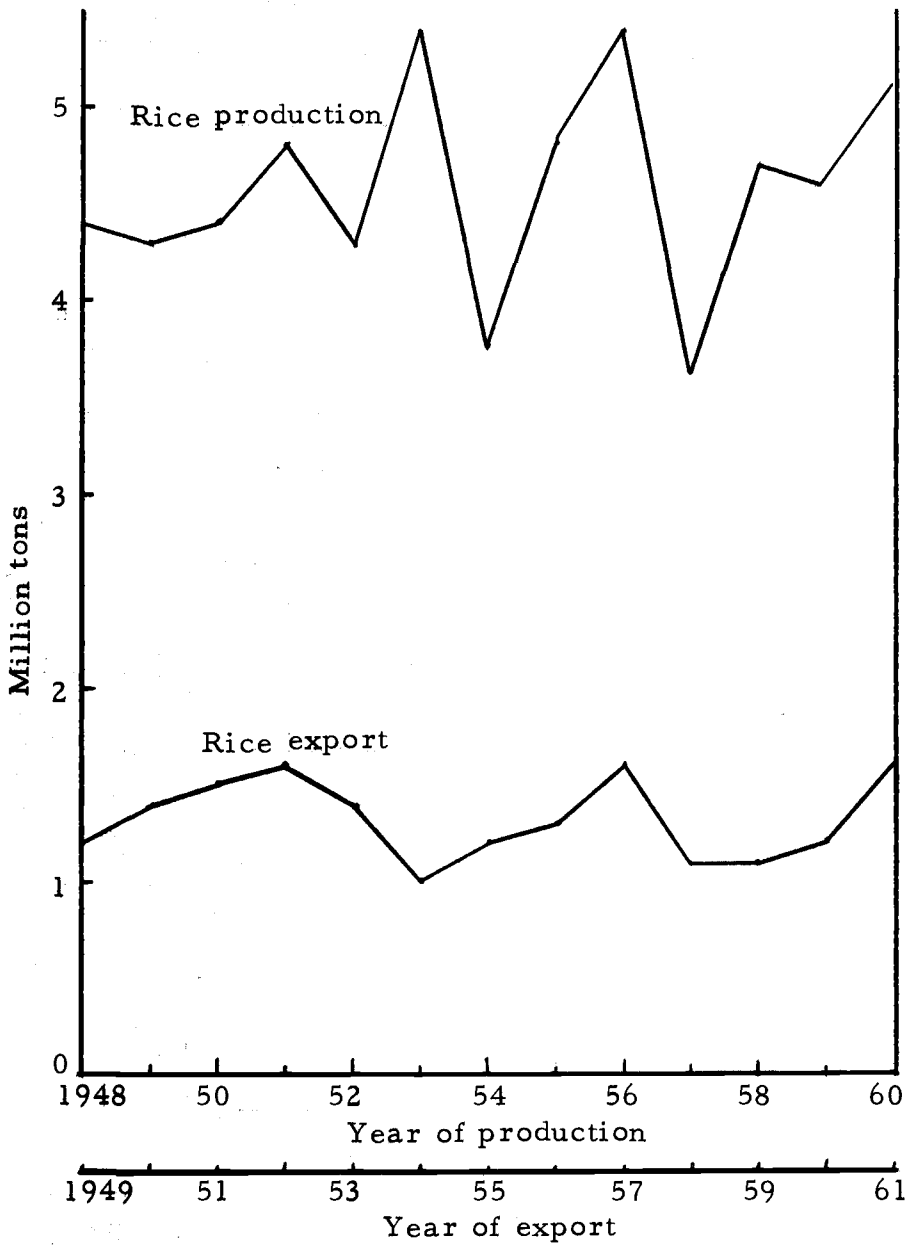

Figure 5. Rice production as compared to rice export of the next year, Thailand, 1948 to 1961.

Sources: (10, p. 38)
(24, p. 37--adjusted data, and 108).

Rice Export and Total Production

The amount of rice exported as compared to total production is shown in Figure 5. This indicates that rice exports are related to annual rice production in the previous year. When the relationship of rice export to production has been computed, it is found that 56 percent of the change in export can be explained by the change in production of the previous year ($r^2 = .56$). Most of the other 44 percent change in rice export is likely due to other factors such as change in the world price or demand of the importing countries. In short, it can be said that annual production is the major factor in determining the volume of exports.

The expansion of rice exports, coupled with a declining yield per rai and a steady increase in domestic demand, raises the question as to whether or not production in the future will be enough to satisfy the home consumption as well as maintaining the export level.

The figures given in Table 6 suggest that during the beginning of this century more than 50 percent of total rice production was exported. The percentage declined to 42 and 41 percent during the periods of 1910-11 to 1919-20 and 1920-21 to 1929-30 respectively. The trend was as high as 49 percent during 1930-31 to 1939-40 due

Table 6. Percentage of rice exported to total production, Thailand, 1907-08 to 1961-62. [1]

Period	Percentage
1907/08 - 1909/10	51
1910/11 - 1919/20	42
1920/21 - 1929/30	41
1930/31 - 1939/40	49
1940/41 - 1947/48	17
1948/49 - 1953/54	30
1954/55 - 1958/59	28
1959/60 - 1961/62	26

[1]Preliminary.

Source: (1) period 1907-08 to 1947-48 (10, p. 53)
(2) period 1948-49 to 1961-62 (24, p. 37-38, 108).

to the rapid increase in production in this period as mentioned earlier. During the World War II period, export volume accounted for only 17 percent of total rice production. Comparing the post-war period to pre-war, the percentage of rice exported showed a rapid decrease going from 49 percent in 1930-31 to 1939-40 to 30 percent in 1948-49 to 1953-54. This percentage dropped to 28 percent during 1954-55 to 1958-59 and 26 percent in 1959-60 to 1961-62.

The rapid decline in rice exports as a percentage of total rice production stems from the rapid increase in domestic demand as population has increased. On the other hand, rice production has been rather stable during the last decade. Therefore, to maintain

rice exports at the present level, a definite increase in production is necessary. Otherwise, while the population keeps increasing and the area suitable for planting to rice is rather stable (including the decreasing yield per rai); rice export may likely become less and less in the years ahead. This decline in export will have an effect on foreign exchange earnings, the income to farmers and most other economic sectors which will bring major obstacles in economic development. If the country wishes to stimulate a more rapid economic development, more rice exports will be necessary.

Conclusion

Demand for rice can be classified as: demand for consumption, demand for other uses and demand for export. Through the years domestic disappearance or domestic demand has been increasing largely due to population growth. It has been shown that the price of rice and the income of the people has little effect on the quantity consumed. Changes in price and income do explain some of the changes in the quality of rice purchased. It is believed the trend in domestic demand will continue to increase considerably because of the rapid growth in population and the slow rate of change in consumption patterns.

The export demand has been rather stable during the last

decade. Not only does demand and price of the world market effect rice exports as might be expected, but total domestic production is also a major factor.

CHAPTER IV

RICE PRODUCTION AND ECONOMIC DEVELOPMENT

Though it has been realized that Thailand's economy can not rely on rice alone, and that diversification of crops has been emphasized, rice will remain the most important crop. This is so because about 72 percent of the population are rice farmers, half of the export value is from rice and the government has always earned about 1,000 million baht[1] annually through rice premiums[2] (25, p. 2; 2, p. 10).

Since economic development has been stressed during the last decade, Thailand, as a developing country, also has a development plan. The National Economic Development Act was passed late in 1960. This plan is a two three-year plan, starting from 1961 to 1963 and 1964 to 1966. Since most established factories have to rely on agriculture products for their raw material, Thailand, as an agricultural country, must take into consideration its agricultural development so that industrial development can take place. Thus,

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[1] About 21 baht equal one dollar.

[2] Premium is one kind of tax that the government imposes in order to obtain a permit to export rice. The government has been using this premium as an export control by varying its rate.

the development plan of Thailand has set a priority on increasing productivity and production of agricultural products as a whole, together with conservation of forests and better transportation and communication.

This chapter will deal with the role rice is playing in the development of the country and its contribution to the development.

The Role of Rice in Economic Development

As economic development is emphasized, all sectors in the economy are sure to have some share in the plan. This section will deal first with the nature of economic development and then describe the importance of rice in playing this role.

Most economists in defining economic development emphasize increasing per capita income, national income, rate of growth and productivity. Meier and Baldwin (25, p. 2) have summarized economic development as "a process whereby an economy's real national income increases over a period of time. And if the rate of development is greater than the rate of population growth, then per capita real income will increase." According to this definition, the process in which the national income or gross national product (GNP) increases over a long period will be effected by the role of rice which is so important in Thailand. The GNP is estimated from the total market

value of all final goods and services produced in the economy in a year (13, p. 166). Therefore, it can be seen that in order to consider economic development, growth in GNP must be greater than population growth.

In the past decade, GNP has increased from 28,219.8 million baht in 1951 to 57,133.2 million baht in 1961, while agricultural value rose from 14,139.1 million baht to 21,716.1 million baht during the same period (28, p. 11-12). When comparing agricultural value to GNP in percentage terms in 1951, it amounted to 50.1 percent while in 1961 it amounted to 38.0 percent. While the relative importance of agriculture has gradually decreased, it is still a very important part of the GNP.

Rice constituted about 42 percent of the total agricultural value in 1951 and started to decrease its share when other cash crops were promoted, but in 1961 the value of rice was still about 39 percent of total agriculture. Even though the percentage of the share fluctuated during the last decade, the widest range was from 33 to 45 percent. From these figures, it can be concluded that rice has contributed nearly half of the agricultural value, even though the percentage is on a decreasing trend but the rate of decrease is rather slow.

Since rice has been the main share in agriculture and

agriculture has the main share in GNP, therefore, as a single crop, rice would constitute a relatively large percentage of GNP. The importance of rice value to the GNP is shown in Table 7.

Table 7. Value of rice production as compared to GNP, Thailand, 1951 to 1961.[1]

Year	Rice	GNP	Percentage of rice to GNP
	--million baht--		
1951	6,006.8	28,219.8	21.3
1952	4,818.2	29,548.5	16.3
1953	5,321.2	32,164.5	16.5
1954	4,709.9	31,997.3	14.7
1955	6,331.9	39,334.0	16.1
1956	7,219.8	40,928.9	17.6
1957	5,690.3	41,514.0	13.7
1958	5,969.9	42,210.1	14.1
1959	5,986.5	46,674.2	12.8
1960	7,103.9	53,014.6	13.4
1961	8,426.5	57,133.2	14.7

[1]Preliminary

Source: (28, p. 10-11)
(24, p. 37-38).

In 1951 rice comprised about 21 percent of the GNP, while in 1961 its share decreased to about 15 percent. It can be seen that the share of rice in GNP is on a slow declining trend. In order to help contribute to the growing GNP, rice has to at least maintain (even increase) its share in GNP. This will not be possible if

production does not increase. Even though now many other cash crops have started to play important roles in agriculture such as corn, cassava and jute, their production still varies from year to year depending on the market situation. It will take some time before other cash crops will contribute very much to GNP. Until then, rice should be the crop that takes an important part in helping to increase the GNP.

Rice Production and Domestic Demand: Unlike some of the developing countries, Thailand has not experienced a shortage of food because of the abundance of rice, which is inexpensive but provides the necessary calories. This fact coupled with very few problems of land tenure has eliminated one major hindrance to economic development; that is the problem of feeding the people.

About two-thirds of the rice production has been consumed annually in the country. However, if population continues to increase at the current rate (3.2 percent), the demand for home consumption will increase rapidly. Table 8 gives some idea as to how rice production (paddy basis) per capita in Thailand has decreased in the past decade. It is quite clear that rice production per capita has decreased almost 100 kilograms or 25.4 percent since 1948. If the country wants to maintain the present level of export, increase in production is necessary.

Table 8. Rice production per person (paddy basis), Thailand, 1948 to 1961. [1]

Year	Kilograms per person	Index (1948 = 100)
1948	386.9	100
1949	372.6	96.3
1950	370.3	95.7
1951	370.2	95.7
1952	324.5	83.9
1953	393.7	101.8
1954	265.3	68.6
1955	331.4	85.7
1956	364.5	94.2
1957	238.0	61.5
1958	298.5	77.2
1959	284.2	73.5
1960	296.6	76.7
1961	288.6	74.6

[1] Preliminary.

Rice Production and Export Earnings: Another point that needs to be considered concerning economic development in a country like Thailand is the necessity of obtaining foreign exchange earnings. This foreign exchange will be used to obtain more capital goods needed in the country in order to increase productivity and production. Rice export value has been contributing a large part to agricultural export earnings.

From Table 9, it can be seen that rice has been about half of the total agricultural export value even though it is now on a declining

Table 9. Total export value, agricultural export value and rice export value, Thailand, 1950 to 1961.[1]

Year	Total export	Agricultural export	Rice export
		-------billion baht-------	
1950	3.42	3.03	1.67
1951	4.37	4.01	1.83
1952	4.55	4.14	2.63
1953	5.69	5.21	3.75
1954	6.11	5.56	3.09
1955	7.01	6.35	3.13
1956	6.72	5.94	2.86
1957	7.29	6.49	3.62
1958	6.19	5.76	2.97
1959	7.26	6.64	2.58
1960	8.42	7.65	2.57
1961	9.72	8.78	3.60

[1]Preliminary

Source: (24, p. 107-123).

trend. By increasing the productivity and adjusting the premium, rice export might increase even though the future market does not look bright because of very stiff competition. Thailand will need to struggle to keep its place in the market. For this developing period at any rate, rice is sure to be playing an important part.

Figure 6 shows total export, agricultural export and also rice export value. It can easily be seen that rice export value has been erratic while total export and other agricultural export values

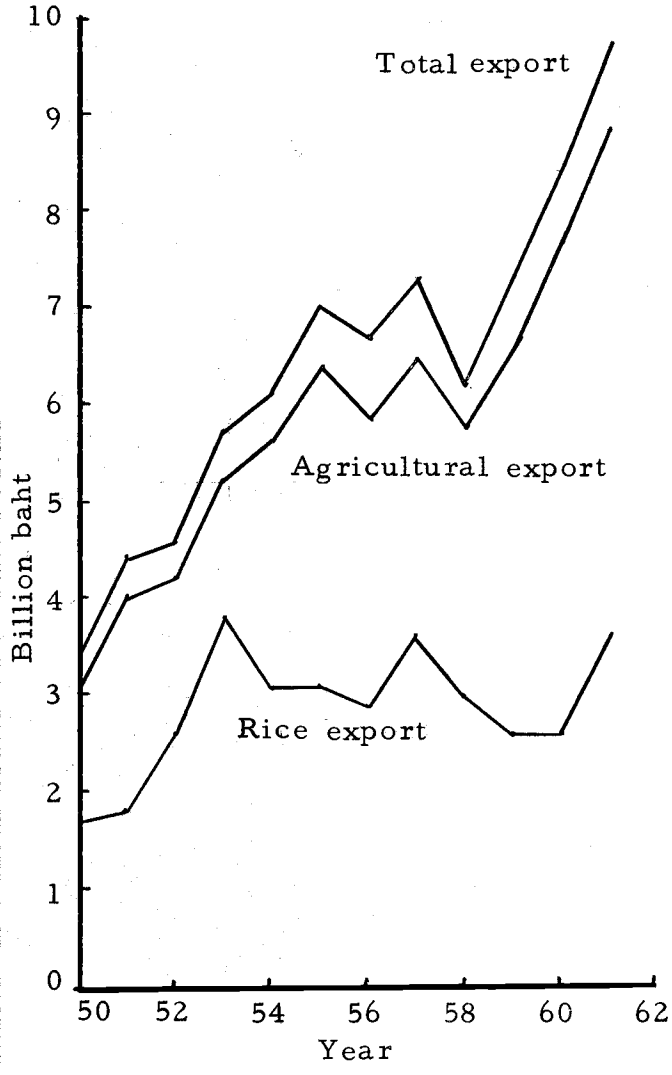

Figure 6. Total export value, agricultural export value and rice export value, Thailand, 1950 to 1961.

Source: Table 9.

are increasing. Yet, rice still contributed nearly one half of all export value.

Rice Production and Economic Growth

Since economic development can not progress without economic growth, this section will be devoted to a discussion of the specific relation of rice production to economic growth. First of all, brief consideration is given to the relationship of demand and supply to economic growth.

The equilibrium rate of growth requires that demand and supply must grow at the same rate, or if new capacity is to be utilized, that equivalent new demand must be generated. The demand aspect has to do with the question of how much capital formation is required to attain a certain rate of per capita income growth. From Harrod-Domar's Theory the above statement could be shown mathematically as:

$$\Delta Y = \frac{s}{k} Y$$

or

$$\frac{\Delta Y}{Y} = \frac{s}{k}$$

Where s is a constant ratio between saving and income, k is a constant capital output ratio and Y is income (7, p. 151-152). That is, income or demand must grow at a constant percentage rate to $\frac{s}{k}$

in order to assure no idle capacity of capital.

Thailand's GNP in real term (1952 price) from the year 1951 to 1961 continued to increase at an average annual rate of four percent, or nine percent at market price (11, p. 33; 29, p. 14). According to the economic development plans for the two periods, 1961 to 1963 and 1964 to 1966, the rate of growth projected was five percent annually. Per capita income which is now increasing at two percent per year will be projected to the level of three percent (27, p. 7). The target for economic growth will be fulfilled by more aggregate output within the country, and also demand has to increase at the same rate. Although the relative importance of rice production has been declining during the last few years, rice production is still the mainstay of Thailand's economy.

Relative to the income of the farmer, the available statistics show that in 1953 net income from agriculture of a household in central Thailand was 1,533 baht (16, p. 16). There are reasons for such low income besides the well known one of low productivity. First, from total annual production, not all the rice was sold. The average farmer in the Central Region of Thailand sold only about 40-42 percent of total production (16, p. 130). Another study (3, p. 38) showed that about 45 percent of the rice farmers in the Korat

Province[1] sold rice, the other 55 percent of them produce rice only for home consumption.

Secondly, a number of farmers are in debt, and pay their debts after selling some crops. In 1957 it was found that about one half the farmers in the Central Region had average debts of 3,300 baht per family (16, p. 78, 80). Still another reason for the low income of farmers is the fact middlemen have been earning considerable profit in the rice market. Furthermore, the government has earned part of its income through the premium policy on rice and has kept the price of rice relatively low for the benefit of the consumers. This means farmers have been subsidizing the consumers and paying tax to the government.

All these factors have impact on the income of farmers who comprise 72 percent of the population. If the income of these farmers were increased, the result would be the purchase of other commodities, some of which would be home produced products. If more demand were created, the increase in production would result in more employment. Therefore, improving the income of rice farmers is very necessary.

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[1] One province in the Northeast Region.

Target for Rice Production in Development Plan

One of the major parts of the development plan is devoted to agriculture with emphasis on increasing productivity and improving quality. Other related parts of the plan deal with better communication and transportation (27, p. 3). This section will deal only with an explanation of the plan for rice production (26, p. 1, 35).

The target for rice production is to increase from 7.2 million metric tons in 1959 to 7.6 million metric tons in 1963, or an increase of about 1.3 percent annually.

As for the problems concerning export, it is stated that:

> In order to improve the nation's rice export, the following shall be undertaken:
>
> (1) The minimum rice reserve for export will be 120,000 tons compared with the present small stock of 70,000 to 80,000 tons in Bangkok and Thonburi area. Adequate stock of rice for export will enable the exporters to meet the demand in time, and also help to minimize the fluctuation of price. However, the task of building sufficient reserve stock to meet the export demand as specified above, will be left in private hands.
>
> (2) To achieve more effective quality control, the rice to be exported will be milled in Bangkok and Thonburi area, where paddy can also be stored better according to the grade classifications. Furthermore, additional rice mills will not be permitted in an area where existing mill facilities are already more than adequate.

(3) Most of the existing rice mills are inefficient, capable of producing only 65 percent milled rice. A higher percentage could be achieved if the old milling machinery were replaced by modern equipment.

(4) To uphold the traditional reputation of Thai rice in the world market, the Ministry of Economic Affairs will take strict measures to insure the quality of rice exported.

Conclusion

Since economic development is the most emphasized topic of discussion in Thailand today, the best benefit can be achieved only if all parts of the plan are interrelated and carefully developed into an overall plan. As for a development plan for rice production, it is necessary to have knowledge of demand as a basic background. By knowing the pattern of domestic demand, export volume can be projected, and then it is possible to estimate production requirements to meet the goals.

The analysis shows that an increase in rice production will help economic development by increasing GNP. An increase in income to farmers will help to create more demand, which will maintain and generate economic growth.

CHAPTER V

SUMMARY AND CONCLUSIONS

Demand for Rice in the Future

Demand for rice in Thailand can be classified into two categories, (1) domestic demand and (2) demand for export. Domestic demand can be sub-divided into demand for food, seed, animal feed and industries. The major outlet of rice is for domestic consumption.

Demand for rice as food in Thailand was not influenced by changes in price or income during the period considered (1948-1961). It was estimated that in the long run when income increases, quantity of rice consumed tends to decline. This decline can be expected because of a change in tastes and preferences. Such changes, however, may not be significant in the next one or two decades. The growth of population will be the dominating factor in increasing the demand for rice in the near future. From the population projection, if the rate of population growth is maintained, it is estimated that by 1970, population in Thailand will be about 36 million. If the assumption were made that price of rice and income of the people remain at the 1961 level, using the equation of demand derived in this analysis, it

was estimated that the demand for rice consumption in 1970 will be 5,241.80 thousand metric tons (or 8,064.31 thousand metric tons on a paddy basis).

The average amount of rice used for seed in the past decade was 512.26 thousand metric tons. It is believed that the demand for seed in 1970 will be much the same because the farm area is expected to remain about constant. The demand for animal feed and use in industry will increase, while it is believed that the amount of loss and waste will decline. Data dealing with these items as a whole for the last ten years show the rate of change is not significant. Therefore, the demand in 1970, for these miscellaneous uses is assumed to be about equal to the average demand for the last decade which was 222.78 thousand metric tons. Total domestic demand for rice, will be about 8,799.35 thousand metric tons in 1970.

It is believed the projected increase in population at a rate of 3.2 percent is a reasonable one at least up to 1970. If rice production holds at present levels (7,142.5 thousand metric tons) in the years ahead, domestic demand alone will absorb all the rice production in the country. Since foreign exchange earnings have always been needed, rice exports need to be maintained (or even increased). It is clear that an increase in total rice production is essential.

Possibility of Increasing Rice Production

In general, increase in total production can be obtained by increasing the farm area, productivity, and minimizing loss. It has been observed through the last decade that total rice production can not be increased in any important way by expansion of the farm area. Land suitable for rice production has already been cultivated. So in increasing total rice production in Thailand, consideration must be given to increasing productivity and minimizing loss.

Increase productivity in this sense means increase yield per rai, which can be attained by various means, some of these means have already been instituted by the government. They are discussed below.

Irrigation: Since most rice growing still depends on rainfall which is uncertain, irrigation has always been stressed as the important factor in obtaining satisfactory yields. Many irrigation projects have been started. The important one is the Chao Phya Project in the Central Plain which will be completed in the near future. This project will provide full benefits to the Central Region, the most important rice growing area, not only for irrigation water but for flood control as well. It is believed that when the project is completed, two crops can be grown in this area every year.

Improved Seed: Thai farmers have been selecting their own rice varieties for quality and yield for a long time (25, p. 12). The Department of Rice has started a general program to aid in selecting suitable varieties for different conditions. This has been going on since 1950. Besides this program, a seed multiplication program was started in 1956. The goal is for setting up about 50,000 stock seed farms per year, aimed at having enough rice produced on those farms to use as seed for the whole country. This program when it is completed will be sure to have some effect not only in increasing production but for better quality of rice as well.

Pest Control: Pests have been a real problem in rice culture. It has been estimated that about three to ten percent (or 1,050 to 3,500 thousand rai) of rice land is annually damaged by pests (25, p. 18). The government has been trying to handle this problem but trained personnel and funds available are limited. More work needs to be done on pest control in order to increase average production per rai. The principal problems are the cost of chemicals and equipment, gaining farmers confidence in their effectiveness, adjusting equipment to suit the different type of farming, and danger in handling the pesticides.

Fertilizer Application: According to FAO experts, food production could be increased by at least 50 percent in almost all countries of the world, and it could be doubled in many areas, simply by better and more intensive use of fertilizers, manures and legumes (31, p. 39). This should also be true in the case of rice production. Successful programs in using fertilizer will depend on demonstration and advisory service as well as the cost of fertilizer which farmers will be able to afford.

Mechanization and Efficient Use of Land and Labor: A program for greatly increased mechanization will not be seen in the near future as well as more efficient use of labor which is relatively abundant. Work along these lines should be continued but not emphasized so long as labor is readily available.

Another way to increase production is to minimize loss and waste of rice. Even though storage is very important, most of the rice farm storage system in Thailand is not adequate. This results not only in loss and deterioration of quality but also reduces germination of the rice used for seed in the next year. It is estimated that damage from storage of paddy is about four percent of the total paddy stored (one percent from insect, two percent from birds and mice, and one percent from moisture) (2, p. 152). To maintain the quality and minimize loss and damage in rice production a better storage

system will be necessary, especially when rice can be grown twice a year.

In short, an increase in total rice production may be attained by various means all of which have been emphasized to some extent in development plans. The full implementation of economic development is restricted by lack of funds, personnel and the attitudes of the people. As farmers and others become better informed and can see some results of growth and development, further development may be easier to achieve. At the same time, farmers must be given incentives to produce more by improving prices, facilities for transport as well as the credit system.

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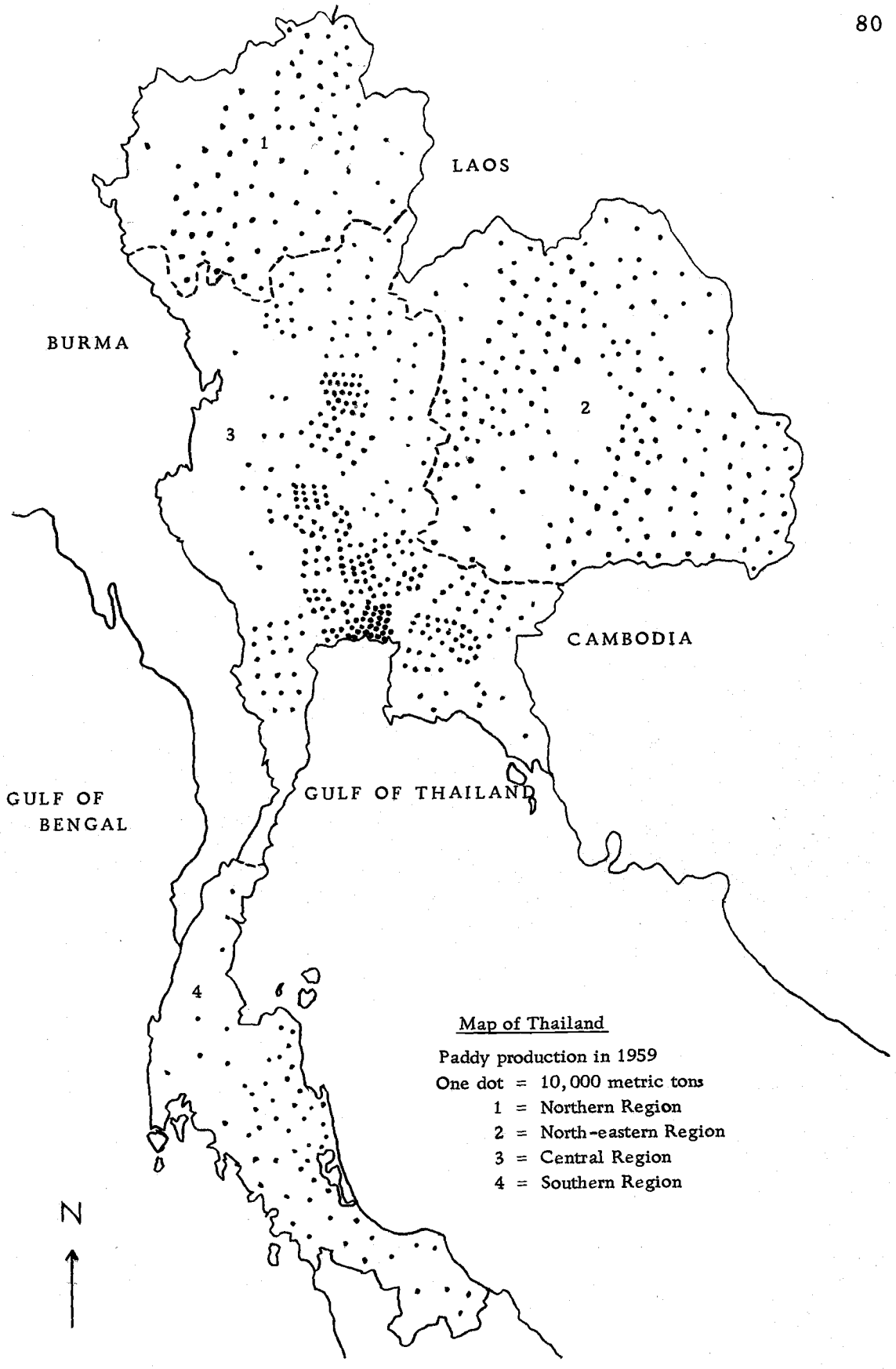
APPENDICES

APPENDIX I

Figure 1



Map of Thailand

Paddy production in 1959

One dot = 10,000 metric tons

1 = Northern Region

2 = North-eastern Region

3 = Central Region

4 = Southern Region

APPENDIX II

Table 1

Table 1. Average wholesale price of five and ten percent rice in Bangkok area, wholesale price of paddy, and per capita income, Thailand, 1948 to 1961.[1]

Year	Wholesale price			Per capita income
	Five percent rice	Ten percent rice	Paddy	
	--baht/picul[2]--		baht/kwien[3]	--baht--
1948	85.75	82.50	723.85	944
1949	89.50	86.75	711.93	1,115
1950	89.25	82.00	765.35	1,277
1951	90.75	80.75	820.04	1,248
1952	97.75	88.50	729.81	1,260
1953	84.50	79.00	645.85	1,332
1954	86.25	79.50	825.00	1,277
1955	100.75	91.00	863.33	1,528
1956	97.50	91.75	859.32	1,551
1957	97.00	90.75	1,021.96	1,510
1958	107.50	101.50	830.77	1,490
1959	98.50	92.50	850.96	1,598
1960	89.50	80.00	912.04	1,755
1961	102.00	98.50	1,074.13	1,839

[1]Preliminary.

[2]One picul is equal to 60 kilograms.

[3]One kwien is equal to 1,000 kilograms.

Source: Market Division, Department of Internal Trade, Ministry of Economic Affairs,
(24, p. 37-38, 157),
(28, p. 10-11).