CHAPTER I

INTRODUCTION

Rice is the most important food crop in terms of planted area, value of production as well as source of foreign exchange earnings in Thailand. Unlike many developing countries that incur large bills for import of rice, Thailand is earning substantial foreign exchange by exporting its rice.

Over the last two decades the Thai agriculture grew at the remarkable rate of 4.5 percent per year (Puapanichya and Panayotou, 1985). Thailand is self-sufficient in food and a major food exporter in the world. However, most of the growth was accomplished through expansion of planted area with little contribution of increase in productivity. The average annual growth rate in rice area increased from 1.70 percent during 1911-1940 period to 2.18 percent during 1946-1980 and then lowered to mere 0.26 percent during 1981-1990 period (Table 1). Correspondingly, the growth rate of rice production for these three periods were 2.14, 3.40 and 1.78 percent, respectively. However, during the entire period, the yield level remained almost stagnant ranging from 1.32 to 2.02 mt per ha and is among the lowest in the world (Table 1).

Moreover, there is a widespread unequal distribution of income across regions. About 40 percent of the farmers, especially those in the Northeast and parts

of the North, are still below the '*poverty line*', despite decades of agricultural growth. Therefore, the two major issues concerning agricultural sector are : (1) *how can Thailand increase further its agricultural production through raising yields*; and, (2) *how can farmers' income be raised without becoming uncompetitive in the world market owing to high production costs* ?

Table 1. Rice production performance in Thailand, 1907-1990.

Period	Area planted ('000 ha.)		Total Production ('000 mt paddy)		Yield (mt/ha)
1907-1910 [a]	1,461		2,737		1.74
1911-1920	1,906		3,248		1.37
1921-1930	2,515		4,448		1.61
1931-1940	2,912		4,546		1.56
Average annual growth rate 1911-20 to 1931-40 (%)		**1.70**		**2.14**	
1946-1955	4,970		6,546		1.32
1956-1965	5,634		8,177		1.44
1966-1975	7,478		13,182		1.76
1976-1980	8,990		16,400		1.82
Average annual growth rate 1946-55 to 1976-80 (%)		**2.18**		**3.40**	
1981-1990 [b]	8,904		19,181		2.02
Average annual growth rate 1981-90 (%)		**0.26**		**1.78**	

Source: [a] Selected from *The Rice Economy of Asia* (1985). (Tables 4.8, 4.9, 4.11, 4.12 and 4.13).
[b] Office of Agricultural Economics, *Agricultural Statistics of Thailand, Crop Year 1987/88 and 1989/90.*

It is worth noting that, Thailand enjoys a duopolistic competition with United States as the only opponent in the international market for high quality rice. Since,

the world rice market is becoming highly competitive, exploring the possibility of promoting production of high quality rice for exports is essential. In addition, given the slow rate of adoption of high yielding varieties coupled with poor performance owing to various constraints, both physical and institutional, the urgency for diversion to high income crops is clear.

1.1 Government Policies

1.1.1 Rice Policy

In the post-World War II period Thailand has ranked as one of the world's largest rice exporters. The share of Thai rice exports in the international market is around 20 to 25 percent (Tolley *et al.*, 1982). This dependence on rice exports, however, has also posed problems because of the highly unstable and widely fluctuating rice prices in world market. Since rice constitutes a high percentage of the national income of Thailand and is also the main staple for consumption, the government has tried to intervene through taxation of rice exports which could serve as an instrument for stabilizing domestic price of rice in the face of world price fluctuations[1]. It is worth noting that, whatever is the theoretical superiority of the rice export policy, the prices paid to producers in Thailand have traditionally been

[1] A tax on a commodity generates revenue to the government, but its burden has to be borne by buyer in the form of high price received. Thus, an export tax results in a rise in price paid by the foreign buyer or a fall in the domestic price of the commodity in the country imposing the tax. One important determinant of the size of the net gain or loss is the extent to which the tax is passed on to foreign buyers which in turn depends on how responsive foreign demand is to changes in the price charged by the exporting country. Assuming Thailand is a price taker in the world rice market, the export tax would then be reflected entirely by a fall in the domestic price which implies burden to the producer (Tolley *et al.*, 1982).

below world levels. The farm level price of rice as a percentage of world price remained at 71 percent in 1961-1965, 55 percent in 1966-1970, 62 percent in 1971-75 and 70 percent in 1976-80, respectively (Barker *et al.*, 1985).

There has been much debate on whether Thailand can influence international prices to some extent. Tolley *et al.* (1982) estimated the foreign elasticity of demand for Thai rice to be -4.00 for the short run and argues that in the long run it could conceivably be higher as substitution takes place and as present market relations and buyers' preference break down though it would still not approach infinity unless international trade were fully liberalized. And further suggested that, an optimal tax can be justified with its rate depending on the magnitude of the long-run and short-run foreign demand elasticities (Tolley *et al.*, 1982).

1.1.2 Rice Policy and Adoption of New Technology

Attempt of depressing domestic rice prices may hinder the adoption of new inputs in rice production[2]. Reasons often cited for the slow rate of adoption of high yielding varieties include lack of water control and accompanying inputs which increase the profitability of these varieties, the quality oriented nature of rice research in Thailand to meet standards in the export market, and the heavy

[2] A farmer tend to use an input - say, fertilizer - until the last unit employed contributes to the value of output an amount just equal to its cost. For a single farmer the price he pays for fertilizer and the price he receives for paddy sold can be taken as given. The contribution of fertilizer to output is expected to fall, however, as more and more of it is used. Thus, when paddy price is made artificially low, farmers would tend to cut down their fertilizer consumption; if in addition the fertilizer price is kept high, its use could be curtailed further. Such price distortions led to inefficiencies in production and higher costs (Tolley *et al.*, 1982).

indebtedness of farmers in the Central Plains, which prevents the adoption of a technology requiring capital and credit. An IRRI study postulated that, "labor and fertilizer costs are higher for high yielding varieties than for traditional varieties, and these costs rise with the degree of water control .... despite significant differences in net return and variable cost per hectare, variable cost per unit of output for high yielding varieties is not significantly different from that of traditional varieties. There is thus little gain in cost efficiency with the new technology .... This suggests that the profitability of adopting modern inputs depends as much on the future of world prices as on the price incentive used" (Tolley *et al.*, 1982).

1.1.3 Fertilizer Policy

It is believed that the key to significantly higher yields is a combination of fertilizer in appropriate quantities, irrigation, and improved seed varieties. Unfortunately, a combination of policies encouraging monopolies in the production and import of fertilizer in the past has led to unduly high fertilizer prices, which when combined with the rice pricing policies resulted in very unfavorable fertilizer/rice price ratios which ranges from 5.0 in 1955 to 2.9 in 1977 (Hayami and Ruttan, 1985). It is worthy to note that, Thai farmers have been among the lowest fertilizer users in Asia ranging from 2.4 kg per ha to 17.0 kg per ha for the period 1964-1981 (Puapanichya and Panayotou, 1985). Figure 1 presents the fertilizer use in Thailand for the period 1967-1990. The quantity used in agriculture increased steadily for the period, but the use of fertilizer in rice production fluctuated considerably.

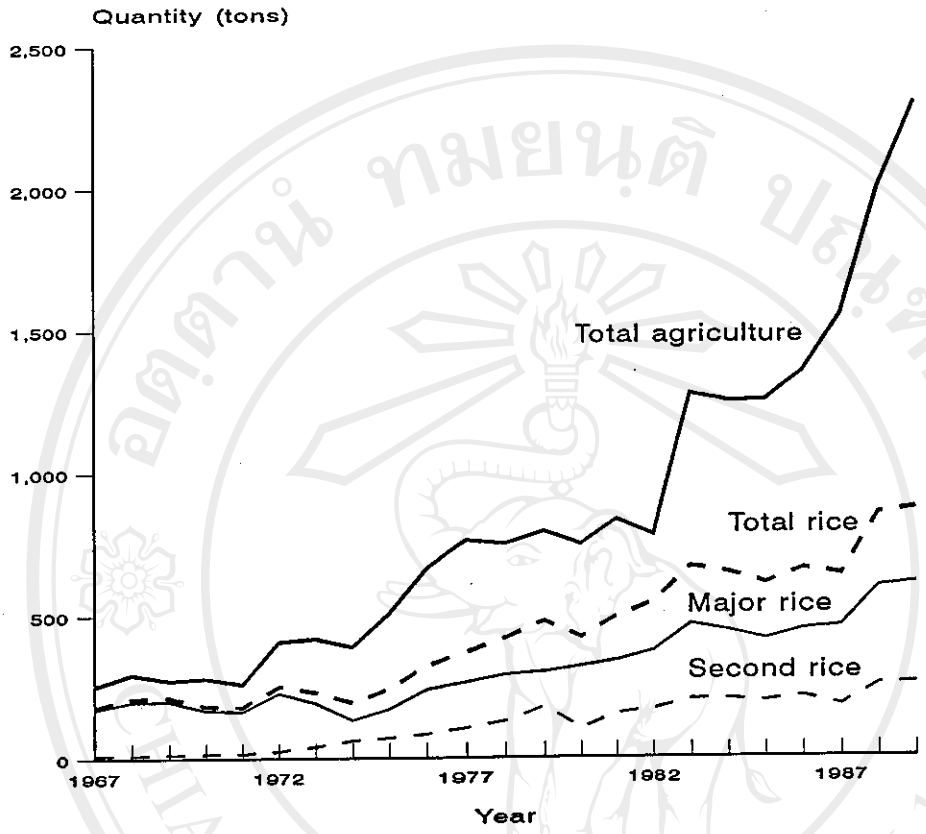

Figure 1. Trends in fertilizer use in Thailand, 1967 to 1990

Source: *Food Policy Analysis* (1985) and *Agricultural Statistics of Thailand, Crop Year 1987/88 and 1989/90.*

Average application rate for rice was about 5.2 kg of material per rai in the 1973/74 crop year and increased to 6.4 kg of material per rai in the crop year 1978/79. However, for the second rice crop, the rate increased significantly from about 9 kg of material per rai in 1973/74 to about 42 kg of material per rai in 1978/79 crop year (Puapanichya and Panayotou, 1985).

Various policies concerning chemical fertilizers were implemented since 1963. In response to the oil-crisis of 1973, the government declared fertilizer to be a competitive industry. In 1975, a fund of 500 million baht were allocated to the Marketing Organization of Farmers (MOF) for fertilizer purchase at competitive bidding. Another policy was the imposition of an import tax at a rate of 20 percent of the CIF. However, the impacts of these policies have been mixed.

1.2 High Quality Rice of Thailand

1.2.1 Meaning and Importance

In setting rice standards, rice growers and exporters establish certain criteria to grade their commodities. The most common criteria involve physical properties such as length of kernel, degree of milling, percentage of broken, proportion of damaged grain, colored grain, moisture level and impurities (Kaosaard and Juliano, 1989). For understanding consumers' preferred rice quality, the criteria lie in the tastes and preferences of the consumers with respect to the cooking quality. It also depends on the historical and socio-cultural factors of the country in question. The chemical properties represent a first approximation of the preferred cooking qualities.

Kaosaard and Juliano (1989) postulated that, as income of rice consuming countries rise, grain quality becomes more and more important for both traditional exporters and importers. Particularly, for the traditional exporters, grain quality is

essential in sustaining traditional markets and penetrating into high income and high technology-requirement markets. Improving the grain quality does not only improve welfare to consumers but also provides an assurance that emergent surpluses will find a rewarding market. Also, substantial price difference between different qualities implied non-perfect substitution and hence technological changes that improve the quality of rice may yield high gross return. In particular, improving quality characteristics related to genetic sources or varieties may reduce processing cost and directly raise returns to farmers (Kaosaard and Juliano, 1989).

1.2.2 Khao Dawk Mali: The Thai High Quality Rice

Khao Dawk Mali, a non-glutinous fragrant variety, is considered as the top quality rice in Thailand and has a high demand in world rice market. Grown in the main wet season, Khao Dawk Mali constituted 18.4 percent of all rice area for the year 1990/91 (Fig. 2).

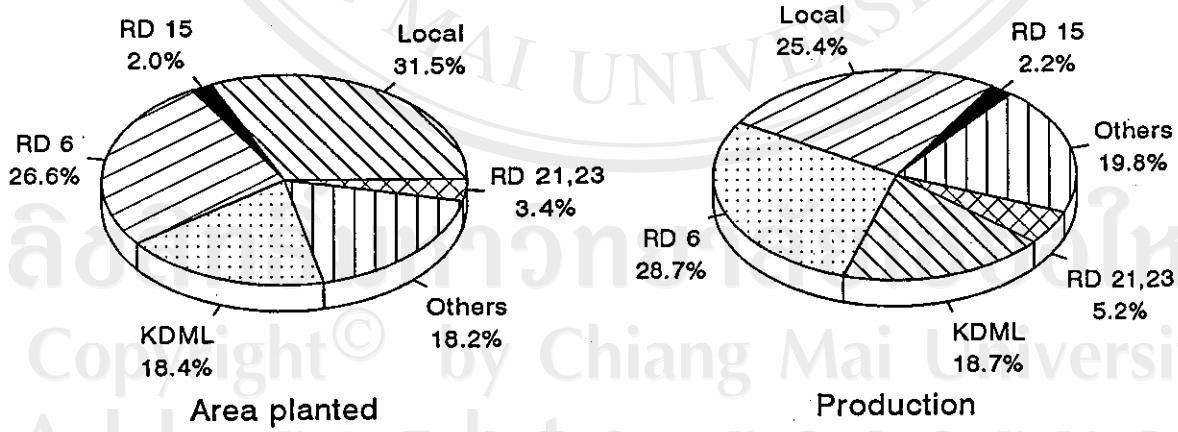

Figure 2. Area planted and production of rice by varieties for wet rice season in Thailand, 1990/91.

Source: Department of Agricultural Extension, *Rice Data Classified by Rice Varieties*, Thailand, 1991.

During the past decade (1980-1991), Khao Dawk Mali production grew at a remarkable rate of 16.13 percent per year in twelve major growing areas concentrated in the Northeast and Northern regions of Thailand, while during the same period, the overall rice production grew only at the rate of 1.78 percent per year (Fig. 3).

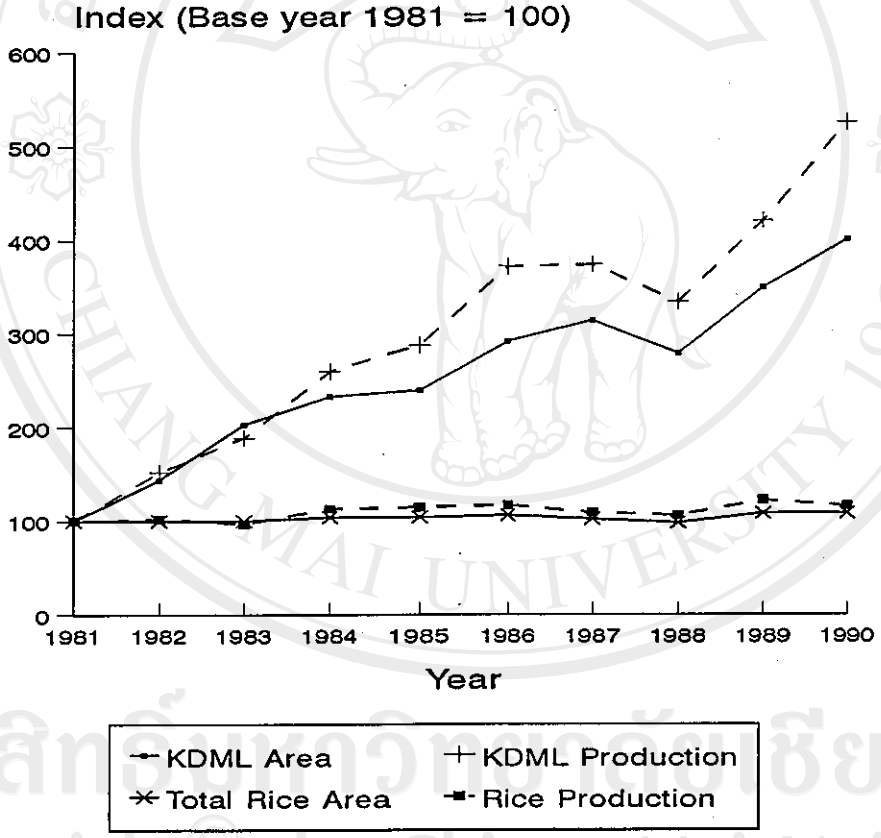

Figure 3. Index of area planted and production of Khao Dawk Mali and total rice crop in Thailand, 1981 to 1990.

Source: Bank of Agriculture and Cooperative, Department of Domestic Trade and *Agricultural Statistics of Thailand*, 1987/88, 1989/90.

1.2.3 Share of Thai High Quality Rice in World Market

The world rice market is a thin one where only four percent of global production is traded. Moreover, if further classification of rice standards are made, the market size become more smaller. This small, residual and fragmented market combined with inadequate and inaccurate production forecast in most producing countries make the market of rice relatively volatile compared to other primary commodities (Kaosaard and Juliano, 1989).

Hong Kong, a traditionally rice consuming but non-producing economy, has been a traditional market of Thai rice. The market share has been as high as 64.5 percent in 1962 which fell sharply during 1963 when there was an acute production shortage in Thailand. Gradually Thailand regained the position of largest supplier in 1986 when her share accounted for 49.9 percent. The other two major suppliers were China and Australia. In the Hong Kong market, the share of fragrant Thai rice rose from 20 percent of total rice export in 1960 to about 80 percent at present (Kaosaard and Juliano, 1989).

The export volume of Khao Dawk Mali increased almost six folds from 148.5 thousand tons in 1988 to 823.1 thousand tons in 1991 (Fig. 4). Asia alone imports about 60 percent of the total export. The major customers of high quality rice are Hong Kong, Singapore, Middle East and USA.

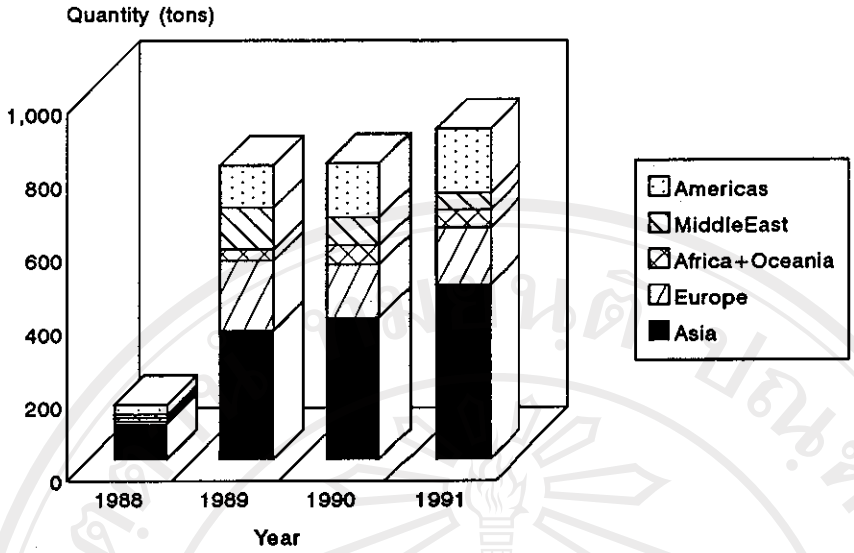

Figure 4. Quantity of Khao Dawk Mali exported from Thailand to rest of the world.

Source: Private Rice Section, Department of Cereal Trade, Ministry of Agriculture and Cooperatives.

With respect to price level, Khao Dawk Mali enjoys advantage in the domestic market over RD 15 (a non-glutinous variety developed from Khao Dawk Mali for higher yield) and local varieties (mainly glutinous traditional cultivars) (Fig. 5). However, in the later period there seems to be a downward pressure in Khao Dawk Mali price. Examining the stability of export earnings and unit value of exports of Thai rice of different grades between 1957-1987, Purgsiganont (1989) revealed that high standard rice (better or equal to 5% broken) tended to be more stable than the medium (between 10-20% broken) and lower standard rice. The Coppock's instability index estimates indicated that, the export earning and price for high standard Thai rice are generally lower than the medium and lower standards (Table 2).

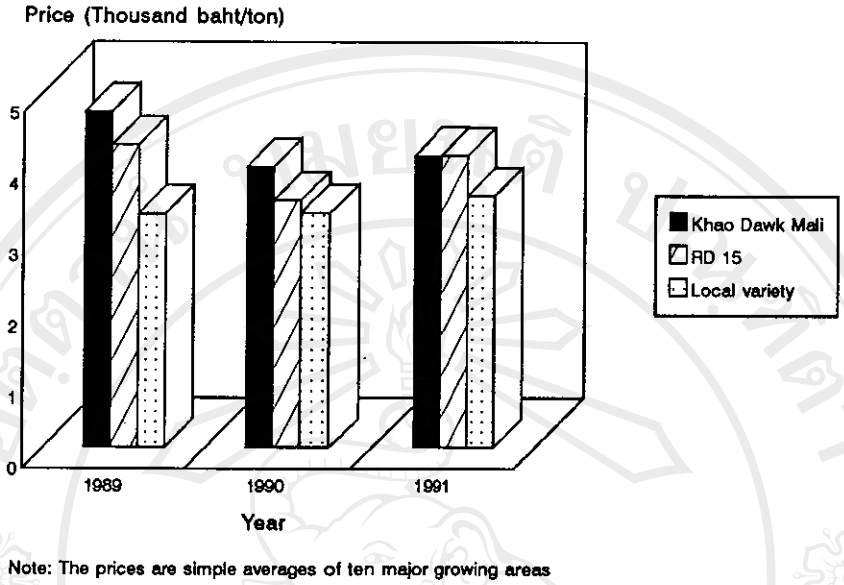

Figure 5. Domestic price of Khao Dawk Mali, RD 15 and the local variety rice in major growing areas of Thailand, 1989 to 1991.

Source: Bank of Agriculture and Cooperatives and Department of Domestic Trade.

Table 2. Coppock's instability index for Thai rice

Period	Price			Export earning		
	High quality	Medium quality	Low quality	High quality	Medium quality	Low quality
1957-1962	7.08	9.67	12.26	11.84	24.28	193.97
1963-1968	11.08	10.87	14.11	7.57	103.10	62.97
1969-1974	48.14	66.71	76.78	74.18	145.08	242.69
1975-1980	22.66	22.34	22.52	22.49	93.64	218.97
1981-1986	13.23	17.15	13.13	14.41	35.44	51.01

Source: Adapted from Purgsiganont (1989)

More importantly, high quality rice market is very close to a duopolistic market type with the United States and Thailand as the two major actors. Hence prices in this markets are very much affected by both the Thai export and the United States' agricultural policy. The Thai export premium policy which tended to place higher premium on higher standard rice with incremental premiums during production booms introduces distortions in the prices of high standard rice in the international markets.

1.3 Rationale

From the above analysis, it is evident that, in order to maintain the stability of rice export earnings in the long-run, Thailand should seek the opportunity to boost up the export of high quality rice. This consideration is important because, some of the Asian nations, such as, Vietnam, Cambodia who are moving towards a market oriented economy, potentially have the advantage to offer low quality rice at a very competitive price in the world market owing to their cheap labor cost. Thailand, whose economy is growing fast and is accompanied by rising labor wages is likely to lose in competition in the near future. This will force the farming population to switch from growing low priced subsistence crops to high valued cash or market oriented crops in the long run.

Since, there exists an opportunity of duopolistic market with the United States in the high quality rice market with little chance for other countries to enter in the near future, Thai government should explore the possibility of promoting

production of high quality rice for exports. Moreover, as income level of Thai people are rising, there seems to be a potential tendency to move towards the consumption of high quality rice.

Over the past decade, Khao Dawk Mali production steadily expanded from 36.4 thousand rai in 1980/81 to 98.8 thousand rai in 1987/88 and then declined in the subsequent years and dropped to 85.7 thousand rai in 1990/91 in the Chiang Mai province. However, on the contrary, the yield level boosted up from a mere 380 kg per rai in 1980/81 to 655 kg per rai in 1990/91 (Table A3 in the Appendix). This implies that farmers in this province switch varieties in order to maximize profit as well as fulfill their own consumption need of glutinous rice, since the drop in expansion is consistent with the drop in output prices in the same period. Therefore, undertaking demand study for inputs at the farm-level would facilitate in understanding the current situation and the nature of farmers' responses to input prices changes jointly considering the possibility of seed variety changes, and also the impact of economic incentives introduced by alternative policy instruments.

1.3.1 Demand Studies for Rice in Thailand

Various researches on rice production has been done in Thailand. So far, to our knowledge, very few studies used the analytical framework of normalized restricted profit function to analyze demand relationships in Thai agriculture. Adulavidhaya *et al.* (1979) and Puapanichya and Panayotou (1985) used normalized restricted Cobb-Douglas profit function to analyze farm-level data of agricultural

crops including rice and Sriboonchitta (1983) used single product translog cost function for agricultural output in Chiang Mai Valley. However, none of the previous studies considered the possibility that cultivators can respond to price changes not only by adjusting their use of variable inputs but also by switching to different varieties, so as to maximize with respect to a *meta-production function* (the envelope containing the production surfaces of all potential seed varieties). Input demand models that do not consider the possibility of seed variety switching would underestimate response to price and hence introduce bias in estimation (Pitt, 1983).

The present study, is thus, an attempt in this line and uses the Two-Stage Switching Regression procedure utilizing normalized restricted translog profit functions for both Khao Dawk Mali and glutinous rice varieties.

1.4 Objectives

The broad objective of this study is to jointly determine the demand for variable inputs and choice of rice varieties at farm-level in Chiang Mai province. The specific objectives are :

a) Present the input-output descriptions of Khao Dawk Mali and other glutinous rice varieties.

b) Estimate the average costs and returns for Khao Dawk Mali and other glutinous rice varieties.

c) Analyze the farmers' decision making process with respect to changes in variable input prices as well as switching between rice varieties.

d) Estimate the variable input demand and output supply elasticities jointly determined with rice seed variety choice by profit maximizing farmers.

1.5 Literature Review

1.5.1 Estimation Methods

Joint estimation of the normalized profit function and factor shares has been a popular method for obtaining indirect estimates of input demand elasticities as early as 1971. Normalized restricted Cobb-Douglas profit functions were employed by Lau and Yotopoulos (1972) for cross sectional study of farms in India. The results suggested that, the indirect elasticity estimates obtained for labor and land were more efficient than the direct estimation from production functions due to the existence of simultaneous equations bias in the production function (Lau and Yotopoulos, 1972).

Similar claims were made by Yotopoulos *et al.* (1976) from their study of cross sectional farm household data in Taiwan. They employed the same method of analysis with two distinct features added: (1) increase in the number of variable inputs from one to four, (2) and incorporating the test of hypothesis of structural change between successive cross section.

Sidhu and Baanante (1981) used the normalized restricted translog profit function to estimate farm-level input demand for Mexican wheat variety in Indian

Punjab and claimed that it allowed a more disaggregated analysis of the farm production structure compared to Cobb-Douglas formulation. The increased flexibility permitted measurement of different impacts that exogenous variables have within and across input demands and output supply functions. Four variable inputs and seven fixed factors were specified in their model (Sidhu and Baanante, 1981).

Lopez (1984) asserted that he was able to derive all the relevant information with respect to the structure of production of an industry using the knowledge of only a profit function for Canadian agriculture.

Adulavidhaya *et al.* (1979) used normalized restricted Cobb-Douglas profit function to estimate input demand and output supply elasticities of Thai agriculture. Agricultural output, four variable inputs (labor, animal, mechanical, and seeds-fertilizer), and two fixed factors (fixed assets and land) were included in the function (Adulavidhaya *et al.*, 1979). Their results indicated that, the output supply and the factor demands were highly sensitive to changes in output price.

Puapanichya and Panayotou (1985) used normalized Cobb-Douglas profit function to validate profit maximization behavior and constant returns to scale for irrigated and non-irrigated rice area in Thailand. Agricultural output (rice, maize, cassava, and sugarcane), three variable inputs (seed, fertilizer, labor) and two fixed factors (land and fixed farm assets) were included in the function. The results suggested that, farmers in both areas are profit maximizers and the constant returns to scale exists in Thai rice agriculture. Also, the own-price elasticity of supply of

irrigated rice was found to be higher than non-irrigated rice (0.649 vs 0.508) (Puapanichya and Panayotou, 1985).

Sriboonchitta (1983) used single product translog cost function to analyze the relative share of labor and estimate input demand elasticities, elasticities of substitution for Chiang Mai Valley. The results suggested that, demand for inputs are inelastic and mixed relationships (both complementary and supplementary) exists between inputs across two farming techniques, the animal power farming and the tractor power farming technique (Sriboonchitta, 1983).

1.5.2 Estimation Utilizing Meta-Production Function Approach

Few studies has been conducted using the conceptual framework that farmers could response to a price change by manipulating the variable input use as well as switching to different seed varieties. Studies conducted by Pitt (1983) and Sumodiningrat (1982)[3] are major two studies that were specifically designed to test the model of Figure 6. Pitt (1983) conducted the study on the response of traditional and modern rice cultivators to differences in the prices of variable and fixed inputs in Java, Indonesia. He stressed that, "fertilizer demand models which do not jointly consider seed variety choice and fertilizer demand will underestimate response to price" (Pitt, 1983). In addition, he argued that, there is another problem in variety

[3] Gunawan Sumodiningrat, "Varietal Choice and Input Demand in Rice Production in Indonesia", Ph.D Dissertation, University of Minnesota (1982). This reference was cited in Yujiro Hayami and Vernon W. Ruttan, *Agricultural Development: An International Perspective* (1985), John Hopkins University Press, Baltimore.

specific fertilizer demand and profit/cost function studies. "In these studies, farmers who plant seed varieties other than those investigated are systematically excluded from the sample. The reason is simply that the profit to be obtained from planting Mexican wheat varieties, for example, is not observed from cultivators who plant other varieties. Hence, the least squares estimation may be selectivity biased. The bias comes about because cultivators who would obtain lower-than-average high yielding variety (HYV) profit, given prices and fixed factors select traditional variety (TV) seeds thus truncating the observed HYV profit distribution" (Pitt, 1983). His model differs from the other attempts that, it allows for the analysis of the choice of seed variety and the demand for variable input in a simultaneous equation framework using two stage estimation procedure adjusted for selectivity bias as well.

His estimates indicated that, the elasticity of fertilizer demand for traditional varieties was -0.400 and for modern varieties was -1.561. But the elasticity along the meta-production function which takes into account the shift from traditional to modern varieties, increases the elasticity by about 11 percent from -1.042 to -1.155 (Pitt, 1983). He concluded that, this shift in the response function, associated with a change in varieties, sharply increased the opportunity for Indonesian rice producers to expand rice production by substituting fertilizer for land (in Hayami and Ruttan, 1985).

Sumodiningrat (1982) also drew on data on the response of traditional and modern rice varieties to differences in the prices of variable and fixed inputs in

Indonesia. He found that, the failure in taking into account the effect of variety shifts tended to underestimate the elasticity of demand for several other factor inputs (in Hayami and Ruttan, 1985).