เอกสารทางวิชาการ
DISCUSSION PAPER SERIES

Number 55

Comparative Advantage in Rice Production in Thailand: A Domestic Resource Cost Study*

by

Dr. Narongchai Akrasanee

and

Miss Atchana Wattananukit

คณะเศรษฐศาสตร์
FACULTY OF ECONOMICS

มหาวิทยาลัยธรรมศาสตร์
กรุงเทพมหานคร

THAMMASAT UNIVERSITY
BANGKOK

May 1977.

THAMMASAT UNIVERSITY
FACULTY OF ECONOMICS
DISCUSSION PAPER SERIES

Number 55

Comparative Advantage in Rice Production in Thailand: A Domestic Resource Cost Study*

by

Dr. Narongchai Akrasanee
and
Miss Atchana Wattananukit

*The first author is Assistant Professor of Economics, Thammasat University and Visiting Research Fellow, National Bureau of Economic Research. The second author is a graduate student, Department of Economics, University of Michigan.

NARONGCHAI AKRASANEE AND ATCHANA WATTANANUKIT*

COMPARATIVE ADVANTAGE IN RICE PRODUCTION IN THAILAND: A DOMESTIC RESOURCE COST STUDY+

It is well known that rice is the most important commodity in Thailand. Its significance is in every aspect of life, political, economic, as well as social and cultural. Value added in rice production has consistently accounted for more than 10 percent of Gross National Product, and this was measured in domestic prices which usually gave a very low price to rice relative to its world price. More than 75 percent of the total population of 38.6 million in the early 1970s still lived or worked on the farm where their main occupation was rice growing. Rice has for many years been a major foreign exchange earner, and a major source of government revenue through the collection of export rice premium.[1/] Many aspects of Thai social life have originated from rice villages. And no one can question the political significance of rice in Thailand where most decisions are made in the capital city of Bangkok, whose population of almost 4 million depends on rice as their major diet.

---

* The first author is Assistant Professor of Economics, Thammasat University and Visiting Research Fellow, National Bureau of Economic Research. The second author is a graduate student, Department of Economics, University of Michigan.

+ This is a revised version of (1). Financial support was provided by Stanford Food Research Institute.

The authors would like to thank Scott R. Pearson and Erie Monke for very valuable comments on the earlier version.

1/ Rice premium is duty collected in Thailand on the export of rice.

This study is concerned with one economic aspect of rice production: that is, the comparative advantage in its production in the country and among regions. Our aim is to make an economic evaluation of the export expansion of rice, using the criteria of private and social profitability, nominal and effective protection, and domestic resource cost.[2/] Section I discusses the significance of the study. Areas and techniques of the cases under study are described in Section II. Section III discusses methods of computation used. An analysis of the results, conclusion and policy implications are in Section IV. The Appendix explains calculations carried our in more detail.

2/ See (3) for a discussion on these concepts.

I. RICE AS A MAJOR EXPORT

There are several important reasons for concentrating on the export expansion aspect of rice, two of which are foreign exchange earning and a source of government revenue. As shown in Table 1, rice has been the most important crop export. In 1960, 29.8 percent of export earning came from rice. This proportion went up to as high as 36 percent in 1961. But since then the share of rice in total export earning has either been on the decline of fluctuating at a relatively lower level, even though its export value in 1974 was almost 10 billion bahts. Rising in its place were maize, tapioco products, and sugar, all of which compete with rice in land usage. Their combined share in total export value rose from 9.8 percent in 1960 to 22.2 percent in 1970, and finally to 27.2 percent in 1974. The fact that the export of rice has been on the decline and unstable is a cause for concern, since Thailand relies a great deal on it as a source of foreign exchange earning. The concern will be even more apparent if it can be established that the earning of foreign exchange through rice export has been accomplished with great economy.

The export of rice has also brought the government a sizeable revenue, through the collection of rice premium and export duty. The significance of taxes from rice export is illustrated in Table 2, which shows that the government revenue from this source has been almost the only source of export duties, and it is used to account for as high as 14.5 percent of total government revenue. It has also been fluctuating in more recent years

Table 1

Thailand - Value of Exports of Rice and Selected Major Crops Compared to Total Exports, 1960-1974
(Millions of Baht)

Period	Rice		Maize		Tapioca Products		Sugar		Others		Total	
	Value	%	Value	%	Value	%	Value	%	Value	%	Value	%
1960	2,570	29.8	551	6.4	288	3.3	8	0.1	5,197	60.3	8,614	100.0
1961	3,598	36.0	599	6.0	446	4.5	3	0	5,351	53.5	9,997	100.0
1962	3,240	34.0	516	5.4	423	4.4	46	0.5	5,304	55.7	9,529	100.0
1963	3,424	35.4	857	8.9	439	4.5	122	1.3	4,834	50.0	9,676	100.0
1964	4,389	35.6	1,388	11.2	653	5.3	211	1.7	5,698	46.2	12,339	100.0
1965	4,334	33.5	1,004	7.8	676	5.2	100	0.8	6,827	52.8	12,941	100.0
1966	4,001	28.4	1,577	11.3	644	4.6	82	0.6	7,795	55.3	14,099	100.0
1967	4,653	32.8	1,431	10.1	726	5.1	37	0.3	7,319	51.7	14,166	100.0
1968	3,775	27.6	1,647	12.0	772	5.6	-	0	7,485	54.7	13,679	100.0
1969	2,945	20.0	1,767	12.0	876	6.0	47	0.3	9,087	61.7	14,722	100.0
1970	2,517	17.0	1,969	13.3	1,223	8.3	94	0.6	8,969	60.7	14,772	100.0
1971	2,909	16.8	2,286	13.2	1,240	7.2	382	2.2	10,464	60.6	17,281	100.0
1972	4,437	19.7	2,085	9.3	1,547	6.9	1,264	5.6	13,158	58.5	22,491	100.0
1973	3,594	11.2	2,969	9.2	2,537	7.9	1,116	3.5	22,010	68.3	32,226	100.0
1974	9,778	19.4	6,078	12.1	3,836	7.6	3,757	7.5	26,876	53.4	50,325	100.0

Source: Bank of Thailand, Monthly Bulletin, V.XVI, No.4, April, 1976, Table III.7.

Table 2

Thailand - Taxes on Rice Export and Total Government Revenue
(Millions of Baht)

Period	Taxes on Rice Export			Total Export Duties	Taxes on Rice Export as Percent of Total Export Duties	Total Government Revenue	Taxes on Rice Export as Percent of Total Revenue
	Premium	Duty	Total				
1960	745	143	888	1,233	72.0	6,792	13.1
1961	872	189	1,061	1,277	83.1	7,449	14.2
1962	753	161	914	1,098	83.2	8,002	11.4
1963	819	172	991	1,164	85.1	8,819	11.2
1964	1,238	202	1,440	1,609	89.5	9,957	14.5
1965	1,192	197	1,389	1,570	88.5	11,344	12.2
1966	995	192	1,187	1,361	87.2	12,901	9.2
1967	995	199	1,194	1,319	90.5	14,777	8.1
1968	1,268	173	1,441	1,568	91.9	16,889	8.5
1969	1,037	139	1,176	1,505	78.1	18,296	6.4
1970	540	121	661	848	77.9	19,793	3.3
1971	225	144	369	414	89.1	19,355	1.9
1972	158	188	346	406	85.2	21,535	1.6
1973	333	148	481	1,041	46.2	26,950	1.8
1974	3,123	651	3,774	5,001	75.5	38,958	9.7

Source: Bank of Thailand, Monthly Bulletin, V.XVI, No.4, April, 1976, Table II.1.

when the world price of rice has fluctuated more widely. From this viewpoint, the maintenance and expansion of rice export are of major importance.[3/]

Due to its significance in terms of exports and basic commodity, rice has received a great deal of attention. Government after government have interfered with rice from the paddy production level to the domestic consumption and export levels.[4/] Rice policies of each government have been designed to achieve the maximum level of export, a low and stable domestic price of milled rice, and a high and increasing price of paddy. With three objectives which are obviously contradictory, only one major policy instrument has been used: the "rice premium."[5/] The objective of maintaining a low level of the domestic price of milled rice for urban consumption has usually received more weight, and the "rice premium" continued to be used, except when the world price of rice was very low such as in 1970-71. In all of these considerations little attention has been given to the economic comparative advantage of rice. Consequently, the real cost of earning foreign exchange through rice export is not known, hence exerting a small weight in the argument and has played a small role in policy prescriptons on rice.

3/ The statement does not imply that the authors are in agreement with the existing system of export taxes on rice.

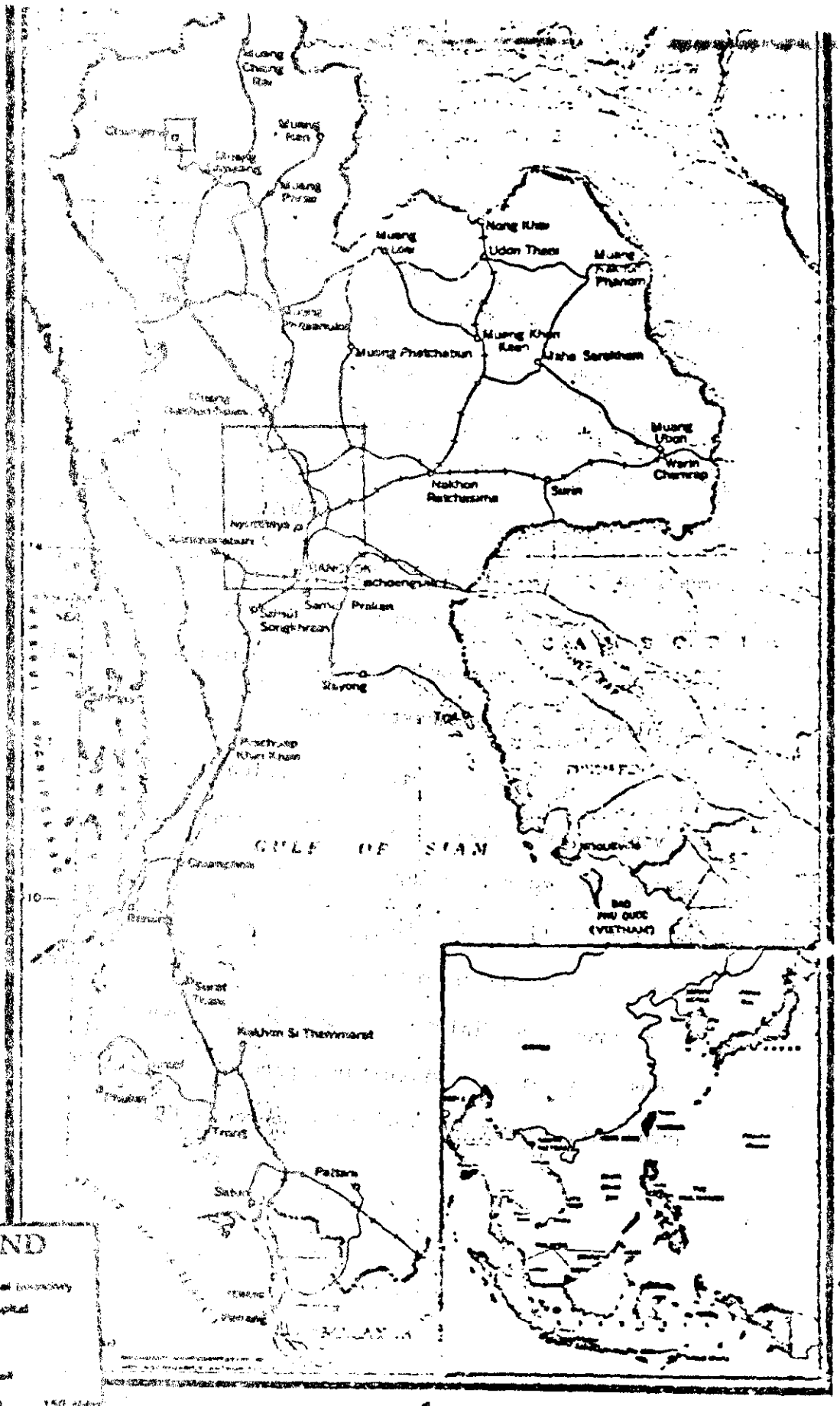
4/ For the most comprehensive analysis of the historical development of rice policies in Thailand, see (4).

5/ The "rice premium" has been the most debated economic and political topic. See (2;4) for more detail.

II. RICE GROWING IN SELECTED AREAS

Rice growing in nine provinces were selected for investigation. All but one of the provinces are in the Central Region. These are Nontaburi, Chainat, Ayudhya, Nakorn Nayok, Chachoengsao, Singburi, Supanburi, and Pathumtanee. The ninth province, Chiengmai, is in the Northern Region. The samples provide us with data on the second crop in eight provinces, and the first crop in two provinces: the latter include traditional varieties on transplanting and broadcasting farms, and modern varieties on transplanting farms. The samples thus enable us to make a cost comparison of crops among different areas, between modern and traditional varieties, and between transplanting and broadcasting farms.

The areas selected are considered to be very important and most relevant for our study, because they usually yield the surplus of rice production for export. Being the delta of the Chao Praya River, the areas are also very fertile, with the possibility of substituting other crops for rice in the wet as well as dry season (see Figure 1). Recognizing the importance of the areas the Ministry of Agriculture conducted an agricultural survey on costs of various agricultural products in the crop year 1973-1974. The survey was, therefore, the major source of our data.



□ = areas under investigation

The difference between the two crops is in the period of farming. The first crop is grown during the wet season, about July/August to October/November, and the second crop during the period of March to June. Farmers generally use traditional varieties of seed which have long stems and produce long grain rice. Modern varieties which produce better yield per rai but are usually more difficult to grow have also been applied. And finally, there are two methods of farming, transplant and broadcast. As implied by their names, under the transplant method seeds are first grown in a small plot of land, which are then transplanted by hands in to a bigger area, whereas under the broadcast method seeds are scattered over the entire area. By implication, the former generally use more labor hours while the latter use more seeds on the same size of land.

III. METHODOLOGY FOR CALCULATING COMPARATIVE ADVANTAGE IN RICE PRODUCTION

To calculate comparative advantage in rice production we need to know private and social value and costs of production. We discuss in turn the methodologies used in obtaining them.

3.1 Private Value and Costs of Production

Private value of production is the return received by exporters for one kilogram of milled rice exported. Private costs of production are imputed costs plus actual expenses in all stages of the production of one kilogram of milled rice. They cover costs of primary factors, tradable and non-tradable inputs, direct and indirect. Primary factor costs are costs of labor, capital and land incurred in the processing and transportation of paddy, and in the production of paddy and its tradable and non-tradable inputs. The costs of tradable inputs are inputs used directly and indirectly in paddy production, such as seed, fertilizer, insecticide and fungicide, and the tradable content of non-tradable inputs such as tractor service,etc.

Methodologies used in deriving private production value and each cost item are presented below.

3.1.1 Value of Production

The private value of production is the f.o.b. price of one kilogram of milled rice less all kinds of export tax. Rice export in 1974 was subject to an export duty of 5.1 percent, a special form of export tax called the

"rice premium" of about 30 percent ad valorem on average, and a requirement to sell "reserve rice" to the government at 50 percent of every ton to be exported for the price of about 25 percent of the f.o.b. price.[6/]

Let P be the f.o.b. price of one ton of rice. The ad valorem equivalent of all export taxes was

$$\frac{.351P + .5(1 - .25)P}{1.5} = .484P,$$

or 48.4 percent of the f.o.b. price. Thus the private value received by exporters for one ton of rice exported was .516P. In 1974 the average f.o.b. price of 5 percent broken rice was ฿11, 170 per ton.[7/] The private return was, therefore, ฿5.76 per kilogram.

3.1.2 Costs of Production[8/]

1. Primary Factor Costs

Labor. The labor cost has two components: labor used in the production of paddy, and labor in processing and transportation and in the production of inputs. For the former, it was obtained by multiplying the wage rate by the number of man-days of hired and family labor. The wage rate used was the weighted average daily wage on an annual basis of a hired

---

6/ The "reserve rice" was 5 or 10 percent broken milled rice. The reserve ratio was reduced from 100 percent to 50 percent after January 31, 1974. And after October 30, 1974, the reserve rice price paid by the government for 5 percent broken milled rice was $250 per 100 kilograms. The system was abolished in 1975. All information is from the Ministry of Commerce.

7/ Ministry of Commerce, Bangkok.

8/ Unless otherwise indicated, data used are from Ministry of Agriculture, Agricultural Survey of the Crop Year 1973/1974, unpublished, Bangkok.

laborer, which was about ฿12 a day.[9/]

Another part of the labor cost was estimated as follows.

a. Processing and transportation costs were estimated from the f.o.b. price of milled rice less taxes less the equivalent farm gate price of milled rice, using the standard conversion ratio of 3 to 2 between paddy to milled rice. Out of this, 80 percent was considered to be domestic cost, and the remaining 20 percent foreign cost. The domestic cost was then divided into 60 percent labor cost and 40 percent capital cost.

Using the f.o.b. price of milled rice at ฿11.17 per kilogram, the equivalent export tax rate of 48.4 percent, and the farm gate price of paddy at ฿2.15 per kilogram, the processing and transportation cost inclusive of profit and traders' margin per kilogram of milled rice was estimated to be,

$$11.17 - .484(11.17) - \frac{3}{2}(2.15) = ฿2.54.$$

The domestic cost was 2.54 x .8 = ฿2.03 per kilogram.

The foreign cost was 2.54 x .2 = ฿.51 per kilogram.

Labor cost was 2.03 x .6 = ฿1.22 per kilogram.

Capital cost was 2.03 x .4 = ฿.81 per kilogram.

9/ The weighted average daily wage on an annual basis can be obtained by averaging the on farm wet season wage and the dry season wage, using the proportions of the seasons as weights. The on farm wage was $12 a day. The areas under study are mostly in the central plane where construction jobs are usually available in the dry season, with the daily wage estimated to be also about $12.

b. Labor costs of other inputs were part of the added cost of imported inputs, and part of the non-tradable inputs.[10/] The distribution between labor cost and capital cost was estimated as below.

Inputs	Labor (%)	Capital (%)
Fertilizer	50	50
Insecticides	50	50
Fuel	10	90
Other	100	-
Tractor and farm machinery	50	50
Animal	20	80

Capital. Capital cost also has two components similar to labor cost. The direct capital cost of paddy production is the opportunity cost of fund invested in the production process plus depreciation of fixed assets. The price of capital was estimated to be 15 percent, and the depreciation rate was set at 10 percent. The calculation of capital cost thus took into consideration the length of time involved in different processes of paddy production.[11/]

10/ Added cost is the cost involved from the point of import to the user, net of taxes.

11/ Since the planting of seed, for example, takes about 6 months from the preparation to the time of cultivation, this should be considered as investment with proper opportunity cost allowed. The opportunity cost is determined by the value of the "investment," the length of time it takes until realization, and the interest rate of 15 percent. But for other assets, the opportunity cost is calculated from its market value and the interest rate of 15 percent. Summing up the opportunity cost of all of these items gives us the opportunity cost of capital.

Another part of capital cost was obtained according to the distribution between labor cost and capital cost as discussed under labor cost. Results on capital cost of each area under investigation are from (1).

Land. Land cost was approximated by the net revenue from growing an alternative crop evaluated at market prices. For second cropping, mungbean is the alternative crop for Chainat, Singburi, Supanburi, Nonthaburi, Ayudhya, Pathumthani and Nakorn Nayok. For Chachoengsao, the possible alternative crop is cassava, and soybean is considered to be an alternative crop for Chiangmai area.

Using information from the Agricultural Survey of 1973-74 the net benefit from growing mungbean, cassava, and soybean was ฿66.40, ฿44.04, and ฿39.30 per rai respectively.12/

For the wet season crop, if the area cultivated is low land or irrigated under 2 or 3 metres of water, the opportunity cost of land is zero. But in the upland area, the land has some possibilities for other alternative uses. The study on the wet season crop is mainly on Singburi and Chainat provinces, which have sugar cane as the alternative crop. The calculation was therefore made from the net revenue from growing sugar cane, which was ฿177.80 per rai.

2. Costs of Tradable Inputs

The major tradable inputs are seed and fertilizer. Other inputs which include fuel, insecticide, etc. are grouped together.

12/ Data on cassava are based on cassava production in Cholburi, a province close to Chachoengsao.

The cost of tradable input is the cost of material component of each input. This is the user's cost net of added cost and all taxes. Since the data we have are the cost of inputs paid by farmers, the material cost had to be estimated. For inputs which were imported, the following equation was used to estimate the material cost,

$$x(1 + t_m)(1 + c) = U_c,$$

where x = material cost

t_m = tax rate on import[13/]

c = added cost[14/]

U_c = user's cost

For domestic inputs the material cost is the user's cost net of indirect taxes. Seed is usually from the previous season, and the material cost of seed is equal to its farm gate value. The cost of the service of tractor and farm machinery was broken down into tradable and non-tradable components. The tradable component was the import content of the service cost net of transportation.[15/] Finally there was a part of processing and transportation cost which was considered to be foreign cost, the amount of which was estimated to be 20 percent of the total processing and transportation cost.

13/ Imports into Thailand are subject to tariff and business tax. t_m is thus the overall ad valorem rate, expressed in percentabe of the c.i.f. price.

14/ Added cost varies from input to input. These were calculated to be 22.2 percent for fertilizer and 21 percent for insecticide.

15/ According to the Industrial Survey of 1971, conducted by the National Statistical Office, the value of tractor and farm machinery production has the following cost structure: value added, 25.8%; domestic input, 5.9%; imported parts and components, 68.3%. Transportation cost was estimated at 6% of the service cost.

The total cost of private tradable inputs, which are shown in Appendix Table A-16, includes import taxes of these inputs.

3.2 Social Value and Costs of Production

Social value of production is the f.o.b. price of one kilogram of milled rice, which was ฿11.17. Social costs of production are costs of primary and tradable inputs valued at opportunity cost.

In this study labor cost at market prices was considered to reflect its opportunity cost. As for the costs of capital and land, we have already approximated the private cost by the opportunity cost at market prices. Thus the social cost and the private cost of primary inputs are approximations of each other, and are taken to be the same.

Except for seed, the social cost of each tradable input was the same as the private (material) cost which has been calculated net of taxes. This is because most tradable inputs were actually traded, and there was little domestic inputs which could have been sold at distorted prices. For seed, the heavy taxation of exported milled rice had the effect of keeping the farm gate price at lower than its social value. The social cost of seed was therefore obtained by evaluating seed at border price, which was the f.o.b. price of milled rice adjusted by the conversion ratio of $\frac{2}{3}$, resulting in the price of ฿7.45 per kilogram of seed.

The total social cost of tradable inputs does not include taxes.

3.3 Social Cost of Foreign Exchange

The resource cost will be evaluated at the actual exchange rate

and at the shadow exchange rate. The shadow exchange rate is defined as the rate of exchange which would have to be set if all trade distortions were removed and the trade balance were to remain the same. The calculation of the shadow exchange rate took into consideration the elasticity of demand for imports, the elasticities of demand and supply of exports, and the knowledge of the structure of trade and factors affecting trade distortions. Using these informations, the shadow exchange rate was estimated to be ₱25.8 per U.S. $1. (See 1.)

3.4 Indicators of Private and Social Profitability and Comparative Advantage

With the information on costs and return, we can proceed to calculate various indicators of private and social profitability and comparative advantage. Six indicators are contemplated, and these will be calculated according to their definition as follows.

1. Private profitability (PP) = value added less factor costs other than capital less indirect taxes, at market prices.

2. Social profitability (SP) = value added less factor costs other than capital, at opportunity cost.

3. Net social profitability (NSP) = SP less capital costs, at opportunity cost. NSP will be calculated at official exchange rate and at shadow price of foreign exchange.

4. Nominal protective coefficient on output (NPCO) = the ratio of gross output at the actual market price to gross output at the world market price. This indicator shows the extent to which the actual gross return differs from what it would be without the output price distortion.

5. Effect protective coefficient on value added (EPC) = the ratio of value added at actual market prices to value added at world market prices. (Value added includes value of the non-traded parts of traded inputs.) This indicator shows the extent to which private value added differs from what it would be without distortion in the prices of output and inputs.

6. Domestic resource cost coefficient (DRC) = the ratio of total (direct and indireet) domestic factor costs, at opportunity cost, to total world factor costs (or to total value added at world market prices), in domestic currency. This indicator shows the extent to which the total domestic cost of producing a unit of output differs from the value obtained from exporting it. If value added at world market prices is shown in foreign currency, then the DRC will show the domestic cost of foreign exchange earned. The coefficient will be calculated at official exchange rate and at shadow exchange rate. When it is expressed at shadow exchange rate, the coefficient value less than one, implying that cost is less than return, will indicate the degree of comparative advantage in the production.

IV. COMPARATIVE ADVANTAGE OF ALTERNATIVE AREAS AND SYSTEMS

Using the methodology outlined in Section III the calculation has been made for the second (dry season) crop in eight provinces and the wet season crop in two provinces. The wet season crop is further broken down into modern and traditional varieties, and transplanting and broadcasting farms. Detailed calculations are given in the Appendix. This section attempts to analyze the results obtained, from which some policy conclusions will be drawn.

4.1 The General Pattern of Comparative Advantage in Rice Production

Comparative advantage is referred to the whole process of rice production; from the production of paddy to the exportation of milled rice. The key issue is if Thailand were to expand the production of rice for export, from which area the production should come, what type of rice and what method to use. The production of paddy is therefore most crucial to our analysis. Consequently the results will be discussed in relation to areas and techniques of paddy production.

Table 3 below shows various indicators of private and social benefits and cost of rice production. As expected the wet season crop costs the economy much less than the dry season crop, as indicated by the highest DRC coefficient of .33 for the former, whereas the lowest coefficient for the latter was .37. In terms of social cost the modern variety was not much superior to the traditional variety, with a difference in the DRC of .02 to .03 for Singburi and Chainat respectively. And finally the transplanting

Table 3

Thailand - Private and Social Profitability, Nominal and Effective Protection, and Domestic Resource Cost of Rice Production in Selected Areas (1973-1974 crop year)

Areas/Techniques	PP[a]	SP[a]	NSP[a]	NSPE[a]	NPCO[a]	NPCI[a]	EPC[a]	DRC[a]	DRC in ฿/$	DRC / SPFX[b] /OER[b]
Second Crop										
Nontaburi	1.82	7.08	6.01	8.51	.52	.91	.45	.37	7.64	.29
Chainat	1.64	6.9	5.84	8.38	.52	.89	.46	.40	8.21	.32
Ayudhya	1.55	6.78	5.73	8.24	.52	.88	.46	.41	8.36	.33
Supanburi	1.48	6.75	5.65	8.19	.52	.89	.46	.42	8.65	.33
Chachoengsao	1.43	6.64	5.52	8.04	.52	.85	.46	.43	8.78	.34
Chiengmai	1.57	6.8	5.81	8.45	.52	.81	.49	.43	8.78	.34
Nakorn Nayok	1.28	6.51	5.38	7.93	.52	.86	.47	.45	9.21	.36
Pathumtanee	1.06	6.31	5.22	7.73	.52	.89	.46	.46	9.36	.37
First Crop										
TV, TF[b]										
Chainat	2.55	7.78	6.79	9.44	.52	.80	.49	.33	6.7	.26
Singburi	2.84	8.08	7.16	9.84	.52	.80	.49	.31	6.26	.25
MV, TF[b]										
Chainat	2.90	8.16	7.20	9.87	.52	.83	.49	.30	6.08	.24
Singburi	2.93	8.24	7.32	10.02	.52	.88	.49	.29	6.0	.23
TV, BF[b]										
Chainat	2.68	7.76	6.81	9.42	.52	.70	.49	.32	6.54	.25
Singburi	2.64	7.70	6.77	9.38	.52	.69	.50	.33	6.7	.26

Source: Appendix Table A-16.

[a] See text.

[b] TV, TF = Traditional varieties, transplanting farms.
MV, RF = Modern varieties, transplanting farms.
TV, BF = Traditional varieties, broadcasting farms.
SPFX = Social price of foreign exchange.
OER = Official exchange rate.

and broadcasting techniques yielded almost identical DRC coefficients, again using Chainat and Singburi as samples.

Although the cost of the dry season crop has been found to be higher than the wet season one, the growing of the second crop was still very efficient in all provinces under study. The DRC coefficients ranged from .37 for Nontaburi to .46 for Pathumtanee. Or to put it more simply, if Thailand were to increase the export of rice the domestic cost of earning an extra U.S. dollar at the official exchange rate would range from ฿7.64 up to ฿9.36, for paddy production from Nontaburi and Pathumtanee respectively, considerably lower than the exchange rate of ฿20.40 per U.S. dollar. The efficiency was even more pronounced when DRCs were expressed in terms of the shadow exchange rate, which was calculated to be ฿25.8 per U.S. $1, indicating a strong comparative advantage in rice production.

The variation in DRCs was not large among the eight provinces. This was not surprising since, except for Chiengmai, the provinces are in the Central Region. The Chiengmai result was impressive in the sense that it shows that it was economic to grow the second crop even in the high land. The ranking of provinces according to social cost or social profitability is very similar, and fifth according to the domestic resource cost. The ranking of provinces according to the private profitability criteria also follows the same pattern.

Chainat and Singburi have been chosen for the study on comparative advantage of different techniques of production. A comparison between modern and traditional varieties on transplanting farms shows the modern varieties

to have a slight advantage over the traditional ones. This is true in terms of both private benefits and social cost. And Singburi seems to be more suitable for the modern varieties. As mentioned earlier, the difference in advantage between the two types of farming is negligible. While transplanting farms seemed to be slightly more profitable privately for Singburi, broadcasting farms were slightly more profitable in Chainat. Socially, transplanting farms were more profitable in both provinces.

Table 3 also shows the degree of protection. Since the same export tax rate was applied to rice from all areas, the nominal rate of protection was a uniform negative rate of 48 percent. As for inputs, the nominal protection was also negative because the high export tax on rice kept the price of seed low, and there was a low level of protection on other inputs, some of which had only a small amount of domestic production. Finally the effective rates of protection were slightly different among different areas and different techniques, ranging from 50 to 55 percent. Considering the whole system of incentives on output and inputs in this regard, we could therefore conclude that there was a strong disincentive against rice production in Thailand.

Another important set of results shown in Table 3 is the differences between private and social profitability, which were very large in all cases under study. The differences ranged from ฿5.06 to ฿5.31 per kilogram of milled rice, which was about 50 percent of the f.o.b. price of rice at the time. The large differences was due to the high f.o.b. price and the export tax of rice.

4.2 Sensitivity of Domestic Resource Cost

The extent of comparative advantage as given by the DRC coefficients depends upon the price of rice, yield per rai, and various cost components. In this section we analyze sensitivity of the DRC coefficients with respect to these variables, using the elasticity concept. Since the price of rice is the most important variable in terms of its instability in the world market, we will demonstrate the relationship between the world price of rice and Thailand's comparative advantage as a major rice exporter.

a. DRC elasticities

We have selected four different situations to illustrate our DRC elasticities, Chainat and Nontaburi for dry season crop, and Chainat and Singburi for wet season crop using modern varieties on transplanting farms. The DRC elasticities to be presented show the percentage change in that particular variable needed to produce a one percent change in the DRC coefficient. For each variable the lower the value shown, the higher is DRC elasticity with respect to that variable.

Table 4 shows various DRC elasticity values with respect to the opportunity cost of labor, land, domestic capital, fertilizer, processing and transportation, and to yield per rai. The elasticity of DRC with respect to each variable depends upon the significance of that variable in determining the value of DRC. With labor cost and the cost of processing and transportation being the largest cost components it can be expected that the elasticity of DRC with respect to these costs would be highest. This is confirmed by the DRC elasticities ranging from 1.42 to 1.85 for the cost of

labor and 1.38 to 1.73 for processing and transportation cost. The cost of capital is next in terms of the high degree of elasticity. And DRCs are more elastic with respect to fertilizer cost than to land cost for the dry season crop and vice versa for the wet season crop. Finally the DRC elasticities were negative and very high with respect to yield per rai, ranging from -2.18 to -3.14.

The two provinces of the dry season crop have very similar values of DRC elasticities, with almost the same ranking with respect to each variable beginning with the cost of labor, then processing and transportation, yield per rai, capital, fertilizer, and land. The DRC elasticity, with respect to labor cost in Chainat dry season crop, indicated that if the cost of labor increased by 1.46 percent DRC would increase by 1 percent. A similar reading could be made from the table regarding other variables.

Both provinces of the wet season crop also have very similar patterns of DRC elasticities, running from the cost of processing and transportation to labor, yield per rai and capital cost, land, and fertilizer. DRCs are particularly insensitive to the cost of fertilizer for the wet season crop, because of the relatively small usage of fertilizer. For example, the cost of fertilizer would have to increase by 201.2 percent in Chainat before DRC would increase by 1 percent.

DRC elasticities were different between dry season and wet season crop particularly with respect to the cost of land and of fertilizer. For wet season crop the elasticities with respect to land ranged from 7.01 to 7.09, whereas they were between 17.99 to 23.70 for dry season crop. The

Table 4

Thailand - DRC Elasticities

Cost/Yield Areas/Techniques	Labor	Land	Domestic Capital	Fertilizer	Processing and Transportation	Yield
Nontaburi[a]	1.42	17.99	3.35	15.85	1.59	-2.30
Chainat[a]	1.46	23.70	3.75	19.82	1.73	-2.18
Chainat[b]	1.85	7.01	3.19	201.2	1.38	-3.14
Singburi[b]	1.79	7.09	3.33	222.2	1.38	-2.96

Source: See Appendix and Tables A-2 - A-3, A-12 - 13.

[a]Second crop.

[b]First crop, modern varieties on transplanting farms.

opportunity cost of land was rather high during the wet season because of the possibility of growing sugar cane in the area. In the case of the cost of fertilizer the elasticities were 15.85 to 19.82 for dry season crop, and 201.2 to 222.2 for wet season crop. The results show clearly the significance of fertilizer for the dry season crop, and that farmers used a very small amount of fertilizer during the wet season. This was due to technology as well as cost consideration.

b. Relationship between comparative advantage and the world price of rice

We have selected two samples to demonstrate the relationship between comparative advantage and the world price of rice: the dry season crop in Nontaburi and the wet season crop in Singburi (modern varieties) provinces which show the highest degree of efficiency in rice production. Using the technique suggested by Leon Mears, we have constructed two diagrams with the world price of rice on the horizontal axis and the ratio of DRC to the shadow price of foreign exchange on the vertical axis. The ratios were obtained from calculating DRC at various levels of the world price of rice. Using the principle that the ratio of DRC to social price of foreign exchange equal to 1 being the value above which Thailand would no longer have comparative advantage, we could go on to find out the critical minimum world price of rice for Thailand.

Figure 2 demonstrates two Mears graphs, N and S, one for the dry season crop (Nontaburi), and another for the wet season (Singburi).[16/] It

16/ See numerical results in Appendix Section III. As explained in Appendix Section III, we have calculated low and high DRC coefficients. But since the low coefficients seemed to be unrealistically low, we have demonstrated only the high coefficients here. These estimates are considered more conservative and more realistic.

can be seen that for the dry season crop the critical minimum world price was about $180 per metricton. The wet season crop was more efficient, and could withstand the world price as low as about $125 per metricton.

The results shown above depend upon the shadow exchange rate used. If the shadow exchange rate was not as high as the calculated rate of ฿25.8 per U.S. $1, then the critical minimum world price will move up accordingly. To illustrate, suppose the official exchange rate was the minimum shadow exchange rate, S and N will move up to S' and N'. Then the critical minimum world price would be about $150 per metricton for the wet season crop and $220 per metricton for the dry season crop. In view of the likely inaccuracy of the calculated shadow exchange rate it is therefore more appropriate to state the critical minimum world price of rice in a range of $125-150 per metricton for the wet season crop and $180-220 per metricton for the dry season crop.

4.3 Conclusions and Policy Implications

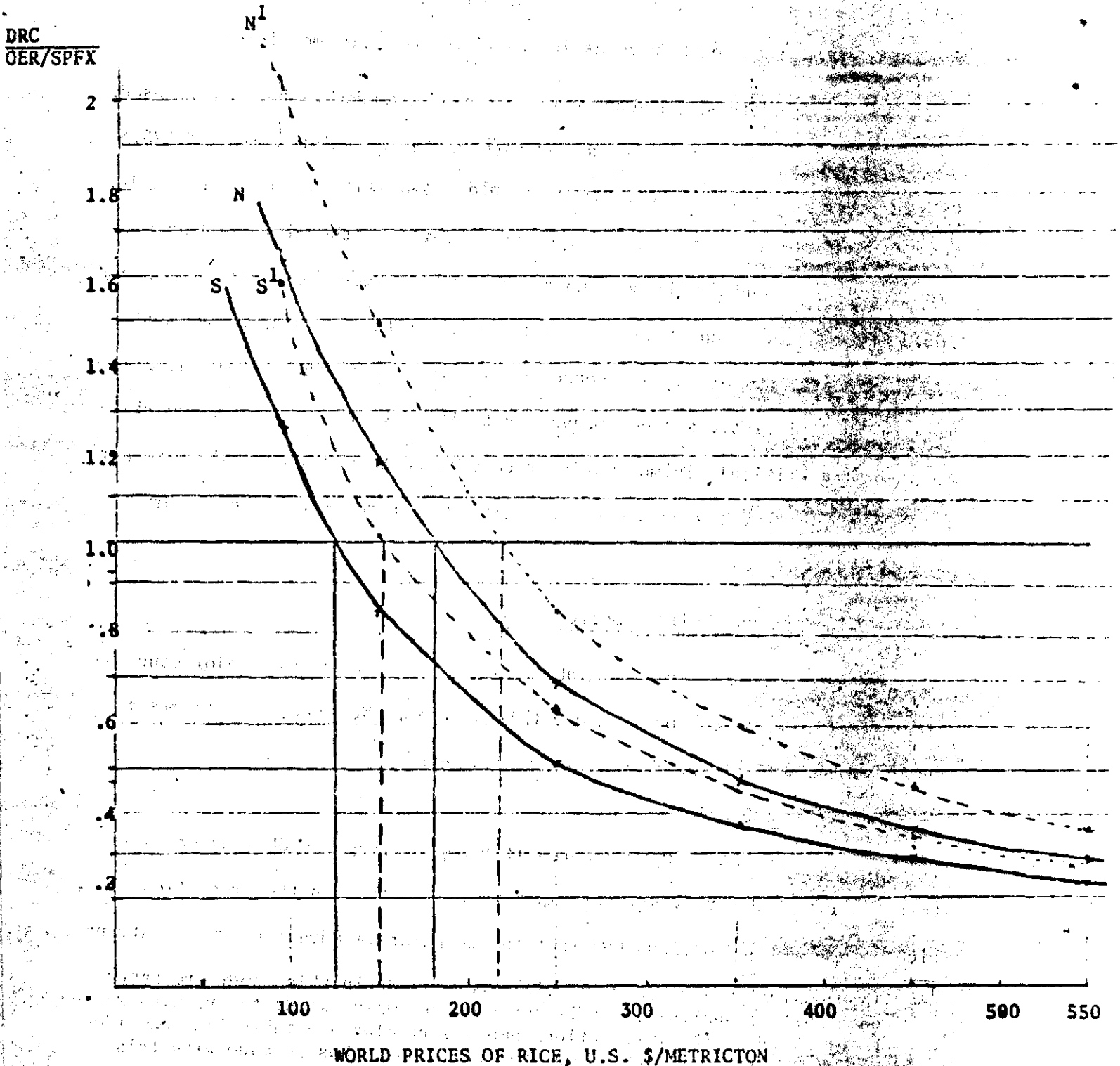
The findings presented above lead us to a number of major conclusions which will be discussed under this section. We will also attempt to draw policy implications from these conclusions.[17/]

a. Conclusions

The most important result though perhaps an obvious one was that Thailand had a very strong comparative advantage in the production of rice. What was not obvious was that the comparative advantage was so strong

17/ The conslusion and recommendations to be made in this paper are based on a partial analysis. It is not known to what extent the results would be affected if the interactions among variables are taken into consideration. Interpretation of our results should thus be made with this limitation in mind.

FIGURE 2: THAILAND--MEARS GRAPHS



Note: OER = Offician exchange rate
SPFX = Social price of foreign exchange
N = Chainat, dry season crop
S = Singburi, wet season, modern varieti transplanting farms
N^1 = N when OER=SPFX
S^1 = S when OER=SPFX

such that DRC at the shadow exchange rate was as low as .23 and the highest value was only .37. It can thus be said that Thailand has comparative advantage in rice production in both wet and dry season crops, in modern and traditional varieties, in transplanting and broadcasting farms, and finally in the areas of the central plain as well as the North.

Secondly the production of rice yielded both private and social profitability, although it was not clear from our results at what level of production the private profitability lied. There has been a general belief that everyone but the farmers directly benefits from this profitability. But judging from the large difference of ฿5-6 per kilogram between private profitability and social profitability, it is doubtful that private profitability, to whoever it might have gone, could be excessive.

Thirdly, the taxation system has been discriminating against the expansion of rice production, as indicated by the negative effective rates of protection. Since other crops were not subject to the same extent of taxes except for sugar whose export became subject to taxes only in 1974, it can be concluded that the strong discrimination against rice acted as an incentive to grow or change to other crops.

Fourthly, changes in cost components had different effects on the levels of DRC in different provinces, and technologies. While the increase in the labor cost would have a strong effect on DRCs in all cases, the increase in fertilizer cost would mostly affect DRCs of the dry season crop. The increase in capital cost through, for example, mechanization, would also generally have a strong effect on DRCs. Since a percentage increase in yield

per rai would reduce DRCs by about a half percent, the total effect of the increased application of fertilizer, mechanization, or labor on DRC would depend upon the extent to which it would improve yield. Thus if the effect on yield is known we can use our results to calculate a "cross effect" between an input, yield per rai, and DRC.

Fifthly, with the "critical minimum" world price of rice known we know at a moment of time how far Thailand was away from that level, assuming a similar cost structure. In 1974 the world price of rice was more than double the critical minimum price, indicating that Thailand had a comfortable comparative advantage price range.

b. Policy implications

The conclusions outlined above lead immediately to a number of policy implications.

1. The most obvious policy implication is that the expansion of rice production, by increasing areas and/or production of the second crop or the first crop, is justified on ground of comparative advantage. In fact the expansion is justified regardless of areas or technologies. But since modern varieties on transplanting farms yielded particularly low DRCs the adoption of modern varieties should be encouraged on this ground.

2. Because of the existence of private profitability the expansion of rice production should be possible. With a large difference between private and social profitability, an effort should be made to narrow the gap.[18/] To accomplish that the recommendation such as the reduction or

18/ Of course it is well known that the large difference was due to the abnormally high price of rice in 1974. Since then the price has declined to a more normal range of U.S. $250-300 per metricton.

abolition of the export tax on rice is a well known one, and we do not intend to enter into any argument here. Our results simply suggest that there should be an effort to bring private and social profitability closer together on economics ground. The likely outcome would be a higher private profitability, thus providing an incentive to expand rice production.

3. Following the above, the high degree of negative nominal and effective protection on rice production resulting from the taxation system suggests a distortion which affects resource allocation such that there will be a tendency for resources to be used for other crops. A more appropriate taxation system on economics ground would be to have a more uniform incentive for all crops. Obviously this is difficult to accomplish in the case of agricultural products whose prices fluctuate more frequently. If prices suddenly rise and if the government does not interfere, it is likely that exporters would benefit from the rise. However, this does not mean that the government should interfere in an ad hoc manner. With the objectives of providing a uniform incentive in mind, effort should be made to create mechanisms through which prices could be stabilized at the level which would provide an adequate incentive in line with other crops.

4. The knowledge of DRC elasticities with respect to various cost components and yield can be used to provide economic parameters for evaluating rice development programs. It is recommended that these values be used in conjunction with other technological parameters. The high elasticities (low numerical values) imply that the programs should avoid using more of those inputs. And finally since the increase in different inputs

would have different effects on the increase in yield, it is suggested that the yield response be calculated for each input. This is in order to evaluate the "cross effect" as mentioned earlier.

5. Continuous assessment should be made on the critical minimum price of rice so that we know the range of prices within which Thailand would remain to have comparative advantage. The expansion of rice export is economically justified as long as the world price of rice is above the critical minimum level.

Citations

1. Narongchai Akrasanee and Atchana Wattananukit, "A Domestic Resource Cost Study of Rice Production in Thailand" (draft manuscript, Faculty of Economics, Thammasat University, October 1975).

2. James C. Ingram, Economic Change in Thailand, 1850-1970, Stanford University Press, Stanford, 1971.

3. Scott R. Pearson, Narongchai Akrasanee and Gerald Nelson, "Comparative Advantage in Rice Production: A Methodological Introduction," Food Research Institute Studies, V. XV, No. 1, 1976.

4. Ammar Siamwalla, "A History of Rice Policies in Thailand," Food Research Institute Studies, V.XIV, No. 3, 1975.

Appendix

1. Calculation of Costs of Production and Indicators of Profitability, Protection and Domestic Resource Cost

1. Cost of processing and transportation (P & T)

Data available are costs of production at the farm level and yield of paddy per rai. Since we need to have costs per unit of milled rice the P & T cost had to be estimated. This was obtained by first converting P & T cost per kilogram of milled rice shown in Section 3.1.2 per kilogram of paddy. Then for each area we multiplied yield per rai by it. Yields per rai were from the Agricultural Survey of 1973/74.

2. Costs of tradable inputs, domestic and foreign

Following the methodology outlined in Section 3.1.2 and basic data in (1), costs of tradable inputs were calculated. Seed was treated as traded, thus appeared as foreign cost. Fertilizer, insecticide, and fuel are fully traded. Costs paid by farmers were divided into four components: material (foreign), added cost (domestic), taxes on import (tariff and business tax on import), and business tax on domestic production. We have grouped insecticide and fuel together and call them "other." Added to this category was import content of the service of tractor and farm machinery. The remaining other costs were treated as domestic cost. Finally, there was the foreign component of the cost of processing and transportation.

3. Market and social costs of rice production

Using information from Section 3.1.2 and Appendix Section I.1 and I.2 above, factor costs and costs of tradable inputs were calculated for

Table A-1

Thailand - Domestic Processing and Transportation Cost per Rai
Unit: Baht

Areas/Techniques	P & T Cost per rai	
	Labor	Capital
Second crop		
Nontaburi	411	274
Chainat	477	318
Ayudhya	444	293
Supanburi	362	241
Chachoengsao	329	212
Chiengmai	296	197
Nakorn Nayok	329	220
Pathumtanee	370	247
First crop		
Traditional varieties, transplanting		
Chainat	344	229
Singburi	395	263
Modern varieties, transplanting		
Chainat	498	332
Singburi	512	341
Traditional varieties, broadcasting		
Chainat	336	224
Singburi	331	220

14 cases, both at market and social prices. Factor costs include costs of labor, land, domestic capital, and an item which was the summation of domestic costs of processing and transportation, fertilizer, other tradable inputs, service of tractor and agricultural machinery. This item was then allocated to labor and capital costs. Costs of tradable inputs include seed, fertilizer, other inputs, and the foreign cost of processing and transportation. Finally, tariffs, or import taxes, as well as business tax of domestic production, of all items were added up. The results are shown in Tables A-2 - A-15.

4. Calculation of indicators of profitability, protection and domestic resource cost

The calculation was made using information from Tables A-2 - A-15, the f.o.b. price of rice in 1974, the overall taxation on rice export, the official exchange rate of $20.40 per 1 U.S. dollar, and the shadow exchange rate of $25.8 per 1 U.S. dollar. Results and step-by-step calculation are shown in Table A-16.

II. Calculation of DRC elasticities

DRC elasticities were calculated with respect to the costs of labor, land, domestic capital, fertilizer, and yield per rai.

For each cost component, it was assumed that it increased by 10 percent. For factor cost, the increased cost was added to the total factor cost of the relevant area. DRC coefficient at the new factor cost was obtained, from which the change in DRC coefficient was calculated. Dividing the percentage change in the factor cost under consideration by the percentage

Table A-2

Thailand - Cost of Production for Paddy from Nontaburi, Second Crop
Yield per rai: 500 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	363.22	363.22	481.72
Land	66.40	66.40	
Capital			308.72
return	33.49	33.49	
depreciation (on NT[a] only)	15.64	15.64	
Nonallocated	790.44	790.44	
Tradable Inputs			
Seed	22.50	80.1	
Fertilizer	198.63	198.63	
Other	72.46	72.46	
Processing and Transportation	170	170	
Taxes: tariffs	8.18		
other	5.12		

Source: See text in the Appendix.

[a]NT = Non-traded.

Table A-3

Thailand - Cost of Production for Paddy from Chainat, Second Crop
Yield per rai: 580 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	512.93	512.93	527.03
Land	66.40	66.40	
Capital			350.49
return	45.98	45.98	
depreciation (on NT only)	9.33	9.33	
Nonallocated	877.52	877.52	
Tradable Inputs			
Seed	25.56	88.57	
Fertilizer	197.27	197.27	
Other	50.03	50.03	
Processing and Transportation	197.2	197.2	
Taxes: tariff	6.98		
other	1.97		

Source: See text in the Appendix.

Table A-4

Thailand - Cost of Production for Paddy from Ayudhya, Second Crop
Yield per rai: 540 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	480.92	480.92	481.07
Land	66.40	66.40	
Capital			327.7
return	43.30	43.30	
depreciation (on NT only)	3.20	3.20	
Nonallocated	808.77	808.77	
Tradable Inputs			
Seed	28.65	99.27	
Fertilizer	211.23	211.23	
Other	43.83	43.83	
Processing and Transportation	183.6	183.6	
Taxes: tariffs	6.95		
other	1.95		

Source: See text in the Appendix.

Table A-5

Thailand - Cost of Production for Paddy from Supanburi, Second Crop
Yield per rai: 440 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	400.62	400.62	428.76
Land	66.40	66.40	
Capital			268.20
return	35.54	35.54	
depreciation (on NT only)	18.43	18.43	
Nonallocated	696.96	696.96	
Tradable Inputs			
Seed	20.45	70.86	
Fertilizer	133.67	133.67	
Other	49.98	49.98	
Processing and Transportation	149.6	149.6	
Taxes: tariffs	6.18		
other	2.35		

Source: See text in the Appendix.

Table A-6

Thailand - Cost of Production for Paddy from Chachoengsao, Second Crop
Yield per rai: 400 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	407.28	407.28	364.7
Land	40.04	40.04	
Capital			243.6
return	33.70	33.70	
depreciation (on NT only)	22.31	22.31	
Nonallocated	608.3	608.3	
Tradable Inputs			
Seed	26.12	90.51	
Fertilizer	109.72	109.72	
Other	58.37	58.37	
Processing and Transportation	136	136	
Taxes: tariffs	6.0		
other	2.02		

Source: See text in the Appendix.

Table A-7

Thailand - Cost of Production for Paddy from Chiengmai, Second Crop
Yield per rai: 360 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	483.23	483.23	314.58
Land	39.36	39.36	
Capital			206.94
return	36.48	36.48	
depreciation (on NT only)	3.58	3.58	
Nonallocated	521.52	521.52	
Tradable Inputs			
Seed	19.73	68.36	
Fertilizer	40.84	40.84	
Other	22.6	22.6	
Processing and Transportation	122.4	122.4	
Taxes: tariffs	2.37		
other	.89		

Source: See text in the Appendix.

Table A-8

Thailand - Cost of Production for Paddy from Nakorn Nayok, Second Crop
Yield per rai: 400 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	448.20	448.20	363.62
Land	66.40	66.40	
Capital			241.82
return	36.47	36.47	
depreciation (on NT only)	23.86	23.86	
Nonallocated	605.44	605.44	
Tradable Inputs			
Seed	22.76	78.86	
Fertilizer	110.30	110.30	
Other	39.46	39.46	
Processing and Transportation	136	136	
Taxes: tariffs	4.91		
other	1.77		

Source: See text in the Appendix.

Table A-9

Thailand - Cost of Production for Paddy from Pathumtanee, Second Crop
Yield per rai: 450 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	504.57	504.57	435.13
Land	66.40	66.40	
Capital			274.2
return	40.04	40.04	
depreciation (on NT only)	12.40	12.40	
Nonallocated	709.33	709.33	
Tradable Inputs			
Seed	22.55	78.14	
Fertilizer	182.64	182.64	
Other	41.05	41.05	
Processing and Transportation	153	153	
Taxes: tariffs	5.9		
other	1.31		

Source: See text in the Appendix.

Table A-10

Thailand - Cost of Production for Paddy from Chainat, First Crop, Traditional Varieties, Transplanting Farms
Yield per rai: 418.30 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	138.70	138.70	357.71
Land	177.80	177.80	
Capital			251.30
return	18.29	18.29	
depreciation (on NT only)	4.80	4.80	
Nonallocated	609.01	609.01	
Tradable Inputs			
Seed	23.16	80.25	
Fertilizer	3.86	3.86	
Other	40.27	40.27	
Processing and Transportation	142.2	142.2	
Taxes: tariffs	3.16		
other	1.82		

Source: See text in the Appendix.

Table A-11

Thailand - Cost of Production for Paddy from Singburi, First Crop, Traditional Varieties, Transplanting Farms
Yield per rai: 480.3 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	141.69	141.69	409.16
Land	177.80	177.80	
Capital			272.39
return	14.83	14.83	
depreciation (on NT only)	4.80	4.80	
Nonallocated	681.51	681.51	
Tradable Inputs			
Seed	22.28	77.20	
Fertilizer	6.78	6.78	
Other	25.91	25.91	
Processing and Transportation	163.3	163.3	
Taxes: tariffs	2.07		
other	1.09		

Source: See text in the Appendix.

Table A-12

Thailand - Cost of Production for Paddy from Chainat, First Crop, Modern Varieties, Transportation Farms
Yield per rai: 606.4 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	153.44	153.44	515.71
Land	177.80	177.80	
Capital			359.73
return	23.23	23.23	
depreciation (on NT only)	4.80	4.80	
Nonallocated	875.44	875.44	
Tradable Inputs			
Seed	27.12	93.97	
Fertilizer	21.24	21.24	
Other	49.11	49.11	
Processing and Transportation	206.18	206.18	
Taxes: tariffs	3.69		
other	2.75		

Source: See text in the Appendix.

Table A-13

Thailand - Cost of Production for Paddy from Singburi, First Crop, Modern Varieties Transplanting Farms
Yield per rai: 622.3 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	183.41	183.41	521.54
Land	177.80	177.80	
Capital			356.06
return	19.75	19.75	
depreciation (on NT only)	4.80	4.80	
Nonallocated	877.60	877.60	
Tradable Inputs			
Seed	19.44	67.36	
Fertilizer	19.13	19.13	
Other	35.72	35.72	
Processing and Transportation	211.58	211.58	
Taxes: tariffs	3.0		
other	.95		

Source: See text in the Appendix.

Table A-14

Thailand - Cost of Production for Paddy from Chainat, First Crop, Traditional Varieties, Broadcasting Farms
Yield per rai: 406.5 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	86.01	86.01	347.56
Land	177.80	177.80	
Capital			237.46
return	16.31	16.31	
depreciation (on NT only)	4.80	4.80	
Nonallocated	585.02	585.02	
Tradable Inputs			
Seed	38.53	133.51	
Fertilizer	.35	.35	
Other	38.49	38.49	
Processing and Transportation	138.21	138.21	
Taxes: tariffs	3.04		
other	1.83		

Source: See text in the Appendix.

Table A-15

Thailand - Cost of Production for Paddy from Singburi, First Crop, Traditional Varieties, Broadcasting Farms
Yield per rai: 402.12 kg. Unit: Baht/rai

Costs	Market Cost	Social Cost	Unspecified
Factor Costs			
Labor	113.29	113.29	339.49
Land	177.80	177.80	
Capital			228.31
return	15.94	15.94	
depreciation (on NT only)	4.80	4.80	
Nonallocated	567.80	567.80	
Tradable Inputs			
Seed	38.82	134.51	
Fertilizer	2.05	2.05	
Other	26.97	26.97	
Processing and Transportation	136.72	136.72	
Taxes: tariffs	2.14		
other	1.21		

Source: See text in the Appendix.

Table A-16

Costs and Returns Data and Indicators for Thailand, 1974
(Thailand Baht per kilogram, or as indicated)

Costs and Return Data and Indicators (1)	Second Crop								Traditional Variety Transplanting		Modern Variety, Transplanting		Traditional Variety, Broadcasting	
	Nonta-buri (2)	Chainat (3)	Ayudhya (4)	Supan-buri (5)	Chachoeng-sao (6)	Chiang-mai (7)	Nakorn Nayok (8)	Pathum-tanee (9)	Chainat (10)	Singburi (11)	Chainat (12)	Singburi (13)	Chainat (14)	Singburi (15)
1. Gross output at actual market prices	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76	5.76
2. Tradable inputs, at actual market prices	1.41	1.24	1.33	1.22	1.26	.83	1.18	1.35	.77	.68	.76	.70	.81	.77
3. Value added, in actual prices [(1)-(2)]	4.35	4.52	4.43	4.54	4.50	4.93	4.58	4.41	4.99	5.08	5.00	5.06	4.95	4.99
4. Factor costs, other than capital, at actual market prices	2.53	2.88	2.88	3.05	3.05	3.35	3.29	3.35	2.43	2.24	2.09	2.13	2.26	2.35
5. Indirect taxes	.02	.004	.005	.01	.02	.01	.01	.003	.01	0	.01	0	.01	0
6. Private profitability [(3)-(4)-(5)]	1.82	1.64	1.55	1.48	1.43	1.57	1.28	1.06	2.55	2.84	2.90	2.93	2.68	2.64
7. Gross output, at world market prices	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17	11.17
8. Tradable inputs, at workd market prices	1.56	1.39	1.51	1.37	1.48	1.02	1.37	1.51	.96	.85	.92	.80	1.15	1.12
9. Value added in world market prices [(7)-(8)]	9.61	9.78	9.66	9.80	9.69	10.15	9.80	9.66	10.21	10.32	10.25	10.37	10.02	10.05
10. Domestic resource costs other than capital, at opportunity costs	2.53	2.88	2.88	3.05	3.05	3.35	3.29	3.35	2.43	2.24	22.09	2.13	2.26	2.35
11. Social profitability [(9)-(10)]	7.08	6.9	6.78	6.75	6.64	6.80	6.51	6.31	7.78	8.08	8.16	8.24	7.76	7.70

(continued)

Table A-16 (continued)

Costs and Return Data and Indicators (1)	Second Crop								Traditional variety Transplanting		Modern Variety, Transplanting		Traditional Variety, Broadcasting	
	Nonta-buri (2)	Chainat (3)	Ayudh-ya (4)	Supan-buri (5)	Chachoeng-sao (6)	Chiang-mai (7)	Nakorn Nayok (8)	Pathum-thani (9)	Chainat (10)	Singburi (11)	Chainat (12)	Singburi (13)	Chainat (14)	Singburi (15)
12. Domestic capital costs, at opportunity costs	1.07	1.06	1.05	1.10	1.12	.99	1.13	1.09	.99	.92	.96	.92	.95	.95
13. Net social profitability at official exchange rate [(11)-(12)]	6.01	5.84	5.73	5.65	5.52	5.81	5.38	5.22	6.79	7.16	7.20	7.32	6.81	6.77
14. Ratio of shadow price of foreign exchange (SPFX) to official exchange rate (OER)	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26
15. Net social profitability at SPFX[(9)x(14)-(10)+(12)	8.51	8.38	8.24	8.19	8.04	8.45	7.93	7.73	9.44	9.84	9.87	10.02	9.42	9.38
16. Nominal protective coefficient on output (NPCO) [(1)+(7)]	.52	.52	.52	.52	.52	.52	.52	.52	.52	.52	.52	.52	.52	.52
17. Nominal protective coefficient on tradable inputs (NPCI) [(2)+(8)]	.91	.89	.88	.89	.85	.81	.86	.89	.80	.80	.85	.88	.70	.69
18. Effective protective coefficient on value added (EPC) [(3)+(9)]	.45	.46	.46	.46	.46	.49	.47	.47	.46	.49	.49	.49	.49	.50
19. Domestic resource cost coefficient (DRC) [(10)+(12)+(9)]	.37	.40	.41	.42	.43	.43	.45	.46	.34	.31	.30	.29	.32	.33
20. Ratio of DRC to SPFX/OER [(9)+(14)]	.29	.32	.33	.33	.34	.34	.36	.37	.26	.25	.24	.23	.25	.26
21. Yield (kilogram of paddy/rai)	500	580	540	440	400	360	400	450	418.13	480.30	606.40	622.30	406.50	402.10
22. Milling ratio (kilograms of paddy/kilogram of milled rice)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

Source: See text in the Appendix.

change in DRC coefficient gave us the DRC elasticity.

In case of fertilizer, its cost was added to the cost of tradable inputs, thus reducing value added at world prices. DRC coefficient was obtained from this new value added and the existing factor costs. The procedure described above was then applied to calculate the DRC elasticity.

Changes in the cost of processing and transportation affected both value added and factor cost. The factor cost part of the P & T cost, which was estimated at 80 percent, was added to the existing factor cost. The remaining 20 percent tradable input part was added to the cost of tradable inputs. The cost was in baht per kilogram of milled rice.

Changes in yield per rai affected average cost and value added. Using costs from Table A-1 and A-2 - A-15, the total P & T cost was adjusted for the increase in yield, also assumed to increase by 10 percent. (The P & T cost considered to be factor cost was $1.37 per kilogram of paddy.) This was added to other factor costs, from which the average cost per kilogram of milled rice was obtained. For value added, the foreign part of P & T cost was added to the cost of tradable inputs. The new average cost and hence value added were obtained for one kilogram of milled rice. DRC elasticity was then calculated.

III. Calculation of DRC at different hypothetical world prices of rice

Two sets of calculation were made. The high estimates were those which were adjusted for only world prices of rice and the tradable input cost of paddy which changed as the f.o.b. price of rice changed. The low estimates

took into consideration the implied change in the cost of processing and transportation (P & T), since this was estimated from the 1974 f.o.b. price of rice. They were considered low estimates because the P & T cost became unrealistically low at a low level of f.o.b. price of rice. They reduce factor costs much more than value added, resulting in a very low DRC coefficient.

1. Factor costs at opportunity cost

To adjust factor costs for the cost of processing and transportation, we used the estimated proportion of 23 percent of the respective world price of rice to multiply the P & T cost. This was then converted to the cost per kilogram of paddy, out of which 80 percent was considered to be factor cost. Multiplying the unit cost to paddy yield gave us the relevant P & T cost. The 1974 factor cost at opportunity cost was then adjusted according.

When the P & T cost was assumed not to change with the world price, the 1974 factor cost at opportunity cost was used.

2. Value added at world prices

Costs of tradable inputs were adjusted for paddy cost. Paddy input was valued at 2/3 of each world price of milled rice. The adjusted value was obtained by multiplying the opportunity cost of paddy at 1974 price by the ratio of the new calculated paddy price to the 1974 calculated paddy price.

The tradable input part of the P & T cost was obtained for each f.o.b. price, using the proportion of 23 percent, out of which 20 percent was the cost of tradable input. This cost of tradable input was deducted from the 1974 cost, following the method of estimation described in III.1 above. The numerical results are shown in Table A-17.

Table A-17

Thailand - Hypothetical World Prices of Rice and DRC

World Price	Nontaburi (Second Crop)				Singburi (Modern Varieties, First Crop)			
	High DRC		Low DRC		High DRC		Low DRC	
	DRC	DRC OER/SPFX	DRC	DRC OER/SPFX	DRC	DRC OER/SPFX	DRC	DRC OER/SPFX
550	.37	.29	.37	.29	.29	.23	.29	.23
450	.46	.36	.42	.33	.36	.29	.32	.26
350	.60	.47	.49	.39	.46	.37	.35	.28
250	.85	.68	.63	.50	.64	.51	.41	.33
150	1.49	1.18	1.02	.81	1.06	.84	.56	.44
100	2.05	1.62	1.43	1.13	1.59	1.26	.77	.61

Source: See text in Appendix A-III.