UNIVERSITI PUTRA MALAYSIA

AN APPLICATION OF SPATIAL EQUILIBRIUM ANALYSIS TO THE PADDY POSTHARVEST SYSTEM IN TANJONG KARANG, PENINSULAR MALAYSIA

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by

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UPM

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PENGGUNAAN "SPATIAL EQUILIBRIUM ANALYSIS" KEPADA SISTEM LEPAS-TUAI PADI DI TANJONG KARANG, SEMENANJUNG MALAYSIA

by

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Pengendalian sistem lepas-tuai padi yang kurang sesuai dan kelewatan didalam pemerosesan padi telah menyebabkan pembaziran di dalam industri ini. Pembaziran adalah di antara 10 hingga 37 peratus, yang berlaku semasa penuaian, membanting, pengeringan, penyimpanan dan pengilangan. Selain itu industri ini mengalami masaalah penurunan kualiti padi, pengeluaran beras bermutu rendah dan kos penggangkutan yang tinggi. Di dalam sistem lepas -tuai padi diangkut dengan menggunakan guni, selain dari kos pengendalian yang tinggi cara ini juga telah menyebabkan kelewatan di dalam pemerosesan padi yang ahkirnya menyebabkan

perubahan warna dan pertumbohan kulat yang menurunkan nilai padi dan beras.

"Spatial equilibrium model" telah digunakan untuk menganalisa sistem lepas-tuai padi di Tanjong Karang, serta mengenalpasti cara-cara untuk memperbaikinya. Model ini berasaskan kepada program linear dengan objektif untuk memaksimakan pulangan bersih tahunan. Tertakluk kepada dua puluh sembilan persamaan batasan, yang meliputi batasan pengedaran padi dan beras, keupayaan, kelewatan, pengendalian, harga, penawaran dan permintaan. Situasi ekonomi jangka-pendek telah digunakan untuk mendapatkan keputusan yang optima dengan cara pengubahsuaian di dalam sistem pengendalian yang ada.

Keputusan asas dari model, dibandingkan dengan data yang didapati dari sistem pengedaran sebenar padi di Tanjong Karang. Hasil dari perbandingan ini, didapati bahawa keputusan dari model adalah lebih kurang sama dengan data yang didapati, ini memberi keyakinan di dalam menggunakan model ini untuk analisa selanjutnya. Model seterusnya diperbaiki dengan menggunakan persamaan yang bukan linear. Walaupun hasil dari penggunaan persamaan bukan linear memberi keputusan yang lebih tepat, tetapi oleh kerana kelemahan di dalam perisian MINOS yang ada, maka penggunaan persamaan bukan linear tidak dapat diteruskan di dalam analisa selanjutnya.

Seterusnya model diubahsuaikan untuk menilai prestasi sistem-sistem pengendalian lepas-tuai padi yang dicadangkan serta menganalisa kepekaan keputusan terhadap perubahan koefisien pembolehubah-pembolehubah yang tertentu. Hasil dari analisa menunjukkan bahawa sistem pengendalian secara separuh pukal dengan kemudahan pengeringan di pusat belian adalah sistem yang sesuai diperkenalkan di Tanjong Karang. Kos pembelian padi, harga beras dan kadar pengilangan dari padi ke beras merupakan pembolehubah-pembolehubah yang penting di dalam industri ini.

Abstract of the thesis presented to the Senate of Universiti Pertanian Malaysia in partial fulfilment of the requirements for the degree of Master of Science.

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Paddy postharvest losses in Malaysia range between 10 percent to 37 percent. These losses occur during manual handling in harvesting of paddy, threshing, drying, storing and milling. The major cause of these losses is attributed to improper handling methods and inadequate handling facilities. In addition, the industry also faces problems of deterioration in paddy quality, low quality rice and high transportation cost. In the present postharvest system, paddy is handled in gunny bags. Besides being costly, this type of handling method also causes delays in processing the paddy resulting in

discoloration of paddy and rice, development of moulds and fungus causing loss of value.

A spatial equilibrium model was used to analyse the existing paddy postharvest system in Tanjong Karang as well as to determine measures to improve the industry. The model is basically a linear programming model with the objective function of maximizing net industry revenue. The model constraints consist of twenty nine set of equations relating to paddy and rice flows, capacity, queuing, handling, pricing, supply and demand. The short-run economic situation is simulated in the model to find the optimal solution. Results obtained from the model show the optimal flows of paddy and rice from production areas to procurement centres, mills and final markets, together with the costs involved in each of the activities.

The basic model results were first calibrated against actual grain flows in Tanjong Karang area. It was found that the theoretical results were close to the actual grain flows to justify confidence in using the model for further analysis. The model was refined by employing a nonlinear drying function. The results of the nonlinear model were more accurate compared to results from the linear model. However, due to the limitations of the existing MINOS package, the use of nonlinear function cannot be extended to other activities.

Changes were then inflicted in the model to evaluate new handling systems and the sensitivity of the results to these changes. The results indicate that the semibulk handling system with drying facilities at procurement centres is a viable and applicable system that can be introduced in Tanjong Karang. Purchasing costs of paddy, rice prices and rice recovery rates are the most sensitive variables in the industry.

CHAPTER 1

INTRODUCTION

Paddy and Rice Industry in Malaysia

At present, paddy is cultivated on approximately 422 million hectares of land throughout Peninsular Malaysia (see Figure 1). Of this total area, approximately 300 million hectares have been provided with irrigation and drainage facilities. The major irrigation areas are found in Kedah/Perlis, Pulau Pinang, Perak, Selangor, Trengganu and Kelantan.

Paddy industry has played and continues to play an important role in the socioeconomics of the country. Malaysians consume rice for their major source (50 to 60 percent) of calories (Zulkifli, 1985). Rice also accounts for a major part of the total household expenditure on food items in Peninsular Malaysia, with the percentage of 24.1 percent (Household Expenditure Survey, 1973). From a household income survey reported in 1984 approximately 116,600 households were known to be involved in paddy cultivation.

Source: Ministry of Agriculture

Figure 1 : Paddy Growing Areas in Peninsular Malaysia

The incidence of poverty[1] among paddy cultivators is 57 percent, making it the group with the highest incidence of poverty in the agriculture sector (Fifth Malaysia Plan). Despite the employment of approximately 20 percent of the total labour force and 57 percent of the available agriculture land for food crops for rice cultivation (Economic Report, 1984), Malaysia is still unable to achieve self-sufficiency in rice (Table 1). The government has to import rice from other countries such as Thailand, Burma, Australia, Pakistan and the United States of America to satisfy consumption requirements. In 1980, the amount of rice imported was 167,000 tonnes. The amount increased to 426,000 tonnes in 1985, which is equivalent to M$255 million[2] (Paddy Statistic, 1980-1985). It is estimated that currently imported rice satisfy about 30 to 40 percent of the country's consumption needs.

The Malaysian government has made a lot of efforts to upgrade the paddy and rice industry. Efforts in this direction include irrigation and infrastructure development, input and output subsidies, research and extension, farmer training, farm mechanisation, credit, as well as providing processing and marketing facilities. Since 1957 till 1985, the government has granted total input and output subsidies of not less than M$2,000 million to the paddy and rice sector (Alwi, 1986).

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1 Households (averaging 5.5 members) with income of less than $137.5 per month are considered poverty (Problem and Rural Poverty in Malaysia, 1983).

2 One US$ = 2.4 M$ in February 1987

Table 1

Self-Sufficiency Rate for Rice, Peninsular Malaysia, 1962-1985

Year	Self-Sufficiency Rate (%)
1962	67
1963	62
1964	60
1965	72
1966	76
1967	70
1968	77
1969	74
1970	78
1971	87
1972	91
1973	88
1974	85
1975	95
1976	91
1977	87
1978	74
1979	92
1980	98
1981	90
1982	81
1983	86
1984	77
1985	75

(Source: Malaysian Ministry of Agriculture
: Paddy statistic various issues)
Note : Self-sufficiency target in 1985 is between 80 to 85 percent

The government's major investment is in infrastructural development, focussing on the provision of drainage and irrigation facilities as can be seen in Table 2. The amount spent from 1956 to 1960 on irrigation and drainage is M$32.0 million and this had been increased to M$1424.6 million from 1981 to 1985.

The paddy price subsidy scheme is an extension of the price support scheme, which was started in 1949. Under this scheme, farmers were given a coupon valued at M$33.05 per tonne of paddy sold. This was in February 1980. In 1981 the value of subsidy was revised to M$165.00 per tonne.

In addition there is input (fertilizer) subsidy scheme. This fertilizer subsidy scheme was started in 1979 with the objective of encouraging farmers to use fertilizer as well as to reduce their production costs. Under this scheme, farmers with less than 2.4 hectares of paddy field were given free fertilizer of 4 kilograms Ammophos, 40 kilograms Urea and 80 kilograms Mixture for each 0.47 hectare they plant.

To support these two schemes, the government spent approximately $696 million for the period 1981 to 1984 (Table 3). Research on various aspects of rice especially developing new variety were also carried out by MARDI (Malaysian Agriculture Research and Development Institute). Since 1972 about 15 improved paddy varieties were released to farmers. Amongst the varieties are hybrid Malinja, Mahsuri, Ria, Bahagia, Murni, Masria, Setanjung, Sekinchang and Kadaria.

Table 2

Expenditure of Irrigation and Drainage Projects (M$ Million)

Period	Actual Expenditure
1956 - 1960	32.0
1961 - 1965	96.7
1966 - 1970	273.7
1971 - 1975	217.8
1976 - 1980	554.8
1981 - 1985	1424.6

Source: First and Second Five Years Plan.
: First to Fifth Malaysian Plan.

Table 3

Government Expenditure in Input and Product Subsidies (M$)

Year	Input Subsidy (Fertilizer)	Product Subsidy (Price)	Total
1981	130,000,000	105,438,354	235,438,354
1982	87,450,000	83,394,471	173,844,471
1983	79,903,016	60,332,394	140,235,610
1984	73,457,760	73,458,000	146,915,760
Grand Total			696,434,195

(Source: Ministry of Agriculture)

These are short-term varieties with potential yield between 3 to 5 tonnes per hectare (Chen Yok Hwa, et al., 1980). To complete the incentives, the government in addition, has also set up credit and marketing facilities, with the formation of Bank Pertanian and Lembaga Padi dan Beras Negara (LPN) respectively.

The goverment incentives have had a positive effect on the production of paddy in Malaysia. In 1960 approximately 303,00 hectares of land was planted with paddy, producing 756,000 tonnes of paddy. By 1981, the total planted area had risen to 561,000 hectares. This increase was mainly due to the rise in off-season crops as a result of the double-cropping system.[3] The percentage of double-cropping increased from 2 percent of the total paddy area in 1960 to 37 percent of the total paddy area in 1981 (Table 4). However, since 1982 the total planted areas had declined. Various reasons have been cited for this declined. The decline has been attributed among other things, to late planting of off-season crops, pest and diseases, poor water management, and the domestic policy of concentrating production in the more cost-efficient areas (Economic Report, 1986/87).

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[3] Paddy planted in the main season is generally harvested during the months of February to April which is the dry season. For the off-season crop, harvesting is normally done during the months of July to October, which is the wet season.