Profitability and Competitiveness of Rice Farming in Malaysia: A Policy Analysis Matrix

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ABSTRACT

In recent years, the Malaysian rice sector has experienced structural changes to improve its competitiveness within a dynamic environment that is influenced by political, technical, economic, and international trade challenges. Using a policy analysis matrix and a rich dataset on rice producing households in four of Malaysia's granary areas, the competitiveness of rice production in Malaysia is analyzed. The empirical results show that rice production is competitive in three of the four granary areas, the exception being Ketara granary area. To fully understand the importance of the competitive farms, they must be identified and studied by further research using disaggregated data. The finding suggests that government policy should focus on encouraging structural changes capable of enabling the local farms to grow enough to earn sufficient income, generate social profits, and thus improve the sector's competitiveness.

Keywords: Policy Analysis Matrix, competitiveness, self-sufficiency, rice production, Malaysia
JEL Classification: D2, Q18

INTRODUCTION

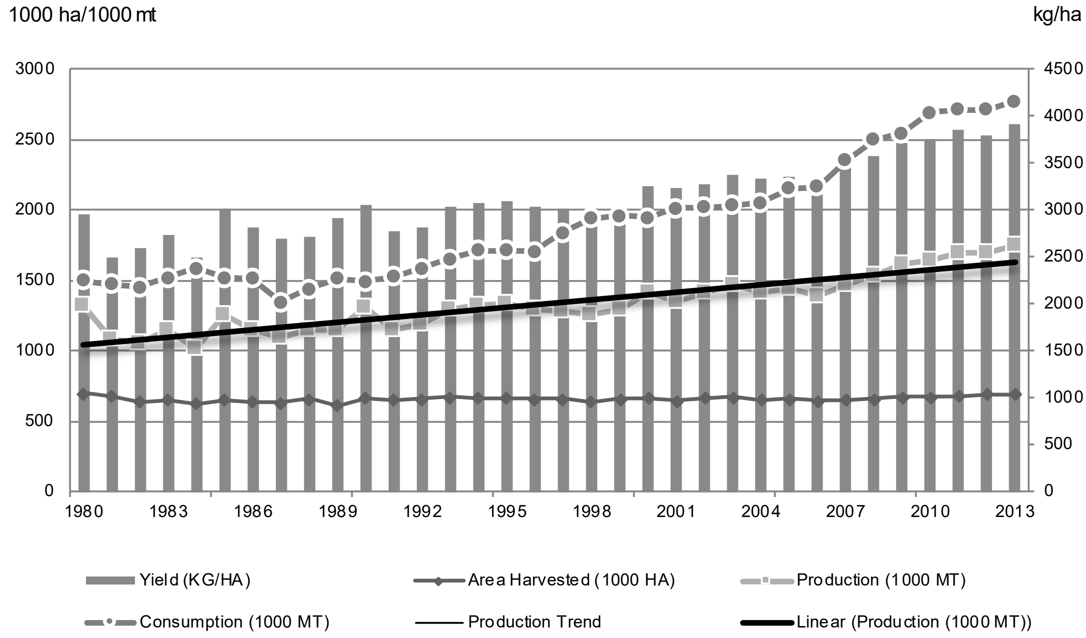
Overview of the Rice Sector

Rice plays an essential role in Malaysian society as it fosters agricultural activity and contributes to the nourishment of a rising population. Rice accounts for 4.1 percent of total agricultural value added. In 1995, rice occupied 6.9 percent of the total agricultural land in Malaysia. This value increased to approximately 9.7 percent by 2005 partly due to the opening of new regions for rice production. As a significant pillar of Malaysian agricultural production, the rice sector is also an important source of employment. Furthermore, rice is a daily staple food and the major source of calorie intake in the country, as Malaysians consume between 2.5 and 2.7 million tons of rice annually.

Even though Malaysia's rice production has fluctuated over the last two decades, it exceeded the long-term trend in recent years from 2006 to 2013 (Figure 1). Between 2005 and 2013, the harvested area increased from 660,000 hectares (ha.) to 690,000 ha. Overall paddy yield in Malaysia has increased from 3.36 metric tons per hectare (MT/ha) in 2005 to 3.91 MT/ha in 2013. This increase in production areas and yields has been attributed to the government's investments in infrastructure, high-yielding varieties, generally favourable growing conditions, and higher productivity (USDA 2012).

Consumption of rice in Malaysia has increased consistently since the 1990s and will continue to do so due to population growth and the increasing number of tourists and immigrant workers in Malaysia (USDA 2013). Additionally, rice is also a raw input for highly demanded food products such as vermicelli. Current rice production in Malaysia is not able to meet growing domestic demand. Malaysia only produces

Figure 1. Rice production, consumption, yield, and harvested area in Malaysia (1980–2013)



Source: USDA (n.d.)

70 percent of its total rice requirement, and imports the remaining 30 percent from suppliers such as Thailand, Vietnam, and Pakistan. Clearly, as the population increases and rice consumption grows, the gap between demand and the supply of rice will continue to widen. Malaysia's lack of self-sufficiency in rice production results in dependence on rice imports, which cost the country millions of Malaysian Ringgit (MYR) annually and increasing its trade deficit.

A series of dramatic changes in rice markets occurred globally, precipitated by a hike in the price of petroleum and world food prices, coupled with the tripling of the rice price in Thailand and other major exporting countries in 2008 (Jamora and Von Cramon-Taubadel 2012; Rosegrant and Sulser 2002). The 2008 food crisis led to an increase in input costs and reduced profits for rice in Malaysia. While the input costs placed further financial pressure on farmers, they continued to struggle to maximize profits and make ends meet. Similar to other developing countries, Malaysia being a net importer of rice was caught in the tension of the food crisis (Tey and Radam 2011; Timmer 2007).

By definition, the concept of food security entails emphasis on providing adequate amounts of food in the context of food production (the primary interest at the national level), while simultaneously ensuring that affordable and nutritious food is easily accessible (the primary interest at the household and individual levels) (FAO 1983). In response to increased efforts to achieve food security, new initiatives have been enacted to ensure citizens have access to sufficient food supplies. Malaysia has more than 100,000 farmers who depend solely on rice production and their employment in the rice industry to live above the poverty level (Md. Wahid, Nik Hushim, and Chamhuri 2014). Thus, robust planning and a coherent commitment from all parties are crucial for establishing food security and effectively addressing poverty.

Furthermore, the Malaysian rice sector struggles to increase its competitiveness within a dynamic environment of political, technical, economic, and trade challenges. Globalization and international trade, which are vital to Malaysia's development, expose the rice sector to competition with producers in other countries. As a member of the World Trade Organization (WTO), Malaysia is bound by the results of the Uruguay Round Agreement on Agriculture. These commitments include rules and regulations in the areas of domestic support, export subsidies, and market access in agriculture. Whether or not Malaysian rice production is profitable from a comprehensive economic perspective depends on its comparative advantage, under conditions of no subsidies or with the limited subsidies that are permitted under WTO rules. Therefore, an assessment of comparative advantage can be helpful to assess how rice production can contribute to poverty reduction and food security in Malaysia.

The Evolution of Rice Market Policies in Malaysia

Malaysia is one of the most liberalized trading nations with low tariffs on most commodities and products (Ahmad and Tawang 1999). Low tariffs on staple food imports can be interpreted as an attempt to find a compromise between the objective of stimulating production to increase food security, and the objective of ensuring that food is available to consumers at affordable prices. As rice is considered to be a strategically important commodity, the Malaysian government intervenes more in the rice market than in other commodity markets. Policy measures for rice include: (1) a monopoly on imports; (2) controlled prices for milling, wholesale, and retail rice;

(3) fertilizer subsidies; (4) price support; (5) provision of drainage and irrigation facilities; (6) spurring innovation; and (7) public investments in research and development (R&D).

The Malaysian government has been intervening in the rice industry since the country's independence in 1957. The transition from colonial to post-independence government shifted the rice policy towards achieving self-sufficiency and reducing dependence on imports. As explained by Rudner (1975), the newly-elected independent government targeted to achieve food self-sufficiency by 1963. The rice sector was targeted to be 65 percent self-sufficient in order to ensure its accessibility and availability, particularly during a food crisis. Beyond this 65 percent, the government argued that it is cheaper to import rice from the world market so as to release arable lands to more lucrative and profitable industrial crops that yield high value products and provide more export earnings. Table 1 presents the major policy changes in the Malaysian rice sector.

In the Third National Agriculture Policy (1998–2010), eight granary areas were designated as permanent rice growing areas responsible for achieving at least 65 percent self-sufficiency. The Eight Malaysia Plan (2001–2005) increased this target to 72 percent, and the Ninth Malaysia Plan (2006–2010) increased it further to 90 percent. However, these targets were not met. The Minister of Agriculture and the Agro-Based Industry announced that Malaysia is determined to achieve its target to end rice imports and become entirely self-sufficient by 2020 (Mohd Zin 2014).

Aiming for 100 percent self-sufficiency is a political goal that is based not only on economic but also on other considerations such as national sovereignty. Nevertheless, economic analysis can provide information on the economic costs of pursuing this goal, and thus contribute to a comprehensive cost-benefit analysis of self-sufficiency policy. A key distinction to be made here is between the private and social profitability of rice production. If rice production is not privately

Table 1. Major policy changes in the Malaysian rice sector

Year	Major Policy Change
Late 1950s	Provision of fertilizer subsidy scheme, Guaranteed Minimum Price (GMP) and price subsidy, which have continued over the decades
1960s	Initiation of several programs of land development, notably in irrigation and drainage works necessary for double cropping (e.g., Muda Irrigation Scheme in Kedah) (Rudner 1975)
Mid 1970s	Creation of an agency—Padiberas Nasional Berhad (BERNAS)—as a rice monopoly to regulate the development of the rice industry and rice marketing; establishment of the Malaysian Research and Development Institute (MARDI) to spur innovation and enhance research and development (R&D) in the rice sector
1980	Introduction of price subsidy at the rate of MYR 165 (USD 45) per ton and later increased to MYR 248.10 (USD 85) per ton in 1990
Late 1990s	Designation of eight granary areas as permanent rice growing areas
2008	Introduction of a more comprehensive fertilizer subsidy program aimed at expanding the support provided to paddy producers due to the continuous increase in prices (Department of Agriculture 2010)

profitable for farmers in Malaysia, they cannot be expected to contribute to increasing self-sufficiency by increasing production. The government can increase private profitability by providing additional incentives such as input subsidies or price support. However, this raises the issue of social profitability. If the total social cost of producing rice in Malaysia—including private costs faced by the farmers and also the costs of any subsidies or support provided by the government—exceed the value of the rice produced, then increased self-sufficiency in rice is being achieved at the cost of misallocation of scarce resources and reduced economic output in the country as a whole.

Social profitability is equivalent to true international competitiveness and determines whether the production of a product increases or reduces total value added in the economy. If rice production is not socially profitable in Malaysia, then it is not internationally competitive; thus the government's plan to become self-sufficient by 2020 will impose costs on the rest of the economy. This might be politically desirable, but if domestic rice production is not internationally competitive, Malaysia would be better off putting its agricultural resources to other uses that generate higher returns, and using the proceeds to import rice instead. These issues are addressed in this study through an empirical analysis of the competitiveness of rice production in four of Malaysia's most important rice producing areas.

METHODOLOGY

The policy analysis matrix (PAM), which was developed by Monke and Pearson (1989), is a double-entry bookkeeping analytical framework that helps analysts and policymakers to understand (1) the effects of policy on competitiveness and farm-level profits; (2) the influence of public investments on the efficiency of the agricultural system; and (3) the effects of agricultural research and development on economic efficiency and comparative advantage (Masters and Winter-Nelson 1995; Siggel 2006). Its principal strength is that it provides a straightforward policy-induced transfer analysis and allows various levels of disaggregation. Its major weakness lies in the assumption of fixed input-output coefficients (i.e., limitational production technology), which is unrealistic in some settings (Nelson and Panggabean 1991).

As illustrated in Table 2, PAM has two cost columns which present tradable inputs and domestic factors. Tradable inputs are seeds, fertilizers, pesticides, lime, and fuel while non-tradable inputs are labor and land.

The first row of the PAM provides a measure of private profitability *(D)*, which is calculated using revenues *(A)* minus the costs of tradable and non-tradable inputs *(B+C)*. This row assesses the values of all outputs and inputs at private prices, reflecting the actual market or financial prices received by the farmers, processors, or merchants in the agricultural system (Monke and Pearson 1989; Nelson and Panggabean 1991). The underlying economic costs and valuation, together with the effects of all policies and market failures, are included in these prices. Thus, the private profitability calculation indicates whether production is profitable from the individual farmer's perspective.

The second row of the table measures the social profits *(H)* that reflect the comparative advantage and efficiency of the agricultural system or usage of resources. Efficient outcomes are achieved when the resources of an economy are used in a way that creates the highest level of outputs and income. Accordingly, social profits are determined using social prices or values, which provide a benchmark for comparisons because they reflect prices in a free market in the absence of policy interventions, distortions, and market failures (Kanaka and Chinnadurai 2013; Monke and Person 1989).

To calculate social profits, revenue *(E)* and input costs *(F+G)* are valued at social prices that reflect scarcity values or opportunity costs. Social profits measure the international comparative advantage by indicating the foreign exchange saved by reducing imports or earned by expanding exports of each unit of production. A positive value indicates that the production of a commodity contributes to national income, whereas a negative value suggests that the country would be better off reallocating its domestic resources towards the production of another commodity (Kanaka and Chinnadurai 2013).

The third row measures divergences that are defined as the differences between private and social valuations of revenues, costs, and profits. These divergences are separated into three categories, namely: (1) distorting policies, (2) market failure, and (3) efficient policies. Distorting policies (such as a subsidy on input use, or output price support) drive a wedge between private and social prices of tradable outputs and inputs. Market failure such as an externality (e.g., pollution caused by producers that imposes costs on other members of society) also creates a divergence between the private

Table 2. Policy Analysis Matrix (PAM)

Year	Revenue	Cost		Profit
		Tradable Input	Domestic Factor	
Private prices	$A = P_i^D$	$B = \sum_{j=1}^{k} a_{ij} P_j^D$	$C = \sum_{j=k+1}^{n} a_{ij} W_j^D$	$D = A - B - C$
Social prices	$E = P_i^S$	$F = \sum_{j=1}^{k} a_{ij} P_j^S$	$G = \sum_{j=k+1}^{n} a_{ij} W_j^S$	$H = E - F - G$
Effects of divergences and efficient policy	$I = A - E$	$J = B - F$	$K = C - G$	$L = D - H = I - J - K$

Source: Monke and Pearson (1989)

Notes:

The subscript *i* refers to outputs and the subscript *j* refers to inputs,

a_{ij} *for (j = 1 to k)* is technical coefficients for traded inputs in the production of i;

a_{ij} *for (j = k+1 to n)* is technical coefficients for domestic inputs in the production of i;

P_i* is the price of output *i*, evaluated privately *(*=D)* or socially *(*=S);*

P_j* is the price of traded input *j*, evaluated privately *(*=D)* or socially *(*=S);*

*Wj** is the price of domestic input *j*, evaluated privately *(*=D)* or socially *(*=S);*

D (A − B − C) measures private profit;

H (E − F − G) measures social profits;

I (A − E) measures output transfers;

J (B − F) measures input transfers;

K (C − G) measures factor transfers;

L (D − H or I − J − K) measures net transfers;

DRC = G/(E − F);

SCB = (F + G)/E;

$NPC_i = A/E;$

EPC = (A − B)/(E − F).

costs upon which producers base their decisions, and the social costs of these decisions. Efficient policies (such as a tax on pollution caused by producers) correct or offset market failures by reducing the differences between private and social valuations, and thus correcting divergences (Masters and Winter-Nelson 1995; Monke and Pearson 1989).

The various quantities in the PAM can be used to generate a number of ratios that cast light on competitiveness and how it is affected by government policies. These include the following: (1) domestic resources cost ratio *(DRC)*, (2) social cost benefit ratio *(SCB)*, (3) profitability coefficient *(PC)*, (4) subsidy ratio to producers *(SRP)*, and (5) private (social) net return to land *(PNRL/SNRL)*. Developed simultaneously in the 1960s by Bruno (1965) and Krueger (1966), the *DRC* is defined as the shadow value of non-tradable inputs used in an activity per unit of tradable value added $(G/(E-F))$. Hence, the DRC indicates whether the use of domestic factors is socially profitable $(DRC<1)$ or not $(DRC>1)$. We calculate the *DRC* of rice production in each granary area and compared it with the *DRC*s of alternative crops. A granary area has a comparative advantage in rice if the *DRC* for rice is lower than the *DRC*s of alternative crops grown in that granary area.

The social cost benefit ratio *(SCB)* is defined as the ratio of the social cost of producing one unit of an output to the social value of that unit of output $(F+G)/E$. An *SCB* value between zero and one indicates that an activity in question is competitive while a value greater than one indicates the activity is not competitive.

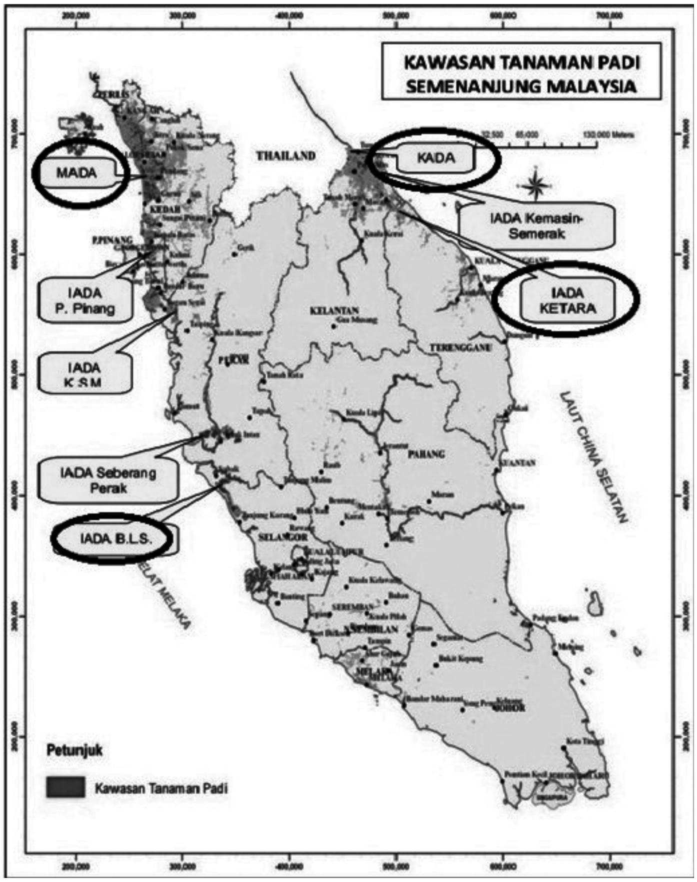
We also calculate the private net return to land *(PNRL)* and social net return to land *(SNRL)*. The *PNRL* is defined as $A-B-C$ without the cost of land use, and the *SNRL* as $E-F-G$ without the cost of land use. The higher the *PNRL (SNRL)*, the higher the private (social) profit per hectare of land employed in the production of the commodity in question (Fang and Beghin 2000; Scandizzo and Bruce 1980; Yao 1997). Scandizzo and Bruce (1980) suggest that the net economic benefit per unit of land is more suitable for ranking the crops than the economic benefit per monetary unit of domestic resources.

The nominal protection coefficient *(NPC)* is one of the most commonly used methods to measure price distortions (Fang and Beghin 2000; Gulati, Hansen, and Pursell 1990; Sadoulet and de Janvry 1995; Taylor and Phillips 1991). It is the ratio of the private price to the social price of a commodity. If $NPC>1$, producers are protected and consumers are taxed. The effective protection coefficient *(EPC)* is defined as the ratio of value added at market price to value added at social prices. Hence, the *EPC* captures the net effect of government policies on both input and output markets (Bureau and Kalaitzandonakes 1995; Sadoulet and de Janvry 1995). However, both the *NPC* and the *EPC* ignore the transfer effects of factor market policies, and thus, do not provide a complete indicator of incentives (Monke and Pearson 1989).

An extension of the *EPC* is the profitability coefficient *(PC)*, which is defined as the ratio of private to social profits $(A-B-C)/(E-F-G)$, or D/H. The PC measures the incentive effects of all policies or net policy transfers. A final incentive indicator is the subsidy ratio to producers (SRP), which is equal to the ratio of net divergences to social prices or $SRP = L/E = (D-H)/E$.

Data for this study were collected from various national and international sources. Four designated granary areas developed by the government for rice double cropping were considered (Figure 2): (1) Muda Agricultural Development Authority (MADA), (2) Kemubu Agricultural Development Authority (KADA), (3) Barat Laut Selangor

Figure 2. Distribution of eight major rice granary areas in Malaysia



Source: Department of Agriculture (2011)

Integrated Agricultural Development (BLS), and (4) North Terengganu Integrated Agricultural Development Authority (KETARA). As detailed in Table 3, in 2010, these four areas accounted for 36.7 percent of the total area dedicated to rice in Malaysia, and 55.8 percent of total rice production.

To complete the PAM, a comprehensive set of data including yields, input requirements, and the market and social prices of inputs and outputs are required. The data employed and their sources are outlined in Table 4, and greater detail is provided in Table 5. After the PAM for each granary area was completed, all data and assumptions were crosschecked with local experts from BERNAS to ensure their reliability and validity. All calculations were conducted on a hectare basis in Malaysian Ringgit.

One important input not mentioned in Table 4 is land, which requires more detailed explanation. Monke and Pearson (1989) suggest using the rental value of land to reflect its opportunity cost. Where data on rental values are not available, they further propose that its "potential productive capacity" can be used to assess its value in the best alternative use. For example, if palm oil production is the best alternative to rice production in the granary areas, the social price of land for rice is given by the social profits it can generate in palm oil production.

In the study areas, many farmers preferred sharecropping or planting oil palms as a substitute for rice (Terano, Zainalabidin,

Table 3. Rice production in major granary areas in Malaysia (2008–2010)

Granary Area	Area (ha)	% Area	Contribution to National Production (MT and %)					
			2008	%	2009	%	2010	%
MADA	96,558	23.2	887,992	37.7	976,192	38.3	912,321	37.0
KADA	32,167	7.7	179,048	7.6	209,950	8.4	201,135	8.2
IADA K.S MANIK	27,829	6.7	169,753	7.2	187,117	7.5	184,563	7.1
IADA BLS	18,814	4.5	174,247	7.4	202,633	8.1	210	8.5
IADA P. PINANG	10,305	2.5	98,436	4.2	107,285	4.3	115,189	4.7
IADA S.PERAK	8,529	2.1	62,076	2.6	70,294	2.8	70,814	2.9
IADA KETARA	5,156	1.2	46,097	2.0	49,082	2.0	52,711	2.1
IADA K.SEMERAK	5,220	1.3	14,757	0.6	16,853	0.7	20,550	0.8
TOTAL GRANARY	204,578	49.2	1,632,406	69.4	1,609,666	72.5	1,557,493	71.3
TOTAL NON GRANARY	211,213	50.8	720,626	30.6	691,637	27.5	707,256	28.7
MALAYSIA	415,791	100.0	2,353,032	100.0	2,301,303	100.00	2,264,749	100.0

Source: Department of Agriculture (2010)

Table 4. Variables of interest and sources

Variable	Description	Sources
Technical coefficients *(a_{ij})*	Large-scale surveys of input use in rice production in the granary areas in 2011 and 2012 used to calculate the technical coefficients	KADA 2014; Rabu and Mohd Shah 2013; Terano, Zainalabidin, and Golnaz 2013
Private output *(P_i^D)* and input prices *(P_j^D)*	Farm gate prices for rice (output) and urea, compound or TSP, NPK, organic fertilizers, pesticides, lime, pesticides, and fuel	National published and unpublished sources; Department of Statistics, Malaysia; Ministry of International Trade and Industry, Malaysia
Social output price *(P_i^S)*	Cost, insurance, and freight (CIF) price of Vietnam: 25 percent broken because Malaysia is a net importer of rice.	Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT)
Official exchange rate		Central Bank of Malaysia
Social prices for fertilizers *(P_j^S)*	Include urea (Europe), TSP (US Gulf ports), organic, and NPK	World Bank, IRRI, and various issues of the FAO food outlook
Private price for wages *(W_j^D)*	Social price for wages *(W_j^S)* is assumed to be equal to the market wages	Department of Statistics, Malaysia

Table 5. Private and social costs calculations for the rice farms in KADA, MADA, KETARA, and BLS granary areas in 2011 and 2011 (MYR/ha)

Granary Area	Item	Costs																Revenue	
		Tradable Inputs												Non-Tradable Inputs					
		Seed		Fertilizers		Pesticides		Lime		Fuel		Others		Labor		Land			
		2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
KADA	Private	110	200	930	973	160	230	240	248	57	76	0	0	1,060	1,120	900	900	6,889	6,589
	Social	116	213	1,089	992	187	244	318	322	72	96	0	0	1,060	1,120	2,000	2,000	5,116	5,336
MADA	Private	95	136	930	862	151	184	200	240	29	42	0	0	722	760	1,000	1,000	6,388	6,603
	Social	143	145	1,087	881	164	195	265	312	36	53	0	0	722	760	2,600	2,600	5,120	5,607
KETARA	Private	102	140	712	829	60	138	0	0	30	29	469	450	520	580	900	900	5,668	5,166
	Social	126	149	833	851	70	146	0	0	38	36	469	450	520	580	2,100	2,100	3,740	4,005
BLS	Private	180	160	1,036	981	80	184	0	0	59	53	659	530	620	980	1,715	900		8,027
	Social	210	168	1,192	1,040	93	187	0	0	74	67	659	530	620	980	2,500	2,100	5,848	5,963

and Golnaz 2013). Hence, the average net income from oil palm in each granary area was used as an estimate of the social prices of land. Information on incomes from palm oil production was provided by an agricultural officer and a land value officer in Selangor, Malaysia. Other data pertaining to the conversion of private to social prices are presented in Table 5.

RESULTS AND DISCUSSION

PAM under Import Parity Price of Rice

The main results for the four granary areas are shown in Table 6. The DRC and SCB were estimated in order to measure the competitiveness of the rice sector in Malaysia. DRC compares the domestic resources costs measured at social price with the value added measured in the social prices. Hence, the DRC indicates whether the employment of scarce domestic inputs in the production of rice generates positive returns for Malaysia (Von Cramon-Taubadel and Nivyevsky 2009).

The empirical analysis presented here demonstrates that three out of four study areas—BLS, MADA, and KADA—had comparative advantage in the production of rice (DRC<1) in the years 2011 to 2012. On the contrary, the results indicated no comparative advantage for rice production in KETARA area as the DRC was greater than one. From the national perspective, it is desirable to produce rice in the three granary areas and expand its production since the social value added is greater than the cost of its import.

In addition, average DRC results should be interpreted with caution. As explained by Von Cramon-Taubadel and Nivyevsky (2009), these results are based on aggregated data that likely conceal relevant variation and the underlying distribution of competitiveness across a set of heterogeneous producers. As such, the results presented here aggregate very efficient farms that were more competitive than average with other less efficient farms that were less competitive than average. This can have significant implications for policy conclusions based on PAM results. For example, support based on the average competitiveness will be excessive for some farms but inadequate for others. Therefore, we are cautious about drawing conclusions from the average DRCs and further analysis of DRC distribution is required to determine factors that influence the competitiveness of farms.

Competitiveness may also be indicated by the SCB ratio. The SCB values estimated in this research are consistent with the results of DRC calculations above. The SCB ratios of less than one indicate profitability of rice farming in each granary area except KETARA.

The measure of net transfer is further shown in the profitability coefficient (PC) which measures the net incentive effects of all policies (Monke and Pearson 1989). Positive PC values

Table 6. Results summary of different indicators of protection and comparative advantage

Area	2011						2012					
	DRC	SCB	PC	SRP	PNRL	SNRL	DRC	SCB	PC	SRP	PNRL	SNRL
KADA	0.92	0.95	12.51	0.62	3,432	274	0.90	0.93	8.15	0.47	2,842	349
MADA	0.97	0.98	31.36	0.62	3,262	104	0.84	0.88	5.11	0.48	3,380	661
KETARA	1.19	1.11	-6.93	0.88	2,874	-415	1.13	1.08		0.60	2,101	-307
BLS	0.86	0.91	10.89	0.88	5,703	524	0.78	0.85	4.76	0.56	4,239	891

Source: Own estimation

were obtained in three granary areas with KETARA as the exception; this area exhibited negative PCs for both years. The positive results in BLS, MADA, and KADA indicate a net effect of policy, which is to subsidize production.

Another ratio indicator to measure net transfer is the subsidy ratio to producers (SRP) that indicates the extent of incentives or disincentives influencing divergences. The average SRP ranged between 0.47 and 0.59 in the year 2012. This means that the divergences measured in this study, which were mainly caused by distortive policies, had increased the gross revenues of the whole system by almost half.

Moreover, further analyses were conducted to measure the PNRL and SNRL, which estimate the returns to the fixed factor land. Both values of PNRL and SNRL were positive for all areas, except for KETARA. This implies that it is feasible for average rice producers to grow rice in KADA, MADA, and BLS.

The results in Table 7 show the divergences between private and social profits. These also depict the effects of different policy transfers, namely: output, input, factor, and net policy transfers. Notably, positive values were recorded for all output transfers (private revenues less social revenues). In contrast, negative values were recorded for all input transfers (difference between private and social prices of tradable inputs) and factor transfers (difference between private and social prices of non-tradable inputs or domestic factors).

The positive values of output transfers reflect the protection received by the system. For instance, protective policies by the government including a price subsidy scheme of MYR 240.10/MT support producers. Meanwhile, the negative values of the input transfers indicate that the producers bought inputs at prices lower than the world market prices due to the subsidy policy on fertilizers, lime, and pesticides. Similarly, the factor transfer values demonstrate that the costs of non-tradable inputs were lower than their social prices. This may be attributed to land as the primary factor of production since its

Table 7. PAM results of rice production in major granary areas in Malaysia (2011–2012)[1]

Granary Area	Year	Output Transfers (MYR/ha)	Tradable Input Transfers (MYR/ha)	Domestic Factor Transfers (MYR/ha)	Private Profitability (MYR/ha)	Social Profitability (MYR/ha)	Net Policy Effects (MYR/ha)
KADA	2011	1,773	-285	-1100	3,432	274	3,158
	2012	1,253	-140	-1100	2,842	349	2,493
MADA	2011	1,268	-290	-1600	3,262	104	3,158
	2012	996	-122	-1600	3,379	661	2,718
KETARA	2011	1,928	-163	-1200	2,874	-417	3,291
	2012	1,161	-46	-1200	2,100	-307	2,407
BLS	2011	4,203	-215	-786	5,703	499	5,204
	2012	2,064	-84	-1200	4,239	891	3,348

Source: Own estimation

1 Exchange rates: USD 1 = MYR 3.05 and EUR 1= 4.25 (October 31, 2011); USD 1 = MYR 3.06 and EUR 1 = MYR 4.27 (October 31, 2012); USD 1 = MYR 2.96 and EUR 1 = MYR 4.21 (November 30, 2014)

social and private values were determined in relation to alternative uses.

Furthermore, the net transfer is the sum of output transfer, tradable input transfer, and factor transfer. It is also the difference between private profits and social profits. Overall, positive net policy transfers are recorded in all regions. Rice production is profitable—without any policy transfers because social profits are positive in all granary areas except for KETARA.

The results also illustrate variations in profitability, both in private and social terms, across the regions. The private profits per hectare of rice production in all granary areas are greater than zero. These demonstrate normal returns and potential expansion of production, unless the farming areas may not be expanded or the substitute crops are more lucrative and profitable at private prices. Moreover, social profits are positive in all areas that recorded a DRC value of less than one; the rice producers in these areas are using scarce resources efficiently. However, the negative social profit in KETARA reveals that rice production in this area depends on government aid. Apart from that, the results of private profits clearly indicate that rice production was highly profitable at private prices in few granary areas. Nevertheless, the profitability recorded at social prices was much lower.

Since its development, PAM is increasingly being used by analysts working in many developing countries, where distortions in the prices are often substantial (Adesina and Coulibaly 1998; Greenaway, Hassan, and Reed 1994; Mohanty, Fang, and Chaudhary 2003). For example, Islam and Kirschke (2010) developed Policy Analysis Matrices for rice production in Bangladesh and expounded that the country has a static comparative advantage in producing rice. Furthermore, it uses its resources efficiently.

Sensitivity Analysis

Morris (1990) postulated that sensitivity analysis is essential for two main reasons. First, the competitiveness analysis is based on simplifying assumptions on production technologies as indicated by the output-input coefficients, government policies, and prices. Since these values affect the analysis, it is vital to identify the degree to which the empirical results are likely to be sensitive to the simplifying assumptions that were made. Secondly, the DRC framework produces efficiency ranking or comparative advantage, which is static as it represents a summary at a fixed point in time. In practice, actual efficiency is dynamic because it adjusts as production technologies, prices, and government policies change. Therefore, it is crucial to determine whether changes in the key parameter values affect the comparative advantage of rice production in Malaysia. To that end, the extent of this relationship was examined under a set of baseline assumptions.

The graphs in Figure 3 summarize the sensitivity analysis results for individual determining factors on the comparative advantage of rice production in Malaysia in 2011. The estimated DRCs of rice production in each granary area were fairly sensitive to changes in the international (reference) price of rice used in the calculation of import parity prices. A 20 percent increase in international price would make the domestic production of rice in all areas socially profitable, with DRC values of less than one.

The effects of changes in other single factors under traded inputs, imported fertilizer prices, seeds, pesticides, and fuel prices, are presented in Table 8. As the country is progressing towards trade liberalization, the costs of these inputs are expected to rise. This will result in a decrease in the comparative advantage of rice farming in all

Figure 3. Changes of DRC in the import price of rice in Malaysia

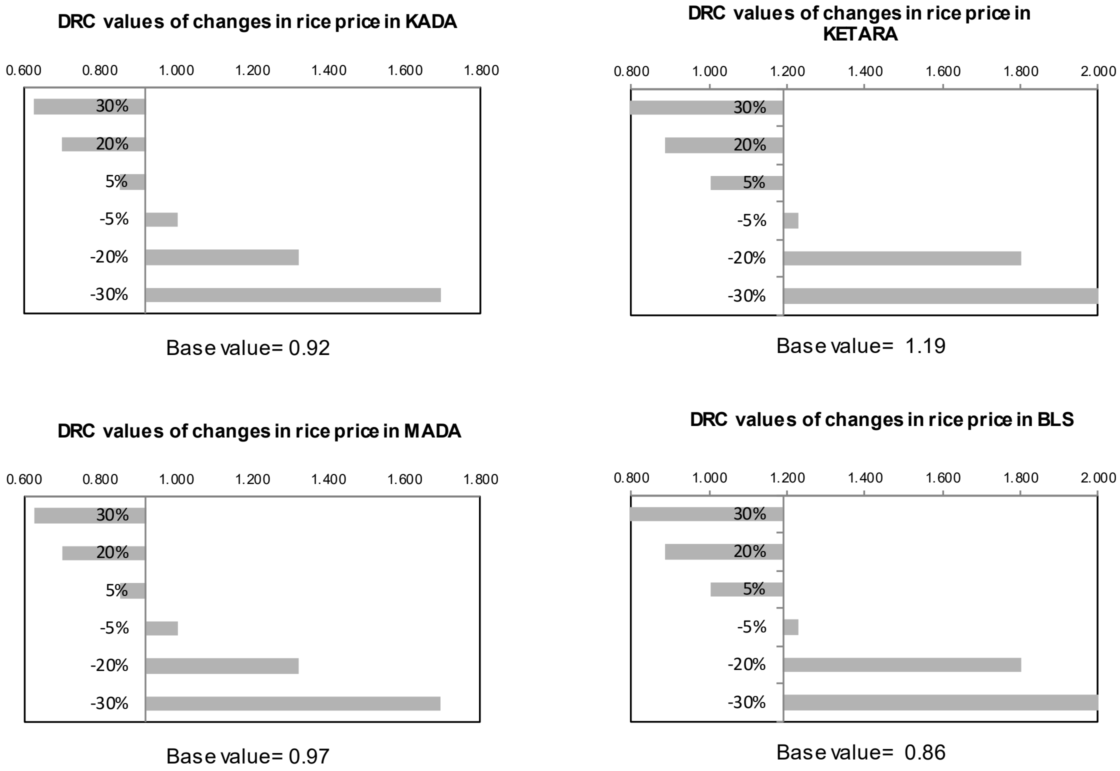


Table 8. Change in selected tradable input prices

Tradable Input	Granary Area	DRC Base Value	10%	25%	45%	-10%	-25%	-45%
Fertilizer	KADA	0.92	0.949	1.000	1.076	0.889	0.849	0.824
	MADA	0.97	1.001	1.053	1.131	0.940	0.898	0.873
	KETARA	1.19	1.236	1.313	1.433	1.146	1.086	1.050
	BLS	0.86	0.891	0.939	1.001	0.835	0.796	0.773
Seed	KADA	0.92	0.921	0.926	0.932	0.915	0.910	0.907
	MADA	0.97	0.974	0.980	0.988	0.966	0.960	0.956
	KETARA	1.19	1.196	1.206	1.220	1.182	1.172	1.166
	BLS	0.86	0.867	0.875	0.885	0.857	0.850	0.845
Pesticides	KADA	0.92	0.923	0.931	0.942	0.913	0.905	0.900
	MADA	0.97	0.974	0.981	0.991	0.965	0.958	0.954
	KETARA	1.19	1.193	1.199	1.206	1.185	1.180	1.176
	BLS	0.86	0.864	0.868	0.872	0.860	0.857	0.854
BLS	KADA	0.92	0.919	0.922	0.925	0.916	0.914	0.912
	MADA	0.97	0.971	0.972	0.974	0.969	0.967	0.966
	KETARA	1.19	1.191	1.194	1.198	1.187	1.184	1.182
	BLS	0.86	0.864	0.866	0.870	0.860	0.858	0.856

Source: Own estimation

major granary areas. Evidently, higher costs of tradable inputs increased the values of DRC, but the magnitude was highest in the case of fertilizer. Accordingly, the high amount of fertilizer used in rice production in the granary areas threatens comparative advantage. For example, increments of fertilizer price by 25 percent in KADA or 10 percent in MADA would diminish the social profits in those areas. In general, profitability was fairly robust for other inputs; even fairly substantial changes in the prices of seed, pesticides, and fuel would not have large effects on DRC values for rice production in the four granary areas.

CONCLUSIONS AND RECOMMENDATIONS

The challenges brought about by trade liberalization have created tougher competition for Malaysia to strengthen its economic growth. The rice sector in Malaysia, which is an important part of the economy in terms of both production value and source of employment, also faces these challenges. More than 100,000 farmers who are mostly living in poverty are involved in rice farming. Thus, the government has intervened in the sector by providing substantial support to rice producers in an effort to increase rice production and for food security reasons. The country aims to become 100 percent self-sufficient in the rice sector by the year 2020. Utilizing a PAM model, this study investigated whether the rice sector is competitive under the existing set of policies and whether production is truly competitive in the sense that it would generate profits in the absence of government policies.

The competitiveness of rice production in the country was analyzed, particularly in the KADA, MADA, KETARA, and BLS granary areas. The results indicate that three out of four granary areas have a comparative advantage in rice production with DRC values less than one. The results indicate no comparative advantage for rice production in the KETARA area as its DRC value was greater than one. The results also show that the net effect of government policies in Malaysia is to support rice production. However, in all granary areas with the exception of KETARA, rice production would generate social profits without this policy support.

We stress that the PAM analysis presented above is based on average data which hide farm-to-farm variability. Even in KETARA, where rice production appears to be socially unprofitable on average, there are probably individual farms that generate not only private but also social profits. A more detailed study based on farm-level data could cast light on this variability and thus provide insights into what the most competitive farms are doing better than the others, and how government policy might be tailored to target support to the farms that require it most. For example, policies might focus more on encouraging structural changes that enable smaller farms to grow until they can generate sufficient income from social profits only, without (or minimal) subsidy. This could help the government attain the goal of higher self-sufficiency at lower costs.

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