Pertanika J. Soc. Sci. & Hum. 23 (S): 1 - 10 (2015)

PERTANIKA JOURNALS

SOCIAL SCIENCES & HUMANITIES

Journal homepage: http://www.pertanika.upm.edu.my/

The Impact of Fertiliser Subsidy and New Variety of Paddy on Malaysian Paddy/Rice Industry

Mad Nasir Shamsudin[1]*, Nurul Nadia Ramli[1], Alias Radam[2] and Zainalabidin Mohamed[1]

[1]Department of Agribusiness and Information Systems, Faculty of Agriculture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
[2]Department of Management and Marketing, Faculty of Economics and Management, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

ABSTRACT

Rice is a staple food for the Malaysian population. Special attention is always given by the government to ensure the sustainability of the Malaysian paddy/rice industry. In order to encourage paddy farmers to increase paddy production, a food security policy for the paddy/rice sector has been implemented by the government towards self-sufficiency by 2020. There are three types of government intervention on Malaysian paddy and rice industry namely fertiliser subsidy, price support and import restriction or quota. There would be some impact to the industry if the government decides to implement a trade liberalisation policy. This is because trade liberalisation involves removing barriers to trade between different countries. Therefore, it would cause the supporting elements of the industry to be limited. In view of this this study has made its main objective the simulation of the impact of a fertiliser subsidy on the Malaysian paddy and rice industry. The methodology used is the system dynamics model. In addition, this study also attempts to simulate the impact of improvement in yield on the performance of the system. The simulation results suggest that there would be a positive impact to the industry with the implementation of the current policy for fertiliser subsidy. Yield obtained would increase with the implementation of the fertiliser subsidy. Consequently, it would increase paddy production. Paddy production would decrease if the government decides to remove the fertiliser subsidy. Hence the self sufficiency level (SSL) also would decrease. Due to the reduction in production, the importation of rice seems unavoidable in order to meet the demand. Meanwhile, due to population growth, the government

ARTICLE INFO

Article history:
Received: 5 January 2015
Accepted: 7 May 2015

E-mail addresses:
mns@upm.edu.my (Mad Nasir Shamsudin)
nurulnadia.ramli@upm.edu.my (Nurul Nadia Ramli)
alias@upm.edu.my (Alias Radam)
zam@upm.edu.my (Zainalabidin Mohamed)
* Corresponding author

ISSN: 0128-7702

needs to find alternative policies to sustain the industry and increase imports in order to ensure adequate supply of rice for the Malaysian population. The simulation results indicate that the introduction of a new variety of paddy leads to increase in yield, and in turn to increase in the production level. The percentage increase in yield and production is about 3% per year.

Keywords: System dynamics, fertiliser, paddy/rice, policies, yield, simulation

INTRODUCTION

Rice is a staple food for the Malaysian population. The paddy/rice industry is an important industry in Malaysia. Therefore, this industry always gets special attention from the government. In 2009, there were 172,000 paddy farmers in the country. Total hecterage for paddy production is currently at 674,928 hectares. Of this, 76% is in Peninsular Malaysia (515,657 ha) while 18% (118,919 ha) and 6% (40,352 ha) are in Sarawak and Sabah respectively. In the case of the paddy/rice industry, formulating policies for the industry is not an easy job due to the complexity of the paddy/rice industry. For example, in early 1970, the middle of 1980 and in 2008, there was instability in rice prices in the world market. This situation had a big negative impact on the industry. In addition, the paddy/rice industry always gets special attention from the government in the form of three types of government interventions namely fertiliser subsidies, price supports and import restriction or quota. Trade liberalisation involves removing barriers to trade between countries. Therefore, under trade liberalisation the supporting elements for the industry would be limited. Thus, if trade liberalisation were fully implemented, it might have some impact on the industry. For example, if the government decides to remove the fertiliser subsidy there would be some impact on production, import and self sufficiency level (SSL). This situation may cause a decline in rice production, increase in import and, hence, decrease the SSL. The introduction a new variety of paddy is expected to have a positive impact on yield. Various studies have shown that productivity of a paddy farm can be maintained with input subsidies. A study conducted by Sarris (2005) indicated that paddy farmers in India received advantages from the input subsidies provided by the government such as irrigation and fertiliser. In addition, farmers also got a procurement at minimum support prices. These subsidies contributed to an increase in rice production. Sidiq (2004) also suggests that in India, supporting elements for agricultural inputs for rice production such as credit with low interest rate increased supply of fertiliser and seed of good quality and played an important role in increasing productivity, improving the quality of rice and reducing losses . All these supports from the government helped to improve SSL for Indonesian paddy and rice production. This finding is consistent with Bakhshoodeh and Soltani's (2002) work, which found that input subsidies, coupon distribution, guaranteed price, credit programmes and

the import of rice using foreign exchange valued at a special cheap rate allocated for food were among the factors that could affect the difference between rice production and demand.

METHODOLOGY

System Dynamics

The methodology used in this study was the system dynamics approach. System dynamics is an approach to analyse a complex system and problem using software for computer simulation. In order to understand the behaviour of complex systems over time, this model involved all the relevant cause-effect relationships, feedback loops and time delays. Fig.1 presents the stock and flow diagram for the system dynamics model for the Malaysian paddy and rice industry.

In this study, the system dynamics model for the Malaysian paddy/rice industry consisted of two types of sub model namely technical component and economic component. Yield represented the main outcome of the technical component. Fertiliser used was a factor that could affect the yield. In this sub model the farmers' net income represented as stock while the inflow in this sub model was farmers' gross income. The technical sub model consisted of three types of outflows namely total cost, farmers' expenditure and farmers' expenditure for fertiliser. The

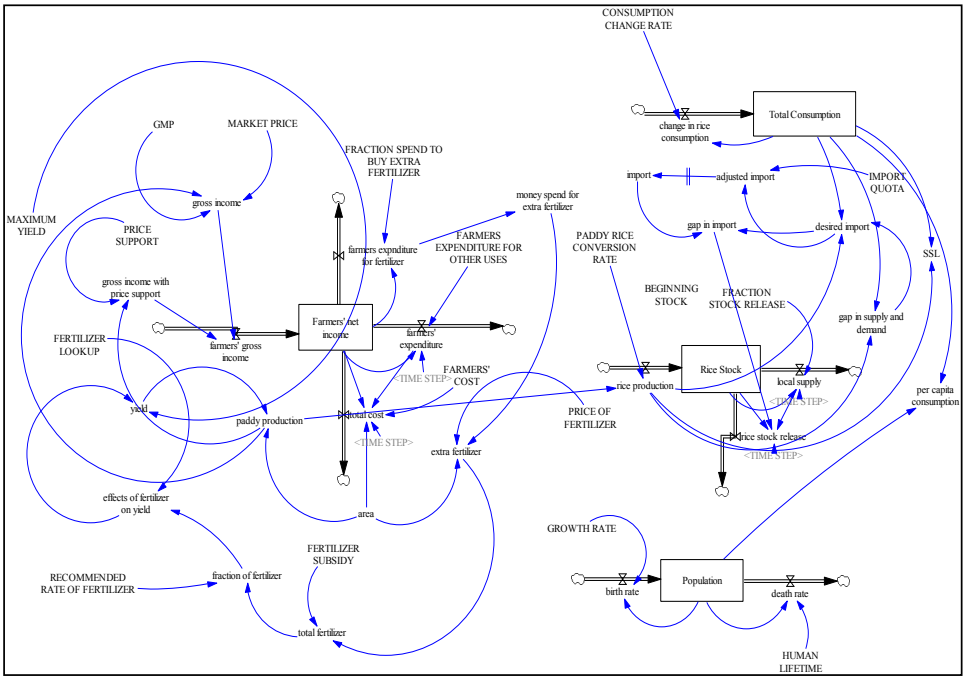

Fig.1: System dynamics model for the Malaysian rice industry

quantity of extra fertiliser used depended on the farmers' expenditure on fertiliser. If the farmers are willing to spend more on fertiliser, it would have a positive impact on the yield and paddy production. Yield is equal to the multiplication of maximum yield and effect of fertiliser on yield. In order to see the impact of fertiliser used on yield, look-up function was used. The yield obtained is at the maximum value when the total quantity of fertiliser used is the same as the quantity of recommended rate of fertiliser. On the other hand, rice production, import and consumption represent the main outcomes for the economic component in this model. In the economic component, there are three types of state variable (stock) namely rice stock, total consumption and population. Rice production represented the inflow of the rice stock while rate of rice stock release and rate of local supply represented the outflows. The conversion of paddy productions equals the rate of rice production. The equation for paddy production is yield multiplied by area planted. Desired import and actual import are the factors that can affect the rate of stock release. Local supply represented the second outflow of rice stock. The minimum function was used. Multiplication of rice stock and fraction of rice stock release is equal to local rice supply. However, in certain extreme conditions, the local supply equals rice stock divided by time step. This equation implies that "it takes what you want" (fraction rice stock release * rice stock) out of the stock. But, if there is inadequate stock, it completely empties the stock (rice stock/ time step). Desired import and import quota are the factors that can affect the amount of rice that needs to be imported. The quantity of desired import of rice to ensure adequate supply for the Malaysian population is represented by desired import. The adjusted import variable represented the adjusted quantity of rice needed to be imported based on quantity of import quota policy imposed by the government. The secondary data used in this study are from the Ministry of Agriculture and Agro Based Industry (MOA), Lembaga Pertubuhan Peladang (LPP) and the Department of Agriculture and Department of Statistic (DOS). In order to see the changes in the behaviour of the system due to the changes in policy instruments, three types of simulation were conducted. Scenario 1 represented as the baseline scenario with no changes in government policy while Scenario 2 referred to the simulation under removal of the NPK fertiliser subsidy. It was assumed that the government would decide to remove the NPK fertiliser subsidy in 2015.

Finally, Scenario 3 referred to simulation under the introduction of a new variety of paddy. It was assumed that in the period from 2014 to 2016, the government would introduce a new variety of paddy that can increase yield. Again, in 2021, the government was expected to introduce a new variety of paddy. Table 1 summarises the descriptions of each scenario.

RESULTS AND DISCUSSION

Baseline Scenario 1: Simulation Under Current Scenario in Malaysia with No Changes in Government Policy

The simulation result for baseline scenario suggests that since there were no changes in quantity of fertiliser used and no new variety of paddy, the yield would be constant at 4.052 metric tonne per hectare per year as shown in Fig.2. Consequently, rice production would remain at 1.609 million metric tonne per year (Fig.3). On the other hand, due to population growth, total consumption would show an increasing trend. The quantity of rice imported was presented in Fig.3. The simulation result indicated that import of rice would increase every year until 2015 to meet the demand. However, due to imposition of the import policy, the import of rice would be the same to import quota after 2015. Therefore, the simulation results suggested that if the import quota remained at the same level after 2015, Malaysia would have a big problem, that is, inadequate supply of rice. Meanwhile, SSL would decline due to population growth. Fig.3 shows the relationship between rice production, import, SSL and consumption for Scenario 1. Simulation results suggested that under the baseline scenario rice production would remain at 1.609 million metric tonne while SSL showed a declining trend due to increase in consumption. SSL would decrease gradually to 56.6% in 2025 from 74.9% in 2011.

Scenario 2: Simulation Under Removal of NPK Fertiliser

In Scenario 2, it is assumed that paddy farmers depend heavily on the fertiliser subsidy provided by the government. The simulation results suggest that the yield obtained would decline from 4.052 metric tonne per hectare to 3.081 metric tonne per hectare in 2015 as shown in Fig.4. These simulation results suggested that the NPK fertiliser was an important factor that

TABLE 1
Descriptions of Three (3) Types of Scenario

	Scenario 1 Baseline Scenario	Scenario 2	Scenario 3
Fertiliser Subsidy	Compound, Urea, NPK	Removal of NPK fertilizer	Compound, Urea, NPK
GMP	RM750/t	RM750/t	RM750/t
Price support	RM248.10/t	RM248.10/t	RM248.10/t
Area planted	611, 166 hectares	611, 166 hectares	611, 166 hectares
Paddy rice conversion rate	65%	65%	65%
Growth rate of population	2.1% per year	2.1% per year	2.1% per year
Average lifetime of human	74 years	74 years	74 years
Import quota	700,000 t/year	700,000 t/year	700,000 t/year
Market price of paddy	RM1100	RM1100	RM1100
Variety of paddy	No new variety of paddy	No new variety of paddy	Introduction of new variety in 2014 and 2021

could help to increase the yield. Similarly, a study conducted by Adekayode and Ogunkoya (2010) found that the increase in the NPK fertiliser used would improve in yield. Therefore, the simulation results suggested that if farmers depended heavily on subsidised fertiliser, the yield obtained would be constant at 3.081 metric tonne per hectare per year.

Fig.5 presents the relationship between quantity of rice production, import, SSL and total consumption for Scenario 2.

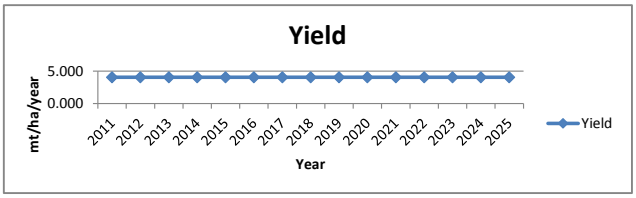

Fig.2: Yield, scenario 1

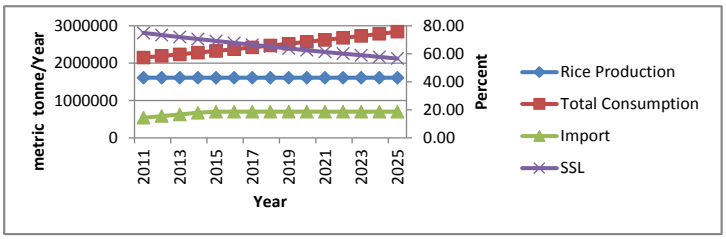

Fig.3: Rice production, total consumption, import and SSL, scenario 1

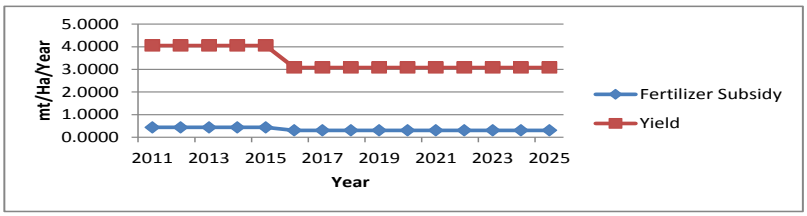

Fig.4: The effects of fertiliser subsidy on yield, scenario 2

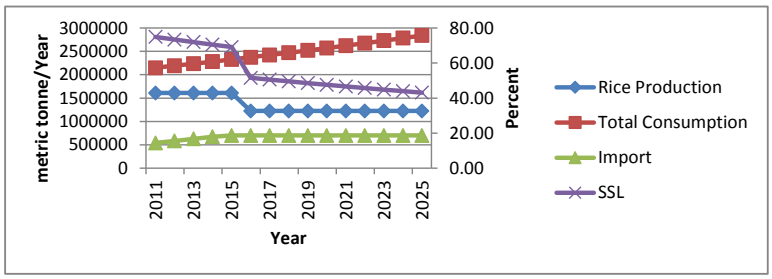

Fig.5: Relationship between rice production, total consumption, import and self sufficiency level (SSL), scenario 2

The simulation results indicated that rice production would decrease from 1.61 million metric tonne to 1.22 million metric tonne in 2015 if the government decided to remove the NPK fertiliser subsidy. Hence, rice production would also decline. Meanwhile, total import was expected to increase every year from 2011 until 2015. The simulation results from Scenario 2 suggested that SSL would decrease drastically from 69.17% to 51.55% in 2016 due to a decline in rice production. Finally in 2025, SSL was expected to decline to 43.08%.

Scenario 3: Simulation under introduction of new variety of paddy

The simulation results suggested that initially, the yield was about 4.052 metric tonne per hectare per year. This yield was constant at this level until the government introduced a new variety of paddy in 2014 that was expected to be in use until 2016. The simulation results showed that there was an increment in the yield obtained when the government introduced a new variety of paddy. The yield increased from 4.052 metric tonne per hectare to 4.172 metric tonne per hectare in 2015. The percentage increase in yield was expected to be about 3% per year in 2015. This is accordance with Wobst and Mhamba (2003), who indicated that factor productivity could be enhanced by enhancing the fertiliser used and through improved seeds. However, if there is no change in fertiliser used or no introduction of a new variety of paddy, the yield would remain constant until the introduction of a

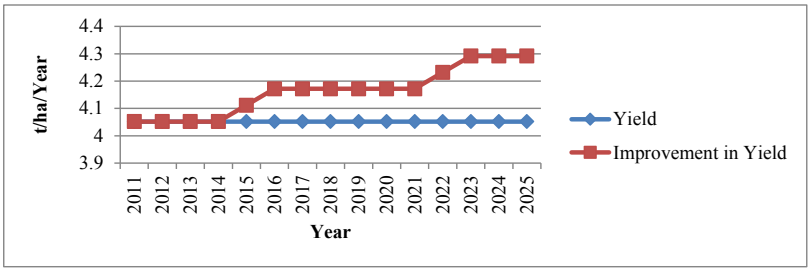

Fig.6: Yield, scenario 3

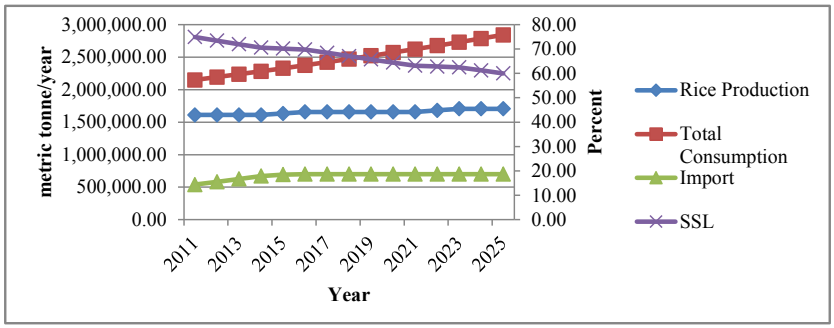

Fig.7: Relationship between rice production, total consumption, import and self sufficiency level (SSL), scenario 3

new variety of paddy as planned for 2021. The simulation results indicated that yield would increase by about 3% from 4.172 metric tonne per hectare to 4.292 metric tonne in 2021.

For the period 2014 to 2016, the simulation results indicated that there would be an increment in rice production as the government had introduced a new variety of paddy. However, in terms of quantity of rice import, after 2015 the rice import was expected to equal import quota. This scenario implied that even though production might increase it would not be able to meet prevailing demand. Initially the SSL was at 74.91% in 2011 but it declined gradually by up to 60% in 2025. The simulation results indicated that from 2011 to 2014, the percentage would decrease in SSL by about 2% per year while in 2015 to 2016 the percentage would decrease in SSL by 0.5% due to the increase in rice production as a result of the introduction of a new variety of paddy in the year 2014 to 2016. Unfortunately, after 2016, the percentage decline in SSL was back to its normal rate of about 2% per year until 2021. Again, in 2021 if a new variety of paddy is used, the percentage decline in SSL will be 0.5% per year. This scenario would occur due to the increase in total consumption. Therefore, it is suggested that for the next 15 years production needs to be increased in order to increase SSL.

CONCLUSION AND RECOMMENDATION

This study attempted to simulate the impact of removal of fertiliser subsidy and the introduction of a new variety of paddy on the Malaysian paddy and rice industry. A system dynamics model was used to perform the analysis. Simulation results indicated removal of the fertiliser subsidy would have a negative effect on rice yield and hence, production, import and SSL. This shows that the fertiliser subsidy provided by the government does have a positive impact on increase in rice production. The simulation results also indicated that the introduction of a new variety of paddy would have a positive impact on the performance of the system.

Therefore, it may be stated that removal of the fertiliser subsidy would make paddy production in Malaysia unsustainable. Improvement in yield does have a positive effect on the industry. However, trade liberalisation would limit the supporting elements of the industry. Therefore, alternative action such as encouraging farmers to buy fertiliser on their own if the government decides to stop subsidising the cost of purchasing fertiliser should be taken. This initiative could help to ensure adequate supply of rice as demand continues to increase due to population growth. In addition, in order to increase yield, alternative policy mechanisms should be introduced. The construction of a new irrigation scheme for rain-fed areas could also be implemented from money saved as a result of removing the subsidy. The

extension services too should be enhanced in order to educate and motivate farmers to invest in increasing yield. The investments by the government in technology transfer, extension and R&D must continue and be strengthened as these efforts could help to ensure the sustainability of the industry. All these efforts would help to improve the productivity of paddy. This is very important to ensure adequate supply of rice for the Malaysian population.

REFERENCES

Adekayode, F. O., & Ogunkoya, M. O. (2010). Effect of quantity and placement distances of inorganic 15-15-15 fertiliser in improving soil fertility status and the performance and yield of maize in a tropical rain forest zone of Nigeria. *American-Eurasian Journal Agriculture & Environment Science, 7*(2), 122–129.

Amin, M. A. (2007). Malaysian paddy and rice industry: Policy implementation and directions. In *50 years of Malaysian Agriculture Transformational Issues Challenges & Direction* (pp.281-308). Serdang: UPM Press.

Bakhshoodeh M., & Soltani G. R. (2002, October). *Rice market liberalization in Iran: Welfare and poverty*. Paper presented at the Ninth Annual Conference of the ERF, Al Sharjah, United Arab Emirates.

Department of Agriculture, Malaysia. (2010). *Paddy production survey report Malaysia off Season,(2009)*. Putrajaya: Department of Agriculture, Malaysia

Department of Agriculture, Malaysia**. (**2010**)**. *Paddy production survey report Malaysia main Season, 2009*. Putrajaya: Department of Agriculture, Malaysia

Elbeydi, K. R. M. (2005). *Dynamic econometric modeling and policy analysis of the Libyan wheat market*. (PhD Thesis dissertation). Universiti Putra Malaysia.

Forrester, J. W. (1961). *Industrial dynamics*. MIT Press, Cambridge.

Forrester, J. W. (1968). *Principle of systems*: Wright-Allen Press, Inc.

Forrester, J. W., & Senge, P. (1980). Tests for building confidence in system dynamics models. *TIMS Studies in the Management Sciences,* 14, 209–228.

Haghighi, M. H. M. (2007). *A system dynamics investigation of employment in the Iranian agricultural production*. (PhD Thesis dissertation). Universiti Putra Malaysia, Selangor.

Marditech Corporation Sdn. Bhd. (2004). *The review of paddy and rice industry in Malaysia*. Selangor, Malaysia: MARDI.

Marditech Corporation Sdn. Bhd. (2008). *A study on the Malaysian rice crisis and its implications on the national paddy and rice industry*; Selangor, Malaysia: MARDI.

Ministry of Agriculture and Agro-based Industry. (n.d.). *Agricultural Statistical Handbook (various issues)*. Putrajaya: Ministry of Agriculture and Agro-based Industry.

Ministry of Agriculture and Agro-based Industry. (1980-2007). *Paddy Statistics of Malaysia*. Putrajaya: Department of Agriculture, Ministry of Agriculture and Agro-based Industry.

Ministry of Agriculture and Agro-based Industry. (2008). *Dasar Sekuriti Makanan Negara* (in bahasa). Putrajaya: Ministry of Agriculture and Agro-based Industry.

Muhammad Khairul Bahri. (2008). *Supply and demand: A case study rice on West Nusa Tenggara, a system dynamics approach*. Retrieved 2010 February from http://www.

scribd.com/doc/18176238/Research-on-Supply-and-Demand-of-Rice-using-System-Dynamics-Approach.

Sarris, A. (2005). *Policies for basic food commodities 2003-2004*. Rome: Food and Agriculture Organization of the United Nations.

Sidiq, M. (2004, February). *Indonesia rice policy in view of trade liberalisation*. Paper presented at FAO Rice Conference, Rome, Italy.

Sterman, J. D. (2002). All models are wrong: Reflections on becoming a systems scientist. *System Dynamics Review*, *18*(4), 501–531.

Sterman, J. D. (2004). *Business dynamics: System thinking and modeling for a complex world*. McGraw-Hill companies.

Ventana Systems, Inc. (2004). *Vensim 5 user's guide*. Ventana systems, Harvard, MA, USA.

Wobst, P., & Mhamba, R. (2003). Towards agricultural development and poverty alleviation in Tanzania: Some policy options (Electronic Version). *Electronic Supply of Academic Publications.*

Wong, S. Y. (2004). *Modeling the rice supply Chain in Malaysia*. (Master of Science in Transportation and Logistics, dissertation). Universiti Teknologi Malaysia, Malaysia.