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The Impact of Price Subsidy on Rice Self-Sufficiency Level in Malaysia: A System Dynamics Approach

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Abstract

The Malaysian government had targeted for the rice industry in the country to achieve 100% rice self-sufficiency where Malaysia's rice self-sufficiency level (SSL) is currently at 65% to 75%. Thus, the government had implemented few policies to increase the rice production in Malaysia to meet the growing demand of rice. This paper focus on analyzing the impact of price subsidy on the rice production system in Malaysia using a system dynamics modelling approach. Scenario analysis was conducted using the developed system dynamics model by making changes on the price subsidy and observe the impact of the changes on the rice production and rice SSL. The developed system dynamics model offers better understanding of the effect of price subsidy on the rice self-sufficiency level. Based on the scenario analysis, the result shows that a 50% increase in the price subsidy leads to a substantial increase in demand as the rice price drops. Accordingly, the local production increases by 15%. However, the SSL slightly decreases as the local production is insufficient to meet the large demand.

1. Introduction

The rice self-sufficiency in Malaysia is at 72% where the remaining is imported from the importers countries in the Southeast Asia such as Thailand, Cambodia and Vietnam (The Sun Daily, 2017). It is very important to ensure its self-sufficiency as rice is the staple food for the majority of Malaysians. Government's effort in ensuring the rice self-sufficiency in Malaysia by implementing series of policies and strategies in the rice production system is highly contributing to the continuity of the rice supply to the growing consumers and demands in this country. The need to sustain the production of rice is very vital in order to meet the demand of rice from the growing population as shown in Figure 1(a) (Najim *et al.*, 2007). The national average yield is low at just over 3 tons per hectare. Thus, local production can only cater approximately 65-75% of domestic requirements (Ministry of Agriculture and Agro-based Industry Malaysia, 2013). Hence, the shortfall is supplemented by imported rice as shown in Figure 1(b).

Nevertheless, the country cannot fully depend on the import of rice to replenish the remaining required supply to the local consumer. This had been proven by the global food crisis that attacked the Asian countries in 2008 that had led to a concern as the importers refused to export their production out of the countries (Mohd and Mohd, 2013). The importance of rice production in Malaysia has directed our country to the formation of policy regarding the sustainability of the local national rice production instead of depending on the import from other countries. The government must not overlook on the impact of the crisis where the importers refuse to sell rice to Malaysia, to the rice production industry. If the food crisis is repeated, Malaysia needs to have a strong policy in the rice production system to avoid the dependency and to ensure a sufficient supply to the local consumers.

Figure-1(a). The trend of the population and domestic rice consumption

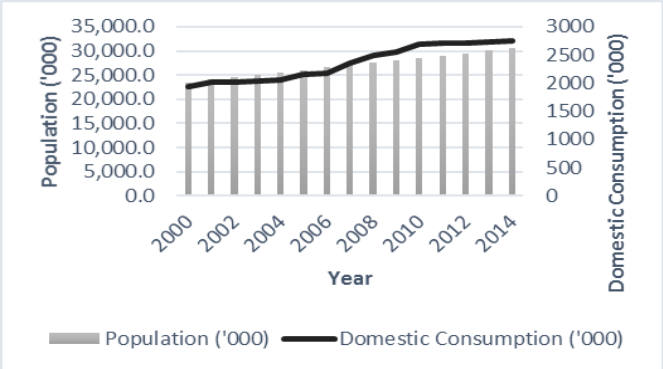

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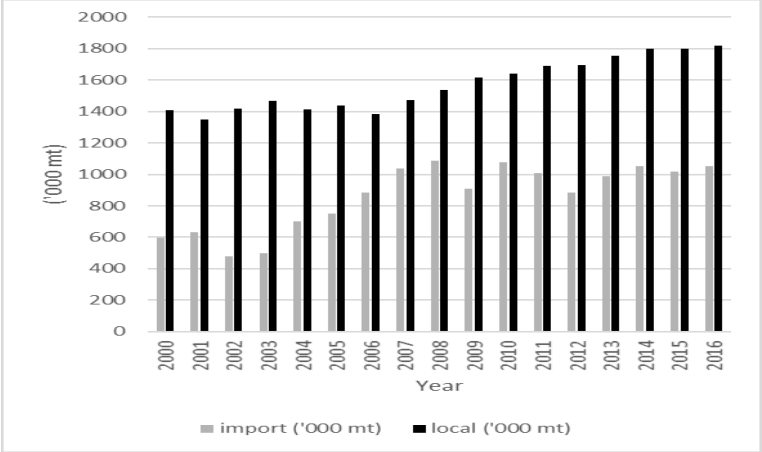
Figure-1(b). The trend of local and import rice



The purpose of this paper is to develop a system dynamics model that observe the behavior of the rice production system and SSL under the scenario analysis of the price subsidy. The model will help in studying the effect of the price subsidy on the rice production system in Malaysia.

2. Literature Review

Several factors have reportedly influenced the rice production in Malaysia. One of the major factors is the price. The production of rice in Malaysia is not cost efficient as to compare with another country like Thailand. This is due to the price of rice for the international market was lower than the average production cost in Malaysia (Mohd and Mohd, 2013). The price production venture is just too expensive for Malaysia to get involved if it is considered based on the economic basis (Najim *et al.*, 2007). Without much aids, only 40% of farmers are reportedly working full time in producing the paddy while others are involved in other profitable economic ventures.Thus, paddy price subsidy scheme is implemented by the government to attract the farmers into the rice production industry by increasing the farmers income. Malaysian government had allocated RM1.3 billion for price subsidy, seed and fertilizers in Budget 2017 (Kementerian Kewangan Malaysia, 2017). Accordingly, this study focuses on the impact of the price subsidy of paddy on the production and self-sufficiency level of rice in Malaysia in order to achieve 100% rice self-sufficiency level by 2020.

Other challenges included changes in climate, dependent on the economic rule, high production cost, lack of land availability, dependency on subsidy and inadequacy in technology and infrastructure. As one of the challenges, climate is uncontrollable. The yield, cultivated area and value of rice crop are affected by the climate factors such as temperature, rainfall and soil moisture (Alam *et al.*, 2011). Plus, rice production involved the area multiplied by yield (Forrester and Senge, 2012). However, Malaysia lack the areas that own large scale river system to produce the high level of rice production. A study showed that productivity and farm size of the rice industry in Malaysia is relatively low (Mohd and Mohd, 2013).

Furthermore, the average production cost is higher than the price of rice in the international market itself (Mohd and Mohd, 2013). Hence, the high level of dependency on the imported rice from other countries which showed that the production venture is too costly. The problem with the dependency on other countries is that Malaysia is exposed to export restrictions as we rely on the market for supplies (Dawe, 2013). Last but not least, technology is essential when it comes to remain competitive in the production of rice. The assistance in the irrigation investment, the use of new seed, improved fertilizer and the greater use of mechanization are among of the backings that are needed by the farmers when working on the increase of paddy production (Dawe, 2013).

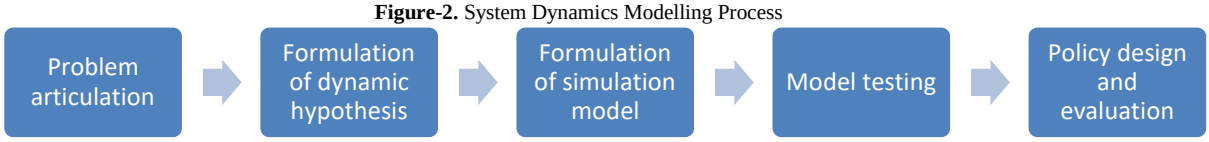
System dynamics is a computer-based approach that is first introduced by Jay W. Forrester to understand and analyze a system's behavior over time. Most complex behaviors usually arise from the interactions (feedback) among the components of the system. The complex and dynamic problem can be studied with this method as the system can be applied to diverse fields of study such as healthcare (Abidin *et al.*, 2014), strategic planning (Hawari and Tahar, 2015), education (Altamirano and Van, 2004), and agriculture (Giraldo *et al.*, 2008). The traditional correlation method used in food production study should preferably be replaced with system dynamics approach as it takes deep interest on the causation of the problems and the evaluation of policies and long-term influence (Giraldo *et al.*, 2008). System dynamics will clearly define the causal relationship between price subsidy and other factors in the system that is dynamic over time (Hellman, 1982). This paper will further discuss the method and analysis of rice self-sufficiency level in Malaysia.

3. Methodology

System dynamics is an approach in understanding the behavior over time of a complex dynamic system (Sapiri *et al.*, 2017). The behavior over time represents the variations and trends in the variables of interest.A complex system consists of interconnected elements that has high degree of feedback among them. System dynamics modelling is conducted through five stages of modelling process. Figure 2 shows the system modelling process that is used to study the rice production system in Malaysia. It involves the problem articulation, formulation of dynamic hypothesis, formulation of simulation model, model testing and policy design and evaluation. It is an iterative

process where constant process of modelling, testing and refinement are conducted through the model development (Hellman, 1982).

Figure-2. System Dynamics Modelling Process



The data source that has been used in the model is extracted from the public open sources such as Department of Statistics Malaysia and Ministry of Agriculture and Agro-based Industry. This data provides the exact figures for the past values of the variables in the rice production system in Malaysia that will assist in the development of the system dynamic model. Some of the data that had been extracted are the values of local production, import, demand, SSL and price of rice to develop the system dynamics model.

Figure 3 shows the causal loop diagram of the production system in Malaysia. The causal loop diagram represents the conceptualization of the rice production system that shows how the variables in the system affect one another. The positive sign (+ve) indicates the changes of the variables in the same direction while the negative sign (-ve) shows that the variables change in the opposite ways (Sapiri *et al.*, 2017). For example, the population and the demand have a positive sign relationship. It shows that as the population increases, the demand also increases. While the negative sign relationship between self-sufficiency level (SSL) and SSL Gap indicates as the SSL increases, the SSL Gap decreases. This is because SSL Gap is derived from the difference between SSL and Targeted SSL.

Figure-3. Causal loop diagram of rice production in Malaysia

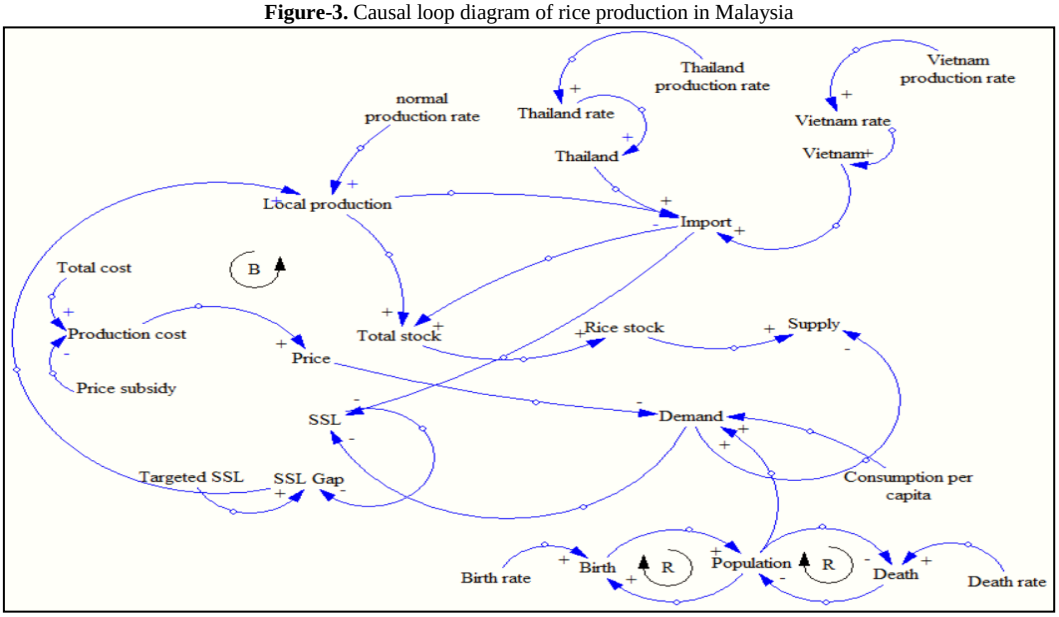
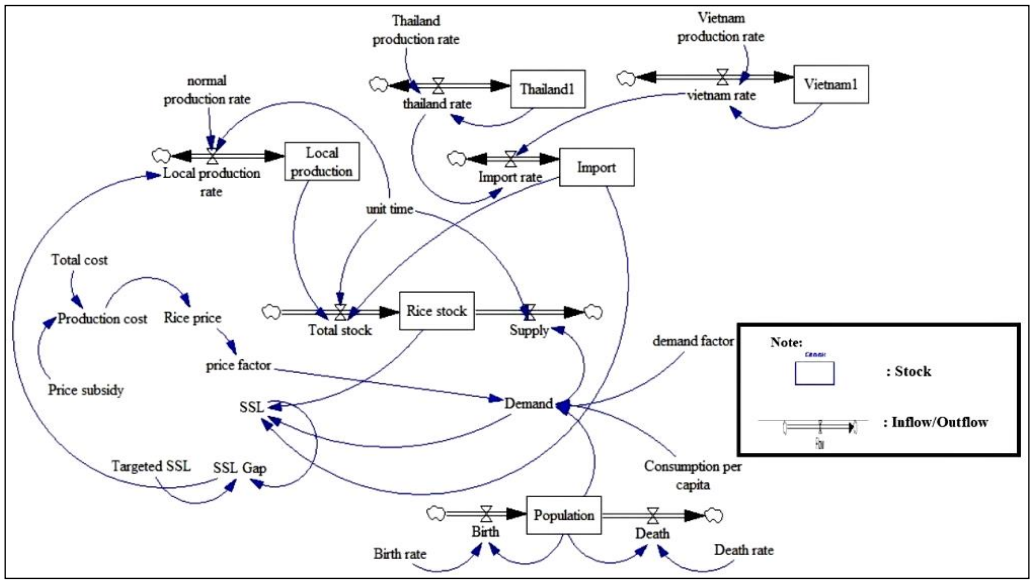


Figure4 presents the stock flow diagram of the production system in this study. The stock acts as the reservoir to accumulate quantities and describe the condition of the system. While the flows function to increase (inflow) and decrease (outflow) the value of the stock. There are six stocks in the figure namely local production, rice import, rice stock, population, Thailand and Vietnam. Thailand and Vietnam are two of the biggest importers for Malaysia. The total rice stock in Malaysia is the total of import and local production. Import comes from the imported rice from Thailand and Vietnam. While the local production comes from the locally produced rice in Malaysia. The local production rate depends on the SSL Gap. The higher the SSL Gap, the higher the local production. Ultimately, increase in the local production will increase the rice SSL. The need to meet a 100% rice SSL is motivated by the increasing demand of the increasing population in Malaysia that is shown by the population stock in the diagram. As mentioned before, this study focuses on the price subsidy to determine its effect on the rice production and self-sufficiency level. The achievement of 100% targeted SSL will be indicated by the SSL Gap in the figure. For example, if the current local production is at 70%, the SSL Gap is 30%. Thus, the price subsidy in the system need to be evaluated and tested to improve the policy to achieve a 100% SSL of rice production in Malaysia.

Figure-4. Stock and flow diagram of rice production in Malaysia



4. Analysis and Findings

From the developed model, scenario analysis is conducted where the current base price subsidy is set at RM300 based on the approximate value of the current price subsidy allocated by the government. To observe the influence of the price subsidy on the other variables in the system, the price subsidy for farmers is set to increase by 50% from RM300 to RM450 (Figure 5 (a)). The price subsidy has lowered the production cost imposed by the farmers and affect the price of rice in the market. Figure 5(b) shows the difference in the rice price in the market as the price subsidy is increased by 50%.It shows that the rice price is lower for 50% increase in price subsidy. This is because price subsidy helps lowering the production cost by the farmers. Lower production cost will directly decrease the rice price in the market. Thus, when price subsidy is increased, the production cost is decrease, and the rice price is decreased.

Figure-5(a). The intervention on price subsidy

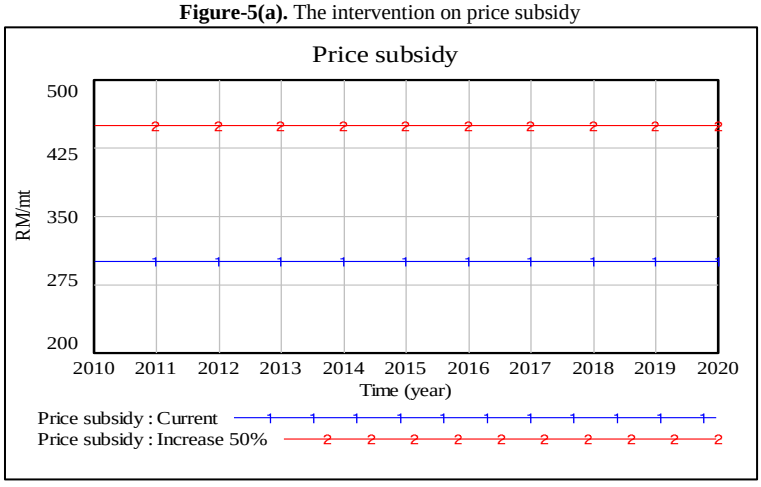
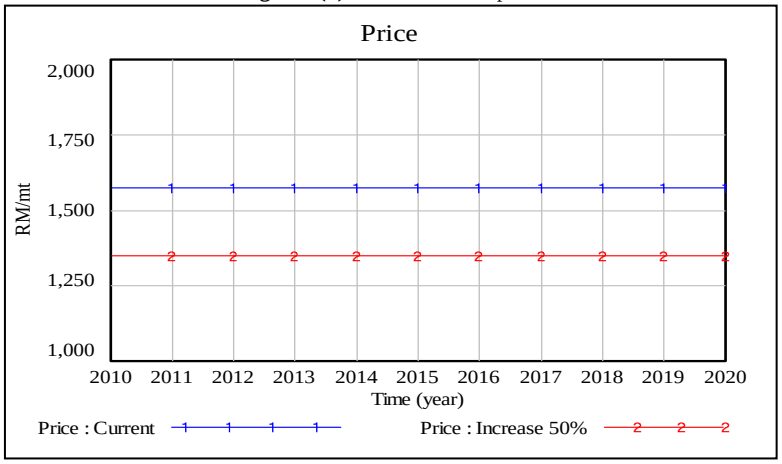
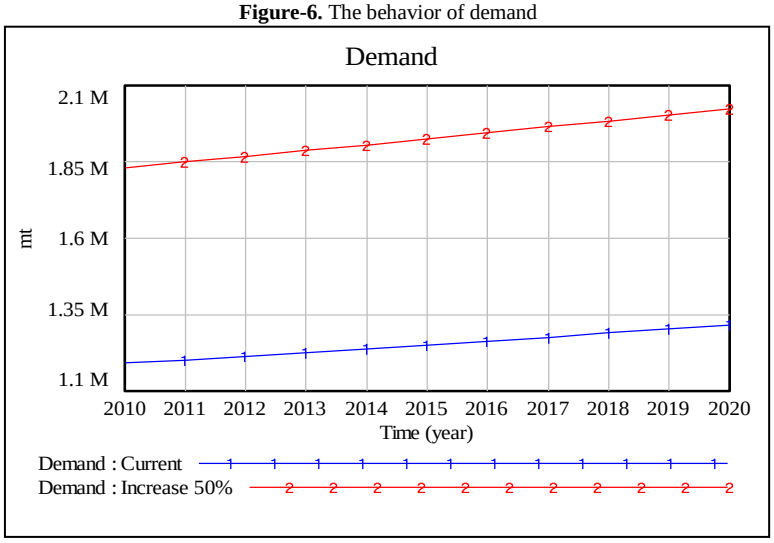


Figure-5(b). The behavior of price



Subsequently, when the price of rice in the market decreases, it will attract more demand from the consumers. The cheaper the price of rice, the higher the demand in the market (Figure 6)). So, the 50% increase of price subsidy has increased the demand of rice from the increasing population in Malaysia.

Figure-6. The behavior of demand



The increase in the demand will affect the SSL and the local production. Higher in demand cause higher SSL gap, and will demand higher local production. Figure 7(a)shows that when the price subsidy increases, the local production also increases by 15%. However, Figure 7(b) shows a decrease in SSL. This occurs as the price subsidy increases, the cost of production and price of rice decreases. Thus, it attracts higher demand from the growing population as the rice price drops. The increase in price subsidy has caused a slight increase in the local production but still insufficient to meet the substantial increase in demand caused by the price drops, and SSL decreases.

Figure-7(a). The behavior of local production

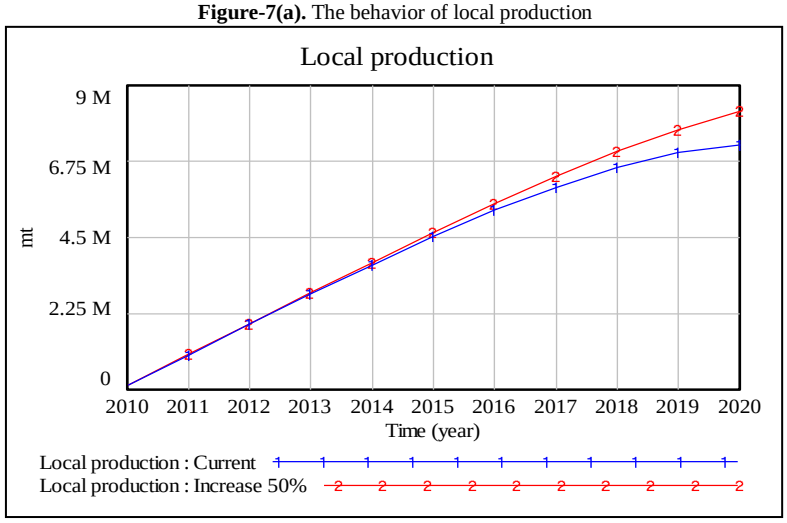
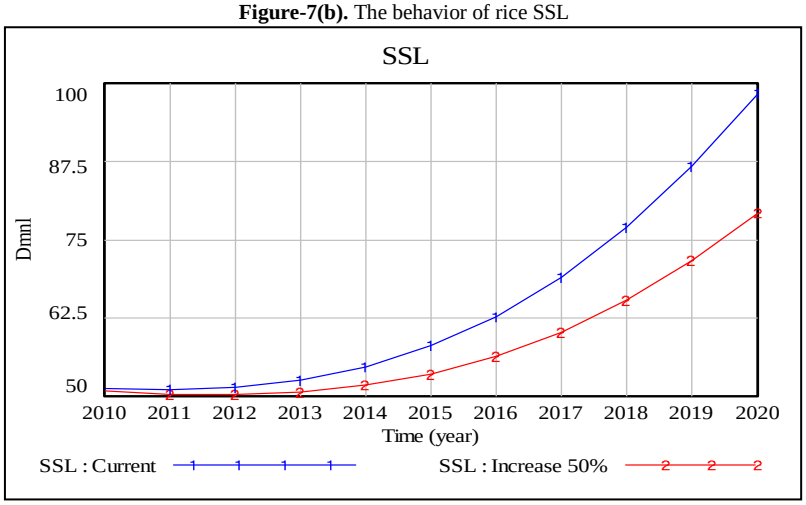


Figure-7(b). The behavior of rice SSL



5. Conclusions

This paper analyse the impact of price subsidy intervention towards the rice production system in Malaysia using system dynamics approach. Based on the preliminary analysis and finding, the increase in the price subsidy leads to a substantial increase in demand as the rice price drops. Increase in demand has increase the SSL gap, which will increase the local production. However, the rice self-sufficiency level slightly decreases as the increment in local production is insufficient to meet the huge increment of demand due to the rice price drops caused by the price subsidy. The developed model fits the purpose of this paper as part of our research study. The model still can be improved as other factors that influence the local

production will be studied to achieve the desired SSL.

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