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SUSTAINING PADDY SELF-SUFFICIENCY AND LAND DEMANDS IN SABAH, MALAYSIA: A STRUCTURAL PADDY AND RICE ECONOMETRIC MODEL ANALYSIS

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Abstract

The objective of this study is to construct an econometric commodity model in order to forecast the long term rice production performance of the state of Sabah, Malaysia. The baseline projection shows that the Sabah rice self-sufficiency is estimated to achieve approximately38% in the next 10 years due to the scarcity of the suitable land bank allocate for paddy cultivation. In order to achieve 60% of targeted rice self-sufficiency level (SSL), the size of land for paddy cultivation must be increased in Sabah. Based on the scenario simulation projection result, the expansion of paddy cultivation area will contribute a positively to the industrial rice production and consequently achieving the expected 60% of SSL by the end of 2024. In a nutshell, the state government of Sabah possess state autonomy on the land management, thus the state government plays a significant key role on promoting the local rice self-sufficiency level in the long-term period.

Keywords: *Paddy and rice, Self-sufficiency level, Commodity model, Food security*
JEL Codes: N5, Q01, Q15, Q18

1. Introduction

In recent decades, a phenomenon of lower rice self-sufficiency rate in Sabah has drawn the attention of Department of Agriculture Sabah, worrying about the food security condition of the state of Sabah. In Malaysia, the rice consumption of Sabah showed an increasing trend from year 1980 to 2012. In 1980, the rice consumption of Sabah was recorded about 115 thousand tonnes and further increased to 375 thousand tonnes in year 2012. According to the

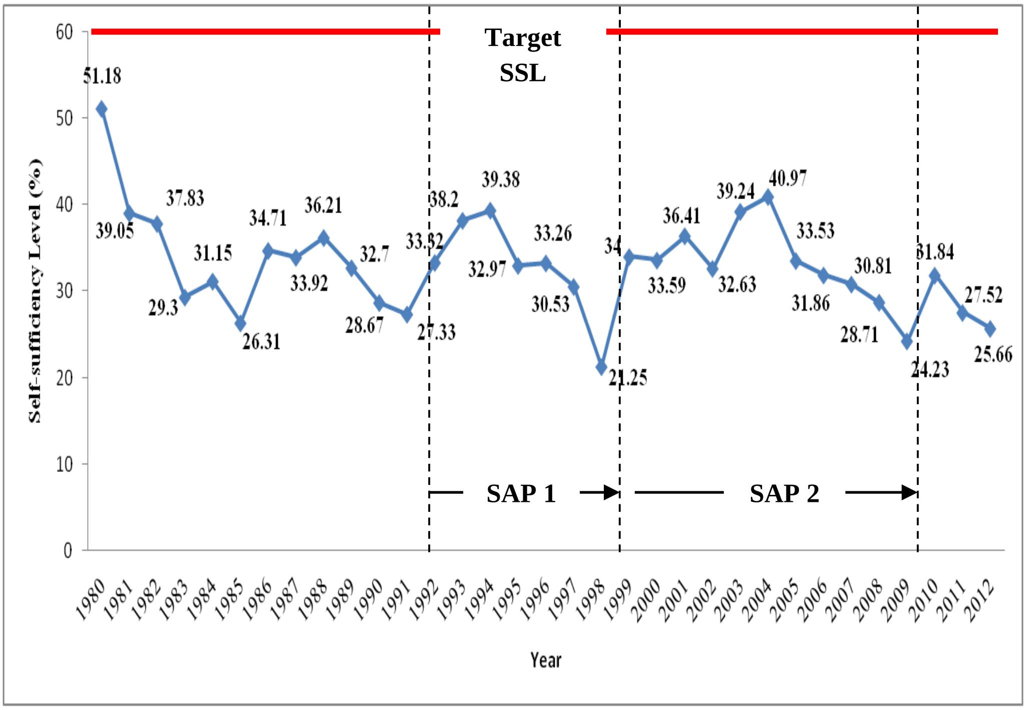
Malaysian Department of Statistics (DOS), the annual population growth rate of Sabah from year 2000 to 2010 was about 10% per annum. The DOS estimated that the population of Sabah will expand further up to 8 million people by the year 2025. Therefore, the rice consumption is also forecasted to grow along with the increasing population of Sabah in the next ten years. Consequently, the expected higher demand for rice in the coming ten years will push the market pressure to the rice producers as well as the famers of Sabah in order to avoid the market shortage of rice. In order to overcome the market shortage, the suppliers of Sabah can choose to import rice from elsewhere or increase the rice productivity of the state. If the rice producers of Sabah failed to resolve the rice shortage issue, the residents of Sabah might be facing a serious food security crisis.

In order to achieve the agriculture sustainability, the state government has implemented the First Sabah Agricultural Policy (SAP1) which aimed to enhance the gross domestic product (GDP) from agriculture contribution as well as to increase the agricultural productivity and efficiency, especially for the food crops such as paddy and rice. In the Second Sabah Agricultural Policy (SAP2) (1999 – 2010), the state government targeted to achieve 60% of rice self sufficiency level (SSL) by the end of year 2010. However, the historical data showed that the rice SSL in Sabah was decreased from 31.84% in 2010 to 27.52% in 2011 and plunged lower to 25.66% in 2012. This indicated that Sabah failed to achieve the targeted 60% of rice SSL in SAP2. In addition, the rice SSL in Sabah showed a significant decreasing trend from 1980 to 2012 and this demonstrated that the local rice production have a slower growth rate compare to the growth of demand for rice in Sabah.

In Figure 1, the rice SSL of Sabah fluctuated between the ranges of 20% to 40% which the rice SSL is not up to the targeted rice SSL suggested by the state government. At the initial phase of SAP2, the rice SSL was about 34% in year 1999 and it increased to 40.97% in 2004. However, the rice SSL showed sign of decrement after year 2004. In consequence, the imported rice of Sabah increases steadily every year. For instance, the imported rice in 2012 was recorded about 243 thousand tonnes, which is about 65% of the total rice consumption in Sabah. From the economic perspective, this implies a stern warning for the industry to have a more organized, effective and productive paddy cultivation programme and rice production system. Hence, this food security issue desperately demands a better cooperation between the state government and market firms, with the objective to produce a more versatile and holistic policy in order to resolve this approaching market shortage crisis.

The planted area used for paddy cultivation in Sabah dwindled from 47 thousand hectares in 1999 to 40 thousand hectares, equivalent to a total of 15% decrement. In term of paddy production, the production increased from 146,971 tonnes in 1999, to 147,186 tonnes in 2012, with an insignificant 0.0001% increment. This indicated that the slower growth of paddy production is the main factor which caused the current rice production in Sabah below the targeted 60% of rice SSL.

There are several main challenges in the rice industry of Sabah, namely suitable land bank scarcity, global climate change, unstable paddy yield, as well as the unstable food price in the market. These have led to a slower production growth in this few decades. In addition, the rapid growth of Sabah population demands a higher production of rice in the future. In order to avoid the serious gap of food shortage, especially rice, the state government has to design a good alternative policy option with the objective to enhance the rice production. However, the state government needs an analytical tool or commodity model to examine or forecast the impact of policy option on this industry before implementing the policy. This can be explained using the analogy of a pilot whom has to gone through a series of simulation training before maneuvering an aeroplane, in which the flight simulation helps to familiarize the pilot with an actual flying condition and thus respond wisely to various conditions in any given circumstances. Therefore, there is a need for the policymakers to forecast the impact of the policy once implemented using commodity model and thus ensuring the expected outcome will fall between the inference ranges of the policy target.



Source: Author's plot based on the data from Agricultural Statistical Handbook, Sabah, Malaysia.

Figure 1. Rice-sufficiency of Sabah, (%), 1980 – 2012

In this study, the main objective is to construct an econometric commodity model and using the model to forecast the paddy and rice industrial supply and demand in Sabah, Malaysia. The first division is to construct a paddy and rice simulation model with the times series econometric approach (AutoRegressive Distrubuted Lag). Furthermore, the second division is to forecast the paddy and rice industry performance (supply and demand) of Sabah in the coming 10 years based on the 60% SSL target in the year 2024. Based on these two divisions, the outcomes of this study will capable to suggest the alternative policies options to the state government or policymakers in order to develop and increase the Sabah rice production, thus achieving the targeted SSL in the next ten years.

2. Materials and Methods

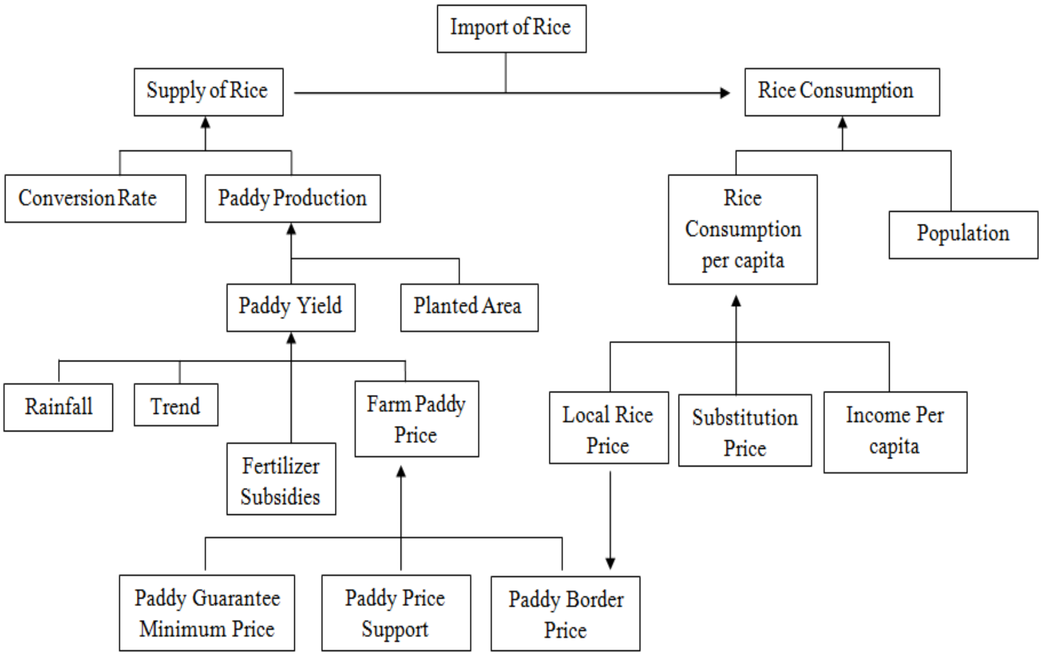
2.1 Theoretical Framework on Rice Model

Most of the commodity models developed by the previous researchers (Shamsudin & Arshad, 1993; Talib & Darawi, 2002; Talib *et al*., 2007; Shri Dewi *et al*., 2011) are mainly based on the concepts purposed by Labys (1973). Generally, the simple commodity model consists of 3 main components which are commodity demand, commodity supply, and commodity prices. If the commodity is a storable product, then the commodity inventories are another important components for inclusion in the model.

Conceptually, the market equilibrium is determined by demand and supply if the commodity is not storable. In contrast, the market equilibrium will not be identified by supply and demand due to excess supply (inventories) which occurs in the storable commodity market. Hence, the commodity price representing the storable commodity market is a market clearing price and it is not the market equilibrium price. The market demand is determined by the market prices and external influences such as economic activity and market preferences. The commodity supply usually depends on the market price and other external influences, for example, technologies, research and development (R&D), geological rank, and climate. According to Labys and Pollak (1984), inventories commonly occur to help the precautionary transactions or speculative motives. Clearly, these commodity components have a causality impact on each other and they are integrated in a loop system.

According to Shamsudin (2008), the general structure of commodity model explains the behavioral relationships on demand and supply of commodity. Based on the simple commodity model of Labys (1973), Shamsudin (2008) extents the commodity model by including the aspects of price determinants as well as other economic, political, and social phenomena. According to Shamsudin (2008), the supply in crop model is determined by the planted area and yield. The government policy is emphasized as an important determinant on the crop planted area and the yield is determined by the expected returns and cost of production. In the open market, the demand is presented in the export demand and domestic demand. In the commodity model, prices have feedback effects on the supply and demand. This indicates that the relative elasticity of demand and supply is a key to determine the significance of commodity stock in the adjustment of the market price.

In this study, we are based on the Labys and Pollak (1984), as well as Shamsudin (2008) commodity modeling framework to construct rice model for the state of Sabah. In Figure 2, the left side figure provides the principle constituents of the supply of rice and paddy, while the right side figure is the principal components of the rice consumption. The key components which represent the supply of rice are paddy production, paddy yield, rice imported, and planted area. The rice production is based on the paddy conversions rate and the current paddy production. However, the paddy production is highly determined by the paddy yield and the paddy planted area. The paddy yield is to represent the productivity of land used. Generally, the paddy production is determined by the technology, fertilizer subsidies, wages, farm paddy price, and rainfall.



Note: Arrows show the major direction of influence

Figure 2. Theoretical Frameworks For Paddy Market Model

In term of demand, the rice consumption is determined by the local rice price, income per capita, and the substitution prices namely price of wheat. The import of rice is included into the Figure 2 as an identity equation and represents the market execs demand. The market rice price is determined based on the market clearing condition which is the total supply of rice from local and imported equal to the total units of consumption.

In order to complete the market loop system, the farm paddy price is added into the paddy market model. In Malaysia, the farm paddy price is determined by the government guarantee minimum price (GMP) and paddy price support or paddy border price. If the border price is greater than the sum value of GMP and the paddy price support, then the border price will be adopted as the local farm paddy price. In contrast, if the border price is less than the incentives given by the government, then the total of GMP and the paddy price support will be used as the farm paddy price.

2.2 The Econometric Model: Paddy and Rice Model Specification

The data used for estimation of the paddy model was collected from Paddy Statistics, Department of Agriculture; Agricultural Statistical Handbook; and *Buku Perangkaan Agro-makanan* 2009-2010. The sample period for this study is from 1980 to 2012.

Based on the theoretical framework, the paddy yield is estimated based on the rainfall, fertilizer subsidies, and farm paddy price. In Malaysia, government provided the guarantee minimum price (PDGM) and paddy price support to the farmer. If the paddy border price is lower than the total incentives given by government, the farm price will be equal to the total incentives received by paddy farmers, and *vice versa*. According to Talib and Darawi (2007), and Asari *et al.* (2011), the climate change and geographical area have to be considered as one of the important factors in determining the agriculture production. Hence, the paddy yield function of Sabah can be expressed as:

$$PDYD_t = f(trend, PDFP_t, RFL_t, FERTS_t) \quad (1)$$

where,

PDYD	=	Paddy Yield (ton/ha)
Trend	=	Technology (trend dummy)
PDFP	=	Border Price; if Border Price > PDGM + price support;
or		
	=	PDGM + price support; if Border Price < PDGM + price support
RFL	=	Rainfall (mm)
FERTS	=	Fertilizer Subsidies (RM)
t	=	Time period

Based on the Equation (1), the trend dummy is expressed in the paddy yield function and represents the level of technology change. It is expected to have positive impact on the paddy yield. Furthermore, the paddy production is specified as an identity equation which is calculated based on the equation of paddy yield estimated in equation 2 multiplied by the planted area.

$$PDQS_t = PDYD_t * PDAP_t \quad (2)$$

where,

PDQS	=	Paddy Production (ton)
PDAP	=	Paddy Planted Area (ha)

The total paddy production needs to be further process in the factory and convert into the rice. In this rice supply channel, paddy represents a main intermediate good to produce the rice as the final good in Sabah. Hence, the rice production is calculated based on the following identity equation:

$$RCQS_t = PDQS_t * PDCR \quad (3)$$

where,

RCQS	=	Rice Production (ton)
PDCR	=	Paddy to Rice Conversion Rate (%)

In term of rice consumption, the main estimation equation is the rice consumption per capita. The determinant factors are real income per capita, local rice price, and rice substitution price. The income per capita is proxy by the real GDP per capita of Sabah, and the rice substitution price is proxy by the wheat price. Based on the demand theory, these two variables are expected to carry the positive relationship on determine the rice consumption. However, the local rice price is expected to have negative relationship with the rice consumption. In other words, the increase of rice price will cause to the local consumption decrease. Therefore, the rice consumption per capita can be estimated based on the following function:

$$RCQC_t = f(RCPR_t, WTPR_t, RGDPC_t) \quad (4)$$

where,

RCQC	=	Rice Consumption per Capita (ton / population)
RCPR	=	Local Rice Price (RM / ton)
WTPR	=	Wheat Price (RM / ton)
RGDPC	=	Real GDP per capita of Sabah (RM / population)

Therefore, the total rice consumption (RCQD) in Sabah is calculated based on the following identity equation:

$$RCQD_t = RCQC_t * \text{population of Sabah} \tag{5}$$

In the rice market system, the import of rice (RCIM) is measured in an identity equation. The import of rice in Sabah is equal to the excess demand in the market, which can express as:

$$RCIM_t = RCQD_t - RCQS_t \tag{6}$$

Furthermore, the local farm price is determined based on the market clearing condition, which is the supply of rice, plus the import of rice, must be equal to the total rice consumption in Sabah. Based on the market clearing concept, the price can be determined based on the following equation:

$$\Delta P_i = P_{i-1} \frac{(Qd_i - Qs_i)}{(Qs_i * \varepsilon_d + Qd_i * \varepsilon_s)} \tag{7}$$

where P is the rice price, Qd refers to the total rice consumption, Qs is the total supply of rice, the ε_d and ε_s represent the constant demand and supply elasticities, respectively. Furthermore, the i denotes as the final condition where the equilibrium point is achieved, while the i_{-1} is the beginning condition before equilibrium. When the equilibrium stage is achieved, the price change or ΔP should be equal to zero at the final point (i).

Finally, the paddy border price (PDBP) is estimated based on its lag price and the lag of rice price. The function of paddy border price can shows as:

$$PDBP_t = f(PDBP_{t-i}, RCPR_{t-i}) \tag{8}$$

3. Results and Discussion

3.1 Estimated Regression Result

This study applies the Autoregressive Distributed Lag (ARDL) approach which proposed by Pesaran *et al.* (2001) to estimate 3 equations for this paddy model. The 3 equations include the paddy yield (Equation 1), local consumption per capita (Equation 4), and paddy border price (Equation 8). In addition, the variables of the estimated equations are transformed into logarithm form. Furthermore, there are 4 identity equations included in this paddy model which the paddy production (Equation 2), rice production (Equation 3), total consumption for rice (Equation 5), and imported rice (Equation 6)are used to complete the loop of structural equation model as illustrated in Figure 2.

Before the regression analysis, the descriptive statistic and the correlation matrix (Table 1) show that all variables are no perfect multicollinearity and all have a normal distributed data except the paddy border price (PDBR). Furthermore, the paddy farm price (PDFP) have a highly correlation in 0.993. This is because of the PDFP is calculated based on the PDBR and the government support price as pre-explained in the Equation (1).However, the higher correlation between PDBR and PDFP do not affect the best estimation result of the model in the following section. This is because these variables are only used as a different exogenous variable in different estimated regression, hence, it will not create any multicollinearity problem.

Table 1. Descriptive Statistic and Correlation Matrix

	FERTS	PDBR	PDFP	PDYD	RCPR	RCQC	RFL	RGDPC	WTPR
Mean	16.09	6.33	6.36	7.87	7.02	-2.18	7.86	7.62	6.20
Median	16.02	6.17	6.21	7.82	7.05	-2.17	7.86	7.68	6.17
Maximum	16.42	7.03	7.03	8.23	7.50	-1.88	8.29	8.09	6.93
Minimum	15.85	6.10	6.21	7.46	6.73	-2.49	7.48	6.96	5.78
Std. Dev.	0.15	0.28	0.26	0.23	0.21	0.19	0.21	0.34	0.24
Skewness	0.37	1.58	1.70	0.04	0.39	-0.15	0.09	-0.40	0.67
Kurtosis	2.05	4.17	4.48	1.70	2.06	1.90	2.12	1.94	3.88
Jarque-Bera	1.86	14.67***	17.73***	2.20	1.92	1.69	1.04	2.27	3.28
Probability	0.39	0.00	0.00	0.33	0.38	0.43	0.59	0.32	0.19
Sum	498.64	196.28	197.22	243.83	217.76	-67.53	243.55	236.36	192.31
Sum Sq. Dev.	0.72	2.32	2.03	1.63	1.37	1.07	1.29	3.48	1.75
Correlation Matrix									
PDYD	1								
RCQC	-0.712	1							
PDBR	0.590	-0.565	1						
PDFP	0.602	-0.544	0.993	1					
RCPR	0.772	-0.794	0.784	0.792	1				
RFL	0.222	-0.270	0.329	0.320	0.263	1			
FERTS	-0.195	0.178	-0.371	-0.360	-0.087	-0.084	1		
RGDPC	0.793	-0.758	0.690	0.694	0.913	0.238	0.074	1	
WTPR	0.392	-0.243	0.156	0.198	0.435	0.140	0.064	0.422	1

Note: ***, **, and * denote as significant at 1%, 5%, and 10% significance level, respectively.

Furthermore, the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) Unit Root Tests are used to check the stationary of the data. The findings show that the set of regressors are a mixture of I(0) or I(1) variables and confirmed that there are no order two or *I*(2) variables. Therefore, the Pesaran *et al.* (2001) unrestricted ARDL Bound Test is appropriate use to check the long-run cointegration hypothesis and if the wald's F-statistic falls outside the critical value bounds, the underlying regressors are concluded to exist the long-run cointegration relationship.

Table 3 shows that the estimated results for paddy yield (Equation 1), local consumption (Equation 4), and paddy border price (Equation 8). The bound test's F-statistic for that 3 estimated equations show fall at above the critical value and it represents that the underlying regressors for these 3 estimated equations exit the long-run cointegration relationship.[1]In Table

[1]The Hendry (1979) general to specific procedure is a widely acceptable technique applies to identify the optimum lag in the final model specification. Hence, we analyze the Equation (1),

3, paddy yield regression shows that the trend and lagged of paddy yield are statistically significant at 1% significance level, indicating that the technology and stock adjustment are important factors to determine the current yield of paddy in Sabah. However, the estimated trend coefficient is relatively small (0.0108) and illustrate that the paddy yield is under the poor growth situation in Sabah. This finding is consistent with the results found by Ahmad (1991). Furthermore, the other estimated variables, such as the paddy farm price (PDFP), rainfall (RF), and fertilizer subsidies (FERTS) are insignificant to determine the paddy yield at 5% significance level but the sign for each variable carried the prior relationship. Based on the Haugton (1983), King (1987), and Ahmad (1991), the estimated fair low of paddy farm price supply elasticities (0.0499) is reasonable and generally acceptable by the researchers even though it is insignificant.

Table 2. Augmented Dicket-Fuller (ADF) and Phillips-Perron (PP) Unit Root Test

	Level		1st Difference		Conclusion
	ADF	PP	ADF	PP	
PDYD	-1.60 (0)	-1.309 (2)	-7.066*** (0)	-12.488*** (24)	I(1)
RCQC	-2.037 (0)	-1.943 (4)	-9.098*** (0)	-12.662*** (18)	I(1)
PDBR	-0.856 (0)	-1.308 (3)	-5.543*** (0)	-5.540*** (3)	I(1)
PDFP	-2.059 (0)	-1.721 (1)	-3.178** (0)	-3.191** (2)	I(1)
RCPR	0.183 (2)	-1.034 (0)	-6.543*** (1)	-9.367*** (4)	I(1)
RFL	-5.239*** (0)	-5.244*** (7)			I(0)
FERTS	-1.895 (0)	-1.841 (2)	-6.202*** (0)	-6.202*** (0)	I(1)
RGDPC	-10.257*** (0)	-10.257*** (0)			I(0)
WTPR	-3.345** (0)	-3.381** (2)			I(0)

Note: ***, **, and * denote significant at 1%, 5%, and 10% significance levels, respectively. The figures in parentheses (…) refer to the selected lag length; where, the ADF test is based on Schwartz Info Criterion (SIC) and the PP test is based on the Bartlett Kernel criterion.

The only variable which shows significant at 5% significance level to determine the rice consumption of Sabah is the estimated local rice price (RCPR). This own-price demand elasticities for rice is about -0.4592 which is greater than that Ahmad (1991) findings but approximate to the King (1987) estimated price elasticities. The negative elasticities of RCPR indicate that if rice price increases by 1%, this will lead to the local consumption for rice decrease by 0.45%, holding other factors constant. Furthermore, the coefficient of wheat price (WTPR) and real GDP per capita (RGDPC) are estimated in positive sign and it is statistically significant at 10% significance level. This positive coefficient represents that if the real GDP of Sabah as well as the wheat price increase by 1%, respectively, then the local consumption for rice will increase by 0.14% and 0.13%, respectively.

Equation (4), and Equation (8) with this technique and the selected optimum lag length for these 3 estimated regressions are (1, 0, 0, 0), (1, 0, 0, 0), and (1, 0), respectively.

Table 3. Estimated Results for Paddy Yield, Local Consumption per Capita and Paddy Border Price

Regression	**Paddy Yield (PDYD)**		**Local consumption per capita (RCQC)**		**Paddy Border Price (PDBP)**	
Lag	**(1, 0, 0, 0)**	**Coefficient**	**(1, 0, 0, 0)**	**Coefficient**	**(1, 0)**	**Coefficient**
	C	0.0732** [2.578]	C	0.1921 [0.159]	C	-1.263*** [-3.088]
	Trend	0.0108*** [4.109]	RCQC(-1)	0.5915*** [4.204]	PDBP(-1)	0.7024*** [12.719]
	PDYD(-1)	0.2681*** [3.287]	RCPR	-0.4592** [-2.465]	RCPR	0.2724*** [3.193]
	PDFP	0.0499 [1.620]	RGDPC	0.1421* [2.193]		
	RF	0.0002 [0.466]	WTPR	0.1324* [2.084]		
	FERTS	0.1773 [0.536]				
Bound Test:	6.689***		5.122**		5.682*	
Critical Value[2]	**I(0)**	**I(1)**	**I(0)**	**I(1)**	**I(0)**	**I(1)**
1%	6.643	8.313	5.33	7.063	8.170	9.285
5%	4.683	5.980	3.710	5.018	5.395	6.350
10%	3.868	4.965	3.008	4.150	4.290	5.080
Diagnostic Tests:						
R^2		0.9195		0.8669		0.9512
Adj. R^2		0.8985		0.7931		0.9455
F-stat.		43.80***		11.73***		168.94***
BG-LM		2.783 (0.248)		5.728 (0.057)		0.707 (0.702)

Note: ***, **, and ** denotes as significant at 1%, 5%, and 10% significance level, respectively. The Figure in bracket […] denotes as t-statistic and the figure in parenthesis (…) denotes as the p-value.

In this study, the paddy border price of Sabah is estimated based on the lagged of border price and the local rice price. The estimated result shows that the lagged of border price and local rice price are the important factors to determine the current border price. The estimated local rice price elasticities is 0.27 and it is statistically significant at 1% significance, indicating

[2]Since the estimated regression have small sample size (n=30), the Bound test's critical value is referred to the Narayan (2005).

that if the rice price increases by 1%, then the border price will follow to increase by 0.27%, *ceteris paribus*.

As an overall result, the estimated elasticities for these regression are in the reasonable magnitude and all variables are carried the prior expected sign. In addition, the estimation results include few diagnostic tests to confirm that model is correctly specified and also holds the CLRM assumptions *i.e.* the R-squared, Breusch-Godfrey serial correlation LM (hereafter BG-LM) test, CUSUM and CUSUM squared test[3]. The BG-LM test is used to test the auto serial correlation problem of the regression and the R-squared is shown by the fitness of the regression equations. The test of CUSUM and CUSUM squared are adopted to confirm the specifications of the regression. The overall results show that the BG-LM test for all estimated equations is insignificant to reject the null hypothesis at 5% significance level, indicating that all models have no auto-serial correlation problem. In addition, the CUSUM and CUSUM squared are both shown in the bound values, indicating that all estimated regressions are correctly specified.

3.2.Baseline Projection

In this section, the estimated elasticities for rice supply and demand are adopted to simulate the baseline projection on the rice production and consumption change of Sabah (Table 4). Based on the historical data, the planted area for paddy in Sabah has achieved 40 thousand ha with 147 thousand tonnes of paddy production in 2012. However, due to the limited land bank for the paddy cultivation, the planted area is projected to increase about 5 thousand ha from 2012 to the end of 2024, which is based on 1% growth rate per annum.

The increase of planted area provides the possibility of paddy production increment in Sabah. In addition, to project the paddy production, the price of paddy or the revenue gained by the farmers in the projection period is assumed always enough to cover their input cost. Based on the assumption of stable climate such as rainfall and fertilizer subsidies provided by government, the paddy production is projected to achieve 151 thousand tonnes in year 2013, 155.6 thousand tonnes in year 2014, and 159.97 thousand tonnes in year 2015. Furthermore, the projected value of paddy production is in the positive growth trend and it is estimated to achieve 207 thousand tonnes in year 2024.

Rice production has recorded 88.8 thousand tonnes in year 2010, 91.5 thousand tonnes in year 2011, and 92.7 thousand tonnes in year 2012. Furthermore, the increase of paddy production will enhance the of rice production by years. The rice production is projected to achieve 95.3 thousand tonnes in 2013 and it is projected to grow continuously by years until it achieves 130.6 thousand tonnes in 2024.Based on the market clearing concept, the consumption value is projected to achieve about 351.6 thousands tonnes in year 2015. Due to the price change effect, the projected value of rice consumption is estimated to be stable until year 2024, which the paddy production is projected to be 346.8 thousand tonnes.

The rice self-sufficiency level for Sabah is decreasing constantly, from 31.84% in year 2010, to 27.52% in 2011 and further down to 25.66% in 2012. Based on the increment of rice production and stable change of rice consumption, the projected self-sufficiency level in year 2013 is 26.66%, 27.66% in year 2014, and 28.66% in year 2015. Due to the limited land bank for paddy cultivation, the self-sufficiency level for paddy is estimated to plunge below 60% in the SAP3. Hence, the projected self-efficiency level is estimated to show the positive growth trend for the following years but only achieve about 37.66% in year 2024.

[3]The CUSUM and CUSUM Squared test are adopted based on the Brown, Durbin, and Evans (1975).

3.3. Scenario Simulation Analysis: Expand Paddy Cultivation Area

In this scenario, we assume that the available land bank for paddy cultivation is no limit. Thus, we based on this assumption to forecast the significant impact of increase of land use for paddy cultivation in Sabah rice industry. In order to achieve the targeted 60% of SSL, land used for paddy cultivation will play a significant role. As projected, the land used for paddy cultivation is suggested to increase about 66,000 hectares from 2012 to the end of 2024 (Table 5). The paddy production is projected to achieve 157,461 tonne in 2013, 173,461 tonne in 2014, and 191,295 tonne in 2015 respectively. This indicates that the projected value of paddy production is in the positive growth trend, and it is estimated to achieve 580,447 tonne by the end of 2024.

Furthermore, the consumption of rice of Sabah is projected to achieve about 378,060 tonne in 2015, and due to the price change effect, it is estimated to be around 609,469 tonne until 2024. Besides that, the imported rice of Sabah is predicted to growth at the beginning of SAP3 and to achieve around 243,899 tonnes by the end of 2024. Based on the increment of land used for paddy cultivation and rice production growth, the rice SSL of Sabah is projected to be 27.58% in 2013, 29.65%in 2014%, and 31.88 in 2015. Due to the increase of land bank for paddy cultivation, the SSL for rice in Sabah is estimated to achieve 60% by the end of 2024.

4. Conclusion

Sabah's self-sufficiency level urged to increase to 60% of targeted rate in future. In order to prevent the future shortage of rice production and reduce the state's import bills, policymakers has been implemented certain policies on growing the rice production, such as SAP1 and SAP2. However, these two Sabah's agriculture policies failed to increase the rice productivity and the SSL is still below the 60% of targeted rate. Hence, this implies a stern warning for the industry to have a more organized and effective cultivation programme. In addition, a better cooperation between the state government and market firms are crucial to resolve this approaching market shortage crisis and lead the Sabah's rice production to sustain in future.

In this study, we aims to construct a structural econometric commodity model and to simulate the impact of paddy land cultivation expansion in Sabah. Based on the findings, in order to achieve the 60% of SSL in 2024, land dedicated to paddy cultivation has played a significant role. The Baseline projection shows that the rice self-sufficiency level of Sabah is forecasted to achieve about 38% due to the limited land bank use for paddy cultivation. However, the scenario projection results show that the expansion of paddy planted area will bring a positive impact on the industry and it is projected to achieve 60% of SSL by the end of 2024. Hence, the allocation of agriculture land for paddy cultivation is needed to be reviewed and rearrange by the government in order to increase the local rice self-sufficiency.

Table 4. Baseline Projection Results For The Paddy And Rice Industry In Sabah, 2013 to 2024

Supply	Unit	Projection											
		2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Planted Area	hactares	40,717	41,124	41,535	41,951	42,370	42,794	43,222	43,654	44,091	44,532	44,977	45,427
Paddy Production	Tonnes	151,322	155,559	159,970	164,563	169,333	174,270	179,370	184,631	190,052	195,634	201,379	207,289
Paddy Yield	Kg per hectare	3,716	3,783	3,851	3,923	3,997	4,072	4,150	4,229	4,310	4,393	4,477	4,563
Rice Production	Tonnes	95,333	98,002	100,781	103,674	106,680	109,790	113,003	116,317	119,733	123,249	126,869	130,592
Import of Rice	Tonnes	262,366	256,419	250,974	245,980	241,376	237,100	233,107	229,360	225,828	222,485	219,311	216,286
Demand													
Rice Consumption	Tonnes	357,587	354,310	351,643	349,543	347,944	346,779	345,999	345,566	345,449	345,623	346,068	346,767
Rice Consumption per capita	tonnes per person	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08
Export of Rice	Tonnes	111.4	110.6	112.2	111.3	111.3	111.4	111.4	111.5	111.4	111.4	111.5	111.5
SSL	%	26.66	27.66	28.66	29.66	30.66	31.66	32.66	33.66	34.66	35.66	36.66	37.66
Price													
Paddy Border Price	RM per Tonne	1089.40	1098.83	1116.16	1139.89	1168.16	1199.35	1232.81	1268.00	1304.66	1342.42	1381.04	1420.41
Paddy Guarantee Minimum Price	RM per Tonne	750	750	750	750	750	750	750	750	750	750	750	750
Paddy Price Support	RM per Tonne	248.1	248.1	248.1	248.1	248.1	248.1	248.1	248.1	248.1	248.1	248.1	248.1
Paddy Retail Price	RM per Tonne	1089	1099	1116	1140	1168	1199	1233	1268	1305	1342	1381	1420
Local Rice Retail Price	RM per Tonne	1,686	1,679	1,738	1,803	1,869	1,932	1,997	2,063	2,130	2,197	2,265	2,334

Table 5. Scenario Projection Results For Paddy And Rice Industry İn Sabah, (2013 To 2024)

Supply	Unit	Projection											
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Planted Area	hactares	42,122	44,992	48,241	52,062	56,107	60,586	66,584	72,123	79,139	88,087	97,632	106,241
Paddy Production	Tonnes	157,461	173,047	191,295	213,22	237,412	265	301,911	338,506	385,091	445,753	514,189	580,447
Paddy Yield	Kg/ hectare	3,738	3,846	3,965	4,096	4,231	4,374	4,534	4,693	4,866	5,06	5,267	5,463
Rice Production	tonnes	99,2	109,02	120,516	134,328	149,57	166,95	190,204	213,259	242,607	280,824	323,939	365,682
Import of Rice	Tonnes	260,535	258,738	257,657	257,775	256,559	254,74	256,698	252,849	250,645	250,286	245,961	243,899
Demand													
Rice Consumption	Tonnes	359,624	367,647	378,06	391,992	406,017	421,579	446,791	465,996	493,141	530,999	569,789	609,469
Rice Consumption per capita	tonnes per person	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.12	0.12	0.13	0.13
Export of Rice	Tonnes	111.4	110.6	112.2	111.3	111.3	111.4	111.4	111.5	111.4	111.4	111.5	111.5
SSL	%	27.58	29.65	31.88	34.27	36.84	39.60	42.57	45.76	49.20	52.89	56.85	60.00
Price													
Paddy Border Price	RM per Tonne	1089.40	1098.83	1116.16	1139.89	1168.16	1199.35	1232.81	1268.00	1304.66	1342.42	1381.04	1420.41
Paddy Guarantee Minimum Price	RM per Tonne	750	750	750	750	750	750	750	750	750	750	750	750
Paddy Price Support	RM per Tonne	248.1	248.1	248.1	248.1	248.1	248.1	248.1	248.1	248.1	248.1	248.1	248.1
Paddy Retail Price	RM per Tonne	1089	1099	1116	1140	1168	1199	1233	1268	1305	1342	1381	1420
Local Rice Retail Price	RM per Tonne	1,686	1,679	1,738	1,803	1,869	1,932	1,997	2,063	2,13	2,197	2,265	2,334

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