SOCIAL SCIENCES & HUMANITIES

Implication of Fertiliser Subsidy Withdrawal on Societal Welfare, Rice Output and Imports in Malaysia's Rice Sector

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ABSTRACT

The study analysed the effects of de-subsidised fertiliser input, as an alternative policy, in the rice sector in Malaysia. Time series data (1980-2012) were collected and analysed through different stages of analyses. The first stage of analysis involved time series econometric model, namely Auto Regressive Distributed Lag (ARDL) which was used for coefficients estimation. Estimated elasticities were subjected to and passed the relevant diagnostic tests. The estimated elasticities were then used for the second stage of analysis - that is scenario simulation (removal of fertiliser subsidy while retaining any other rice production subsidy and support) and forecast. Finally, the generated simulation results were further used in estimating societal welfare through the producer surplus change estimation technique. Results showed, on the average and by 2020, yields declined by 10%, national output contracted by 10% and net import increased by 19.1%. Producer welfare loss stood at RM839 million, revenue saved was RM183 million and the net loss or societal welfare loss was about RM655 million. Thus, the policy option should not be on the decision table of policy makers because of net lost to society in general.

Keywords: Fertiliser subsidy**,** producer welfare, societal welfare, simulation

INTRODUCTION

The global instability in rice prices experienced in early 1970, middle of 1980 and recently in 2008 reinforced the necessity for the Malaysian government interventions in the rice sector. The major objectives of the interventions,

which resulted from formulation and implementation of various policies on the rice sector over the decades by the government, included ensuring food security for the nation; raising farm income and productivity for the farmers; and, ensuring food supply to consumers at a reasonable cost. Interventionist Policy instruments in the rice sector had been consistently maintained and reflected in several National Agricultural Policy (NAPs) and the Malaysia Plans. For example, in the Third Malaysian Plan (1976-1980), besides giving priority to the agricultural sector with the launching of the New Economic Policy (NEP) and execution of large-scale rehabilitation of idle land as well as development of drainage facilities for both non-food (and food) crops production, a major paddy production intervention took place with the implementation of the fertiliser subsidy scheme in 1978.

Based on the fertiliser subsidy scheme, free chemical fertilisers were given to smallholder paddy farmers who owned less than 2.4 ha of land (Amin, 2007).

Hence, it was during this period (Third Malaysian Plan) that the highest self-sufficiency level (92%) of rice production was achieved. Other intervention packages in the rice sector include implementation of policies such as monopoly on rice imports, Guaranteed Minimum Price (GMP) for paddy production, paddy producer price support and provision of increased funds for research and development in rice.

The fertiliser subsidy scheme of the government involves granting 240 kg/ha of compound fertiliser (that is 12 bags of 20kg compound fertiliser per ha) and 100 kg/ha of urea fertilizer (that is 5 bags of 20kg of urea fertiliser per ha). The aggregate amount of fertiliser subsidy per annum has been hovering unsteadily around RM140 million and RM146 million between 1990 and 2000 (Fig.1). This amount later decreased by about 3% (compared with the value in 2000) to about RM141 million between 2003 and 2009. In 2010, the total amount of fertiliser subsidy increased by 13% to RM165 million over 2009 value. It further increased by 6% to about RM 175 million in 2012 (Fig.1).
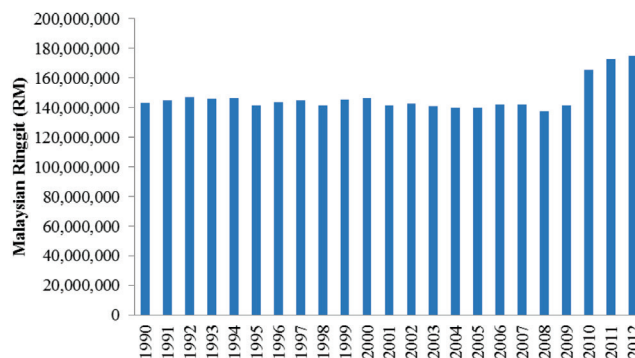

Fig.1: Amount of Fertiliser Subsidy (RM) (1990-2012).
Sources: Paddy Statistics Unit, Malaysian MOA & AI., (2013).

As a result fertiliser subsidy scheme and improvement in the rice production technology, rice yields recorded an increase (on the average) from 2.7 MT MT/ha to 3.8 MT/ha for the period 1990-2012 period (Fig.2). The off-season paddy production recorded an increased in yield from 3.5 MT/ ha to 4.5 MT/ha for the period 1990-2012. The main-season paddy yields increased from 2.7 MT/ha to 3.4 MT/ha within the same period. The national average yield is lower at 3.642 MT/ha in the main season compared with 4.065 MT/ha in the off season.
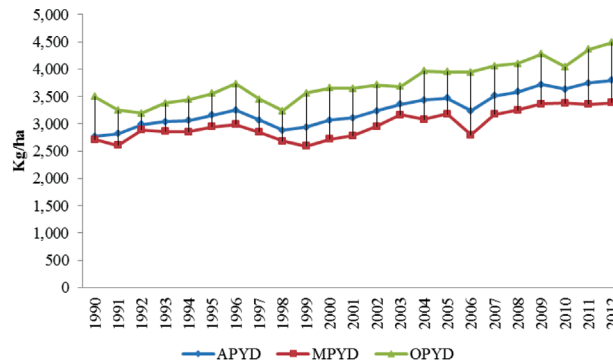

Fig.2: Average Yield (kg/ha) of Paddy Rice in Malaysia (1990-2012).
Note: APYD (All-season Paddy Yield, that is the national yield average); MPYD (Main-season Paddy Yield); and, OPYD (Off-season Paddy Yield).
Sources: Paddy Statistics Unit, Malaysian MOA & AI., (2013).

Even though domestic rice production increased by 38% from 1.2 million MT in 1990 to 1.7 million MT in 2012 as a result of the interventionist policies, such increment still saw a deficit of 42% in the national rice consumption by 2012 (Fig.3). As a result of a shortfall in meeting the national rice consumption, rice imports have increased by over 200% from 330,336 MT in 1990 to 1.05 million MT in 2012 as depicted in Fig.3. Rice imports are necessary to bridge supply-demand gap.
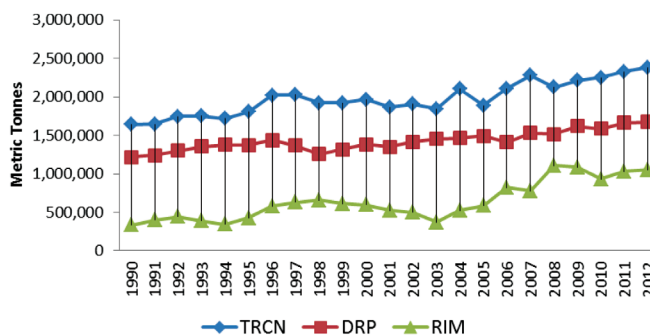

Fig.3: Rice Consumption, Domestic Rice Production and Rice Net Import (MT) (1990-2012).
Note: TRCN (Total Rice Consumption); DRP (Domestic Rice Production); and, RIM (Rice Net Import).
Sources: Paddy Statistics Unit, Malaysian MOA & AI., (2013).

The rice import bill has increased astronomically over the last two decades in the country (Fig.4). The value of rice imports increased by over 500% from US$99,737,000 in 1990 to $606,222,000 in 2012. There was an increase of about 82% from the 1990's value to US$181,585,000 in 2000. Between 2000 and 2012, the value of rice imports into the country increased by over 200%. The highest import value incurred by the country was US$813,305,000 recorded in 2008 during the global shock in rice supply.
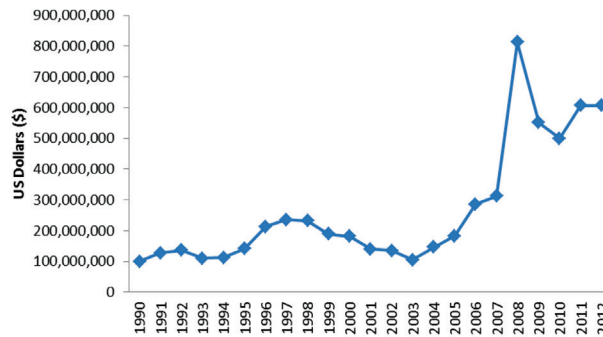

Fig.4: Value of Rice Net Import ($) (1990-2012).
Sources: Food and Agricultural Organization's website: www.fao.stat, (2013).

Vietnam has been the first major rice exporter to Malaysia since 2009. In 2011, Vietnam accounted for 55% of the Malaysian import market (Global Agricultural Information Network (GAIN) Report, 2012). Thailand which had been the first major rice exporter before taken over by Vietnam, is now ranked as the second major rice exporter to Malaysia. The other significant supplier is Pakistan, followed by Cambodia and India. Malaysia's rice import from the United States was about 9,400MT in 2012, which is mainly short-grain rice variety consumed by Japanese and Korean expatriates (GAIN Report, 2013). In 2011, given the policy of import quota, *Padiberas Nasional Bhd (BERNAS),* a state-owned company with the sole right of rice import, was given a 10-year extended mandate as a sole importer of rice until 2021. The government has also granted an import duty exemption to *BERNAS,* which allows the price of imported rice to be marginally higher than the local rice price (Deviga, 2013). In an attempt to protect the local rice farmers and in line with the import quota policy, *BERNAS* merely imports rice just to cover the shortfalls of demand after ensuring the local rice production finds its way to the market.

Malaysia entered into agreements with multi-lateral bodies, namely the World Trade Organization (WTO) and ASEAN Free Trade Area (AFTA). The most relevant of these agreements and with direct impact on the rice sector are the "Agreement on Agriculture" (AoA) of WTO and the "Common Effective Preferential Tariff"

(CEPT) of AFTA. These agreements called for the liberalisation of the agricultural sector by removing all forms of trade barriers including import quota and production subsidy by all member countries. Though at the moment there had been different levels of compliance with the agreement's obligations among member countries, some major changes in rice production and market have been observed by some member countries as a result of enforcement of the agreements. For instance, market-driven rice production in Vietnam has resulted in surplus production making the country the second largest rice producer in the world. 'Vietnam's large rural population is involved in rice production, so the positive impacts of increased exports have been largely dispersed. According to Minot and Gulotti (2000), overall poverty incidence in Vietnam has decreased significantly following the liberalisation policy of the rice sector. Gulati and Narayanan (2002) state that liberalisation of the rice trade could have beneficial effects for societal welfare with all-round effect manifestations including increase in wages, employment and investment. This would contribute to welfare improvement and poverty alleviation.

Generally, the economic welfare change is commonly measured via the Marshallian approach to the estimation of consumer and producer surpluses (Mustapha, 1998). Based on this principle, Fig.5 hypothesises the effect of fertiliser input subsidy on the total output of rice production as well as welfare implications. The subsidy lowered the price of inputs thereby, reducing the total cost of rice production and encourage increased output. The supply curve, S, shifted vertically downward to a new position, S*, as farmers' marginal cost fall. The subsidy induced curve (S*) differs from supply curve S vertically by amount of subsidy z. The total value of production subsidy is provided by trapezium AB. The higher returns to the domestic farmers (Pp) caused by input subsidy induced expansion of output (q_2). The horizontal difference between D and S* (that is q_3-q_2) is a function of ED* (or qm_1). The lower excess demand curve (ED*) is an effect of production subsidy (as the horizontal difference between D and S* is equal to horizontal difference between ED and ED*). However, total removal of inputs or production subsidy would force the curves S* and ED* to assume S and ED. The import would rise from qm_1 to qm_2 (that is changes from q_3-q_2 to q_3-q_1). Per unit returns to domestic farmers would now reduce from Pp to Pw. The lower returns contracted the output from q_2 to q_1 and cause the outflow of variable resources from the de-subsidised sector. The rise in imports which compensated declines in domestic output would not affect the consumers as price remains constant.

By assessing the welfare implication of the policy, the subsidy scheme generated the production efficiency loss represented by area B (Fig.5). This area measures the net value of goods and services sacrificed by domestic economy to produce additional units of output. Area A reflects

a transfer from the government (tax payers) to the domestic producers. Areas A and B comprise the government transfer or the amount of subsidy. However, the removal of the subsidy would result in a loss to producers while the tax buyer is not affected. Society would gain output somewhere as moveable resources are pushed out of the rice sector. In principle, the consumers remain unaffected as long as world prices are not influenced by the change in the nation's import.
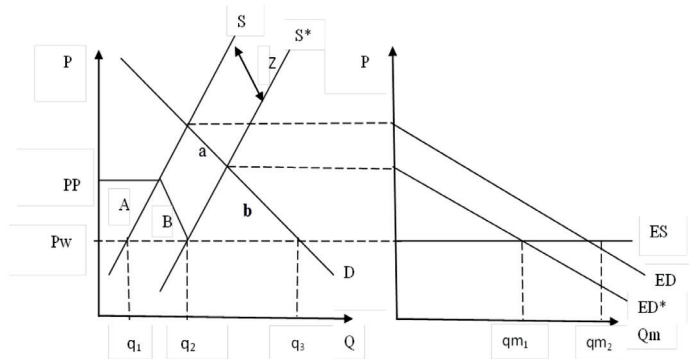

Fig.5: Rice Production Subsidy and Liberalisation Policy (Small Country Feature).

In contrast with inherent societal benefits of "de-subsidise" policy in agricultural sector as required by liberalisation, some findings have shown the importance of production subsidies in raising farm income and output in the Malaysian rice sector. For instance, Fatimah, *et al.* (2005) observed that the price support scheme of the Malaysian rice sector was able to increase output by 65.8% and contribute to a 38.6% change in income, while fertiliser and price support components of production subsidy constitute 58% of total farm income. Hence, the government's efforts to have the potential trade-off between the goal of protecting paddy producers and pursuing rice-food self-sufficiency for the nation on the one hand, and the need to honour her multilateral agreements by making agricultural sector a market driven one on the other hand, certainly depend on knowledge generated from empirical analysis of societal welfare and national rice output implications of production subsidy withdrawal, particularly fertiliser subsidy.

This study has become necessary as a result of paucity of empirical information on the implications of fertiliser subsidy withdrawal from the Malaysian rice sector. Therefore, the general objective of the study is to determine welfare implication of fertiliser subsidy withdrawal policy option in the Malaysian rice sector. Specifically, the study is intended to simulate the effects of de-subsidising fertiliser input (as an alternative policy regime) on rice yields in Malaysia, national output and rice import quantity, and determine societal welfare implication of such a policy.

MATERIALS AND METHODS

Time series data for the 1980-2012 period were collected from the Paddy Statistics, Ministry of Agriculture and Agro-based Industry, Malaysia as well as the, Food and Agricultural Organization (FAO) website. Data were measured as follows: $APAP_t$ = Paddy Area Planted (Ha) in period t; $APYD_t$ = Paddy Yield (Kg/Ha) in period t; $PPPR_t$ = Paddy Producer Price (RM/T) in period t; $PFPR_t$ = Paddy Farm Price (RM/T) in period t; $RRPR_t$ = Rice Retail Price (RM/T) in period t; $WRPR_t$ = Wheat Retail Price (RM/T) in period t; $FESUB_t$ = Fertiliser Subsidy (RM/annum) in period t; $TECH_t$ = Technological progress (Trend); $PPRS_t$ = Paddy Price Support (RM/T) in period t; $RPCN_t$ = Rice Consumption per Capita (Kg) in period t; PCY_t = Income per Capita (RM) in period t; $RTCN_t$ = Rice Total Consumption (T) in period t; POP_t = Country Population (Number of people) in period t; $RNIM_t$ = Rice Net Import (T) in period t; $DRPP_t$ = Domestic Rice Production (T) in period t.

Data analysis process involved specification and estimation of time series econometric models, and using the estimated coefficients from econometric models for simulation and welfare analyses. The functional form of time series econometric model which explains the behaviour of actors in rice market in Malaysia consists of four components, namely the domestic rice producers, consumers, rice importing firm and agency in charge of policy formulation. In this model, the rice supply equation is disaggregated into area planted and yield while rice demand market is represented by both domestic and import demands. The behavioural equations were equations of area planted and yield as well as domestic demand while identity equations involved total domestic production, total consumption, import demand, paddy producer price and price transmission equation.

(i) Area planted: The restricted area planted equation is the Nerlovian type and specified as follows:

$$LAPAP_t = \delta_0 + \delta_1 LAPAP_{t-1} + \delta_2 LPPPR_{t-i} + \delta_3 DPAP_t + \mu_t \dots\dots\dots\dots\dots\dots\dots\dots [1]$$

(ii) Yield: the yield equation was specified as a restricted equation too. The imposed restriction on both equations is necessitated by a protectionist policy on the supply-side of rice sector.

$$LAPYD_t = \lambda_0 + \lambda_1 LFESUB_t + \lambda_2 TECH_t + \mu_t \dots\dots\dots\dots\dots\dots\dots\dots [2]$$

Where; LAPAP = Log of area planted; $LAPAP_{t-1}$ = Log of area planted in lag one period; $LPPPR_{t-1}$ = Log of paddy producer price in lag; DPAP = Dummy for paddy area planted (Dum= 1, if $APAP_t$ is greater than 1983 paddy area planted and 0 if $APAP_t$ is less than or equal to 1983 paddy area planted); $LAPYD_t$ = Log of paddy yield; $LFESUB_t$ = Log of fertiliser subsidy; $TECH_t$ = Technological trend; t = Time period in respective equation; δ and λ = coefficients for respective variables; μ_t = White-noise error term in the respective equations.

(iii) Domestic demand: The demand equation specified as follows:

$$LRPCN_t = \beta_0 - \beta_1 LRRPR_{1t} + \beta_2 LWRPR_{2t} + \beta_3 LPCY_{3t} + \mu_t \qquad [3]$$

Where, $LRPCN_t$ = Log of rice consumption per capita at period t; $LRRPR_{1t}$ = Log of rice retail price at period t; $LPCY_t$ = Log of income per capita; β = coefficient to be estimated; μ_t = White-noise error term.

(iv) Import Demand: The import demand is considered as an excess demand over the country's total rice production. The identity equation is expressed as follows:

$$RNIM_t = RTCN_t - DRPP_t \qquad [4]$$

Other identity equations were specified as follows:

$$RTCN_t = RPCN_t * POP_t \qquad [5]$$

$$DRPP_t = (APAP_t * APYD_t) * 0.644785983(CV) \qquad [6]$$

$$PPPR_t = PFPR_t + PPRS_t \qquad [7]$$

The market clearing condition is given below:

Market Equilibrium (ME) = $DRPP_t$ + $RNIM_t - RTCN_t$

Where, $RNIM_t$ = Rice net import in period t; $RTCN_t$ = Rice total consumption in period t; $DRPP_t$ = Domestic rice production; POP_t = Country population in period t; $PFPR_t$ = Paddy farm price at period t; $PPRS_t$ = Paddy price support at period t; CV = Conversion factor

(v) Price: The symmetric price transmission equation is specified as follows:

$$PFPR_t = f(RRPR_t) \qquad [8]$$

The estimation of co-integrated equations to obtain long-run relationship was done using Auto Regressive Distributed lag (ARDL), as implemented by Narayan, 2004, because the integration order of the variables were I(0) and I(1), and because each equation was estimated as a single equation in view of the presence of single endogenous variable in each equation. The ARDL is specified as follows:

$$Y_t = \alpha_0 + \sum_{i=1}^{K} \propto_{1i} Y_{t-i} + \sum_{i=0}^{K} \propto_{2i} x_{1t-i} + \sum_{i=0}^{K} \propto_{3i} x_{2t-i} + \theta M_t + \varepsilon_t \qquad [9]$$

Normalised Long-run relation coefficients were estimated as follows:

$$\alpha_0 = \frac{\propto_0}{1 - \sum_{i=1}^{k} \propto_{1i}} \quad \propto_2 = \frac{\sum_{i=0}^{K} \propto_{2i}}{1 - \sum_{i=1}^{k} \propto_{1i}} \quad \propto_3$$

$$= \frac{\sum_{i=0}^{K} \propto_{3i}}{1 - \sum_{i=1}^{k} \propto_{1i}} + \theta = \frac{\theta}{1 - \sum_{i=1}^{k} \propto_{1i}} \qquad [10]$$

Where; Y_t = Vector for dependent variables ($APAP_t$, $APYD_t$ and $RPCN_t$); Y_{t-i} Y_{t-i} = Vector for lag-dependent variables ($APAP_{t-1}$, $APYD_{t-1}$ and $RPCN_{t-1}$); X_t = Vector for exogenous variables as specified in the equations 1 to 3; M_t = Dummy variable as specified in equation 1; α = Coefficients to be estimated for different equations; θ = Coefficient for dummy variable K = lag length

According to Labys and Pollak (1984) policy decision making can be simulated by changing the values of the exogenous policy variables and observing their impact

on the target variables Y (endogenous variables). The Malaysian Agricultural Policy Analysis (MAgPA) Model (2012) specified the equations for simulation and forecasting as follows:

$$Y_t = Y_{t-1} + Y_{t-1}(\Delta Y) \ldots\ldots\ldots\ldots\ldots [11]$$

$$\Delta Y_t = \alpha_1 * \Delta X_1 + \alpha_2 * \Delta X_2 + \alpha_3 * \Delta X_3 + \ldots + \alpha_n * \Delta X_n \ldots\ldots [12]$$

$$\Delta Y = (Y_t - Y_{t-1})/Y_{t-1} \ldots\ldots\ldots\ldots\ldots [13]$$

Where, Y = Variable of interest to be projected; Y_{t-1} = One period lag value of the affected variable; ΔY_t = Annual growth rate for the endogenous variables estimated by equation 12 or annual rate of change of the exogenous variables estimated by equation 13; α_1 = estimated coefficient; ΔX = percentage change in exogenous variables.

The analysis of changes in producer surplus represented by a trapezoidal shape (sum of areas of rectangle and triangle) in demand-supply curve as shown in Fig.3 is used in determining the welfare change (Mustapha, 1998; Asaad, 2010). The producer surplus change equation is given as follows:

$$\Delta PPS = DPP_p(PPPR_p) + \tfrac{1}{2}[(DPP_p - DPP_e)(PPPR_p)] \ldots\ldots\ldots\ldots\ldots [14]$$

$$GR = (Q_p * P_p) - (Q_e * Q_e) \ldots\ldots\ldots[15]$$

Society Welfare gain or Net Surplus = 14 + 15

Where ΔPPS = Change in Paddy Producer Surplus; DPP_p = Domestic Paddy Production at the current policy; DPP_e = Domestic Paddy Production at the alternative policy; $PPPR_p$ = Paddy Producer Price (Price at the current policy); GR = Government revenue;

Q_p = Policy induced quantity of rice supply; P_p = Policy Price; Q_e = Alternative policy induced quantity of rice supply; P_e = Equilibrium price.

Unit root and co-integration tests were done using appropriate methods: The unit root test was done using Augmented Dickey-fuller (ADF) and Phillips-Perron (PP) tests. Auto Regressive Distributed Lag (ARDL) (Bounds) testing approach to co-integration, through joint test or F-test statistics, was used. Given the relatively small sample size for this study (33 observations), the critical value for a small size sample generated by Narayan (2005) was used. The lag length selections for each equation was determined through Hendry's general to specific procedure with minimum value of SIC (Schwarz Information Criterion).

Model validation and diagnostic tests were done to validate the predictive ability of the models for valid inferences about the estimated coefficients. The estimated equations were validated using Root Mean Square Percentage Error (RMSPE). The estimated coefficients were subjected to the following diagnostic tests: Autocorrelation (LM) and Structural Stability (CUSUM of Square)

RESULTS AND DISCUSSION

The results of unit root tests are presented in Table 1. The results show that the following variables are I(1): LPPPR, LPFPR, LFESUB, LRPCN, LWRPR, LAPAP and LPCY. But the variables-LRRPR and TECH were confirmed to be stationary at level I(0).

TABLE 1
Unit-Root Test Results

Variables	Level		First Differencing	
	ADF	PP	ADF	PP
LAPAP	-3.56**	-3.54	-4.622***	-6.73***
LAPYD	-3.43	-3.26	-6.25***	-7.22***
LPPPR	-1.36	-1.48	-4.04***	-4.04***
LPFPR	-1.10	-1.20	-4.04***	-0.04***
LFESUB	-1.03	-1.22	-4.59***	-4.59***
TECH		-15.40***		
LRPCN	-3.37	-3.24	-7.34***	-7.35***
LRRPR	-4.03**	-3.96**		
LWRPR	-3.53	-3.53	-9.93***	-9.76***
LPCY	-1.30	-1.71	-4.40***	-4.40***

The co-integration test results show that equations of LAPAP and LRPCN were co-integrated (Table 2). But LAPYD was having inconclusive Bound test results. Further confirmation tests such as the dynamic stability tests and the sign of error correction terms obtained from the equation suggested treating LAPYD as a co-integrated equation.

TABLE 2
Co-Integration Test Results

Dep. Variables (Represent each Equation)	K	SIC (Minimum Value)	F-Statistic	Narayan (2005) CV at 5%		Remark
				I(0)	I(1)	
$\Delta LAPAP_t$	1	-4.61	6.41***	5.39	6.35	Yes
$\Delta LAPYD_t$	2	-2.72	4.97**	4.27	5.47	Inc.
$\Delta LRPCN_t$	3	-2.72	6.98***	3.71	5.02	Yes

Note: (**) and (***) denote significant at 5% and 1% respectively. K= exogenous variables in each equation; SIC= Schwarz Information Criterion (Minimum value in each equation); CV= Critical Values at 5% level of significant.

Estimated Long-Run Coefficients

The discussion of the estimated coefficients is deliberately kept superficial because our interest here is just to show how coefficients used for simulation are estimated. The long-run coefficients were obtained by estimation of equations 9 and 10. In each of the respective equations, the long-run elasticities were obtained after normalising on the lag dependent variables (Narayan, 2004). The estimated long-run level equations were made to pass the autocorrelation test and structural stability test.

Estimated long-run coefficients for LAPAP$_t$-Equation: The partial adjustment of area planted toward the desired level captured by change in the lag dependent variable has expected positive sign and significant at 1% level. The long run elasticity of paddy producer price (PPPR) has expected positive sign but shows no significant relationship with area planted (APAP) to paddy (Table 3). The dummy variable (DPAP) shows significant influence on area planted to paddy.

TABLE 3
LAPAP$_t$-Estimated Long-run Coefficients

Variable	Coefficient	Std. Error	T-Statistic
C	2.74	1.28	2.14**
LAPAP$_{t-1}$	0.79	0.10	8.28***
LPPPR$_{t-1}$	0.02	0.01	0.23
DPAP	0.03	0.04	6.85***
Normalised Long-run Relation			
C	13.26	0.29	45.33***
LPPPR$_t$	0.01	0.04	0.24
DPAP	0.04	0.01	6.62***
R^2 =0.75			
DW=2.13			
LM=5.03			

Note: (**) and (***) denote significant level of 5% and 1% respectively. The LAPAP variable was measured in hectares.

Estimated long-run coefficients for LAPYD$_t$-Equation: The long run coefficient for the trend variable (TECH$_t$) has expected positive sign and statistically significant at 1% level. The long-run elasticity of fertiliser subsidy variable (FESUB$_t$) has expected positive sign but insignificant (Table 4).

TABLE 4
LAPYD$_t$-Estimated Long-run Coefficients

Variable	Coefficient	Std. Error	T-Statistic
C	-1.71	3.05	-0.56
LAPYD$_{t-1}$	0.67	0.12	5.39***
LFESUB$_t$	0.23	0.18	1.28
TECH$_t$	0.05	0.02	2.53**
Normalized Long run Relation			
C	-5.22	9.22	-0.57
LFESUB$_t$	0.69	0.49	1.39
TECH$_t$	0.14	0.04	3.31***
R^2 =0.85			
DW= 2.06			
LM=2.64			

Note: (**) and (***) denote significant level of 5% and 1% respectively. The LAPYD variable was measured in Kg.

Estimated long-run coefficients for LRPCN$_t$-Equation: Table 5 shows that owned price elasticity of rice demand has expected negative sign but statistically insignificant in the long run. The long run coefficient for wheat has expected positive sign and statistically significant at 1% level. The long-run coefficient for income was negative, inelastic and significant at 10% level.

TABLE 5
LRPCN$_t$-Estimated Long-run Coefficients

Variable	Coefficient	Std. Error	T-Statistic
C	5.44	1.11	4.90***
LRPCN$_{t-1}$	-0.21	0.21	-1.03
LRPCN$_{t-2}$	-0.07	0.17	-0.43
LRRPR$_t$	-0.02	0.15	-0.16
LWRPR$_t$	0.09	0.048	1.96*
LWRPR$_{t-1}$	0.16	0.05	3.16***
LPCY$_{t-1}$	0.26	0.09	2.98***
LPCY$_{t-4}$	-0.39	0.09	-4.12***
Normalised Long-run Relation			
C	4.76	1.31	3.63***
LRRPR$_t$	-0.02	0.13	-0.16
LWRPR$_t$	0.22	0.07	3.21***
LPCY$_t$	-0.12	0.07	-1.73*
R^2 =0.69			
DW=1.97			
LM=4.59			

Note: (*), (***) denote significant level of 10% and 1% respectively. The LRPCN variable was measured in Kg.

Estimated price transmission equation for LPFPR: Table 6 shows that the elasticity of RRPR (rice retail price) with respect to paddy farm price is statistically significant. The result suggests that any movement in the retail price in response to global price changes would affect the domestic paddy farm price only in a positive direction.

TABLE 6
Estimated Paddy Farm Price (Lpfpr$_t$) Coefficients

Variable	Coefficient	Std. Error	T-Statistic
C	-0.98	0.34	-2.87***
LPFPR$_{t-1}$	0.91	0.06	14.74***
LRRPR$_t$	0.22	0.08	2.75**
R^2 =0.97			
DW=1.49			
LM=2.53			
RESET=0.73			

Note: (**) and (***) signify significant level of 5% and 1% respectively. The LPFPR variable was measured in Malaysia Ringgit (MR)

The Model Ex Post Prediction Power (Validation) Test Results

The values of RMSPE were generally low (less than 2%) for all the dependent variables (Table 7). The results imply that predictive error associated with estimated equations in tracking the actual data (*ex-post* prediction) was very low and insignificant and hence, it could be used for *ex-ante* projection with an expected high projection validity.

TABLE 7
Model Ex-post Prediction Power (Validation) Tests

Dependent Variables	Root Mean Square Percentage Error (RMSPE)
LAPAP	0.03
LAPYD	0.24
LRPCN	1.60
LPFPR	0.70

Simulation Results of Fertiliser Subsidy Withdrawal as a Policy Option

The simulation results of the target variables provided basis for welfare analysis. The policy scenarios simulated were (i) BL: The baseline scenario represents current government policy in rice sector (that is retaining all forms of production subsidies and supports); and, (ii) SN: removing fertiliser subsidy while retaining any other rice production subsidy and support. The simulation of variables follows equations 11 to 13 as implemented by MAgPA (2012). The projection of the endogenous variables from 2013 to 2020 was made with 2012 data as a base year. In determining the projected value of the variables in 2013 based on equation 11, seven years aggregate mean (between 2006 and 2012) were calculated as rate of change (%) in the control and other exogenous variables in line with equation 13; the estimated mean of change rate in the control variables together with estimated elasticity of endogenous variables were used in computing growth rate in target variables or endogenous variables as provided by equation 12. The projection of the endogenous and exogenous variables from 2013 to 2020 was made with 2012 data as a base year. The price at market equilibrium or price at market clearing was determined using the solver tool in excel window. This process allows simultaneous simulation of the target variables. The effect of SN scenario was compared with the baseline as both were projected to 2020 from 2013. Table 8 shows simulation results in summary.

TABLE 8
Effect of SN on APYD, RDPP and RNIM

Variable	Scenario	Year								Ave. % Δ
		2013	2014	2015	2016	2017	2018	2019	2020	
APYD	Baseline	3,904	4,014	4,127	4,243	4,363	4,486	4,612	4,742	
(Kg)	SN	3,816	3,835	3,853	3,873	3,892	3,911	3,930	3,950	-10
RDPP	Baseline	1,724	1,774	1,826	1,878	1,933	1,989	2,046	2,105	
('000'T)	SN	1,685	1,695	1,705	1,714	1,724	1,734	1,744	1,754	-10
RNIM	Baseline	753.3	801.9	852.9	906.5	962.8	1,022	1,084	1,149	
('000' T)	SN	792	881	974	1,071	1,172	1,277	1,387	1,501	19.1

Paddy Yield (APYD): The implementation of alternative policy of SN lower the projection rate of yield at 0.5% compared with base run at 3% within the period 2013-2020. On the average, simulation result shows 10% decrease in paddy yield by 2020 compared with the baseline scenario. The result implies that removal of fertiliser subsidy while retaining other paddy production supports as alternative policy instrument (SN), would contract paddy yield growth rate from 3% to 0.5% and consequently lead to 10% reduction in yield by 2020 when compared with the baseline projection. The result is depicted in Table 8 and Fig.6.
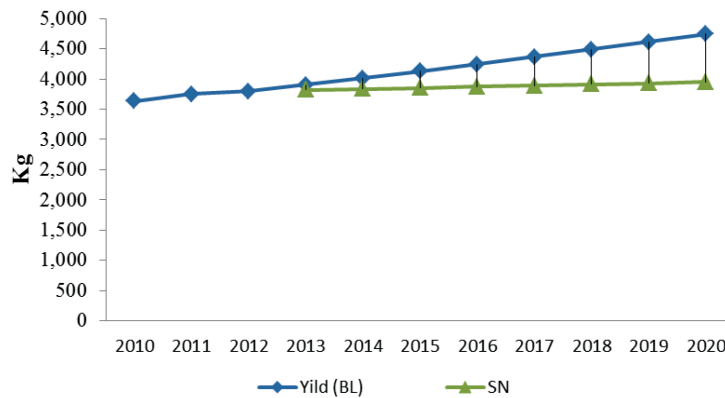

Fig.6: Graphical Illustration of SN Effect on Paddy Yield (APYD).

Rice domestic production (RDPP): Table 8 also shows that the SN policy option implementation would result in reduction of domestic rice production (RDPP) by 10%, on the average, in comparison with Baseline scenario, by 2020. This result is supported by Ramli, *et al.*'s findings (2012). In that study, Ramli simulated the effect of fertiliser subsidy removal on domestic rice production using system dynamics and observed a 24% reduction of domestic rice production (from 1.61 million tonnes to 1.22 million tonnes) just for 2015. In this study, the grand mean of growth rate for 2013-2020 periods was used. This finding is also illustrated in Fig.7.
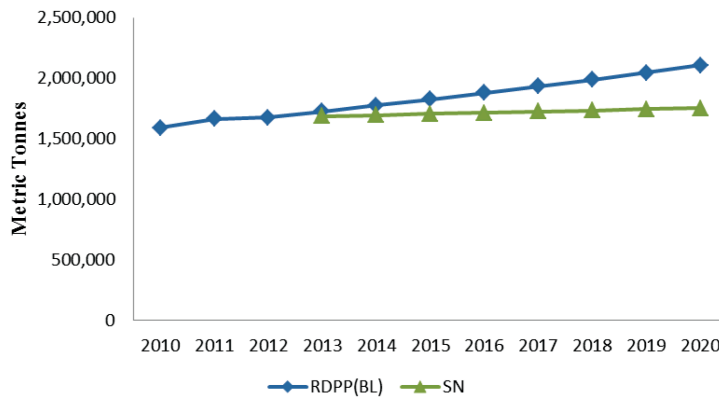
Fig.7: Graphical Illustration of SN Effects on Rice Domestic Production (RDPP)

Rice Net Import (RNIM): Table 8 also shows that if the choice of SN is made as an alternative policy instrument in the rice sector, then the import of rice into the country would increase by 19.1%, on the average, by 2020. Since withdrawal of fertiliser subsidy while retaining the paddy price support and import restriction policy option (SN) would lead to a decline in total domestic rice production by about 10%, in order not to distort the demand–supply equilibrium, a situation that can necessitate domestic price increase, the import of rice must definitely increase by at least 19% (Fig.8). The 19.1% rise in the import as a result of SN policy option constitutes about 51% of the current import level of 35-40% per annum.
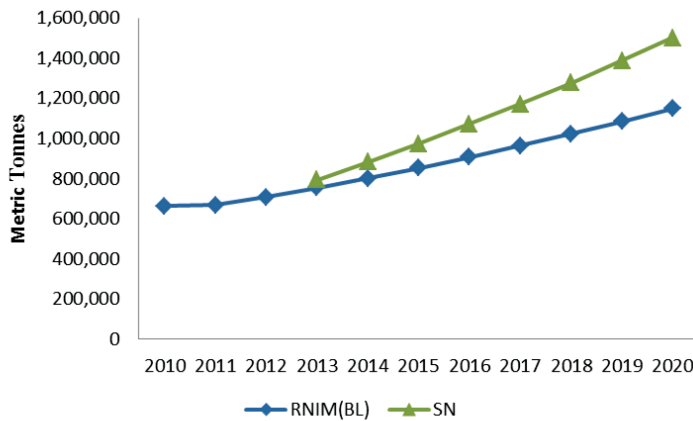

Fig.8: Graphical Illustration of SN Effects on Rice Net Import (RNIM)

Welfare Implication of the Policy Option (SN)

The societal welfare effect of the simulated scenarios was estimated based on equations 14 and 15. The projected values for 2020 were used for the estimation because according to Labys and Pollak (1984), most time series econometric crop models of a supply-demand type perform best in

the short and medium run. However, the approach becomes less effective in the long run. Therefore the period 2013-2020 is considered as medium term and hence, the choice of 2020 as projected value.

Table 9 shows that the estimated producer welfare loss from policy option SN, that is removal of fertiliser subsidy while retaining the paddy price support and import restriction, was about RM839 million and amount saved from implementing the policy alternative is about RM183million. Thus, the societal welfare loss from the SN policy alternative was about RM655 million. It should be noted that SN has no effect on consumer welfare because of the restricted import policy embedded in scenarios; this necessitated the bridging of deficit created by the impact of the policy option on total domestic rice production and hence ensuring domestic price stability.

TABLE 9
Welfare Impact of Sn Policy Option

Welfare Indicators	SN
Producer Welfare Loss ('000' RM)	838,523
Revenue Save ('000' RM)	183,067
Societal loss ('000' RM)	655,456

CONCLUSION

The scenario, SN, resulted in 10% reduction in domestic rice production and 19.1% increase in rice import, which constitute about 51% of the current import level of 35-40% per annum. Paddy farmers were worse-off in terms of welfare by losing about RM839 million but the policy option would guarantee savings in revenue of about RM183 million, which would have been spent as subsidy to the paddy farmers. However, society in general would suffer a welfare loss of about RM655 million. Thus, the implementation of the SN policy option (that is removal of fertiliser subsidy while retaining other production support and import restriction) should not be considered as a viable policy alternative by policy makers because of a net loss to society in general.

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