J. ISSAAS Vol. 17, No. 2:48-57 (2011)

IMPACT OF RICE PURCHASING POLICY ON WELFARE OF BOTH PRODUCERS AND CONSUMERS IN INDONESIA

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(Received: March 4, 2011; Accepted: August 10, 2011)

ABSTRACT

Rice purchasing policy is one of the important instruments in order to ensure national food security. This research sought to (1) analyze the factors that influence the supply and demand for rice in Indonesia, (2) to analyze the impact of the government purchase price rice policy on the producers' and consumers' welfare and, (3) to formulate alternative strategies that could ensure fair welfare distribution to both the producers and the consumers. Four policy alternatives set for the period 2002-2008 were simulated with econometric model of the Indonesian supply and demand of rice industry. Time series secondary data for rice, from 1980-2008, of the Central Bureau of Statistics (BPS), Ministry of Agriculture and National Logistics Agency (BULOG) was quantitatively analyzed using a system of simultaneous equations econometric model, consisting of eight behavioral equations and three identity equations. The Two Stages Least Squares (2SLS) method was used to estimate the parameters of the behavioral equations in the model. This study showed that the government price rice policy is good for increasing rice production but not the best policy for welfare and consequently, the society as a whole is worse off. This study suggests that the government purchase price rice policy should be accompanied with other policies for government programs on rice like: (1) increased irrigated area, (2) increased rice production through improved infrastructural development, and (3) intensified food diversification to reduce overdependence on rice.

Key words: food security, econometric model, food diversification

INTRODUCTION

Rice is the most 'politicized' commodity in many countries in the world, including Indonesia, which is currently the world's third-largest producer of rice in the world. Rice not only continues to be the most important staple food, but it is also the main source of livelihood for small farmers and agricultural households in Indonesia especially in the rural areas. Rice represents 7.2% of average consumer expenditure and the rice sector employs 7.1 percent of the total agricultural workforce. This indicates that rice is a very important commodity for Indonesia (Warr, 2005). The Indonesian government has three objectives in relation to rice: (1) to maintain a national stockpile to deal with disasters and to ensure access to rice by the poor, (2) to stabilize the domestic price at levels considered reasonable for both producers and consumers, and (3) to reduce rice imports, saving of scarce foreign exchange thereby increasing producer incentives, achieving greater equity in farm income, and more adequate nutrition especially among the poor (Basri and Arianto, 2009).

The government relies on the purchase price rice policy to increase rice production. However, the effects of the policy on welfare are not given much attention in that most of the rice farmers are net rice consumers. For the urban poor who rely on wages, a decrease in wages will affect them through the rice policy. A good policy should be one that increases rice production and does not deteriorate the welfare of the poor, especially the small farmers (Ellis, (1992). Therefore this paper discusses to what extent should this policy be effectively implemented and its welfare impacts.

This study sought to (1) analyze the factors that influence the supply and demand for rice in Indonesia, (2) analyze the impact of the government purchase price rice policy on the producers' and consumers' welfare and, (3) formulate alternative strategies that could ensure fair welfare distribution to both the producers and the consumers.

RESEARCH METHODOLOGY

The demand and supply of rice in the Indonesia model, specified in this research, is a system of equations simultaneous econometric model which consists of 11 endogenous variables and 19 predetermined variables which include 13 exogenous and 6 lagged variables. Therefore, the model qualified as over-identified and 2SLS method of model estimation was applied. Koutsoyiannis (1977) stated that under the circumstances of the existence of model mis-specification, missing of relevant variables, multi-co linearity and autocorrelation error, and 2SLS tend to yield more robust estimates.

Time series data for the period 1980-2008, was used for econometric analysis and was yearly aggregated data. It should be noted that in this research, the price used is deflated with the Indonesia consumer price index (2000=100) as the base year. The econometric model used in this research is as follows:

1. Paddy Harvested Area

$$HPDt = a_0 + a_1\,FPURt + a_2PMZRt + a_3PUFRt + a_4IRAt + a_5Tt + a_6YPDt\text{-}1 + a_7HPDt\text{-}1 + Ut_1 \quad \text{.....(1)}$$

Hypothesis: $a_1, a_4, a_5, a_6 > 0$; $a_2, a_3 < 0$ and $0 < a_7 < 1$

Equation (1) shows that the harvested area of paddy (HPDt), is determined by real farmer price of un-milled rice (FPURt), real maize price (PMZRt), and real price of urea fertilizer (PUFRt), irrigated area (IRAt), trend (Tt), lag paddy yield (YPDt-1), and the harvested area of paddy (HPDt-1) the previous year. The relationship between real farmer price of un-milled rice, irrigated area, trend, lag paddy yield is expected to be positive while that of real maize price and real price of urea fertilizer is expected to be negative.

2. Yield of Paddy

$$YPDt = b_0 + b_1FPURt + b_2URFt + b3ITAt + b4YPDt\text{-}1 + Ut2 \quad \text{……..(2)}$$

Hypothesis: $b_1, b_2, b_3 > 0$ and $0 < b_4 < 1$

Equation (2) indicates that the yield of paddy (YPDt) is determined by the real farmer price of un- milled rice (FPURt), urea fertilizer used (URFt), intensified area (ITAt), and the yield of paddy (YPDt-1) in the previous year.

3. Total Paddy Production

$$TPDt = HPDt * YPDt \quad \text{.....(3)}$$

Identity Equation (3) shows that the total paddy production (TPDt), is determined by the paddy harvested area (HPDt) and the yield of paddy (YPDt).

4. Total Rice Production

$$TRPt = TPDt^{*} Kt \quad \text{.....(4)}$$

Identity Equation (4) shows that the total rice production (TRPt) is determined by total paddy production (TPDt), and the conversion factor (Kt) which is 0.63 in this case.

5. Total Rice Imports

$$RIMt = c_0 + c_1 IPRR\ t + c_2 TRPt + c_3 T + c_4 TARRt + c_5 RIMt\text{-}1 + Ut_3 \quad \text{.....(5)}$$

Hypothesis: $c_{1, C2, C4} < 0 \qquad _{C3} > 0 \qquad \text{and } 0 < c_5 < 1$

Equation (5) shows that the rice imports (RIMt) are determined by the real import rice price (IPRRt), total rice production (TRPt), trend (Tt), real rice tariff (TARRt) and the rice imports (RIMt-1) the previous year. The relationship between rice imports and the time trend is expected to be positive while that of real import rice price, total rice production and real rice import tariff is expected to be negative. Indonesia imports rice because of inadequate rice production which cannot satisfy rice demand.

6. Domestic Demand for Rice

$$DDRt = d_0 + d_1 PDRRt + d_2 INYRt + d_3 POPt + d_4 DRASt + Ut_4 \quad \text{.....(6)}$$

Hypothesis: $d_1, d_4 < 0 \qquad d_2, d_3 > 0$

Equation (6) shows that the domestic demand for rice (DDRt) is determined by the domestic retail rice price (PDRRt), income per capita (INYRt), Indonesian population (POPt) and the government raskin program (DRASt) for the poor. The relationship between the domestic retail rice price domestic and raskin program with domestic demand for rice is expected to be negative while that of income per capita and Indonesian population is expected to be positive.

7. Real Farmer Price of Un-Milled Rice

$$FPURt = e_0 + e_1 GPPRt + e_2 TPDt + e_3 FPURt\text{-}1 + Ut_5 \quad \text{.....(7)}$$

Hypothesis: $e_1 > 0 \qquad e_2 < 0 \quad \text{and } 0 < e_3 < 1$

Equation (7) shows that real farmer price of un-milled rice (FPURt) is determined by real government purchase price (GPPRt), total paddy production (TPDt), and the real farmer price of un-milled rice (FPURt) the previous year. The relationship between real farmer price of un-milled rice and real government purchase price is expected to be positive, while that with total paddy production is expected to be negative.

8. Real Domestic Retail Rice Price

$$PDRRt = f_0 + f_1 FPURt + f_2 (DDR\text{-}RSS)t + f_3 STRt + Ut_6 \quad \text{.....(8)}$$

Hypothesis: $\qquad f_{1,} f_2 > 0 \qquad f_3 < 0$

Equation (8) shows that domestic retail rice price (PDRRt) is determined by the farmer price of un-milled rice (FPURt), residual of rice demand and rice supply (DDRt-RSSt), and rice stock (STRt). The relationship between domestic retail price and farmer price of un-milled rice and is expected to be positive while ratio between rice demand and rice supply and rice stock is expected to be negative.

9. Fertilizer of Urea Used

$$URFt = g_0 + g_1PUFRt + g_2FPURt + g_3Tt + g_4URFt\text{-}1 + Ut_7 \quad \text{..... (9)}$$

Hypothesis: $g_1<0$ $g_2, g_3>0$ and $0<g_4<1$

Equation (9) shows that fertilizer of urea used (URFt) is determined by real price of urea fertilizer (PUFRt), real farmer price of un-milled rice (FPURt), trend (Tt) and fertilizer of urea used (URFt-1) the previous year. The relationship between the real price of urea fertilizer and urea fertilizer used is expected to be negative while that real farmer price of un-milled rice and trend are expected to be positive.

10. Rice Stock

$$STRt = h_0 + h_1TRPt + h_2IPRRt + h3EXRt + h4STRt\text{-}1 + Ut8 \quad \text{.....(10)}$$

Hypothesis: $h_1>0$ $h_2, h_3<0$ and $0<h_4<1$

Equation (10) shows that rice stock (STRt) is determined by total rice production (TRPt), real rice import price (IPRRt), rice exports (EXRt) and the rice stock the previous year (STRt-1). The relationship between total rice stock and total rice production is expected to be positive while that of rice import price, rice exports is expected to be negative. The rice exports in this case are the special rice varieties that are exported though in small quantities. It should be noted that Indonesia reported a trade surplus equivalent to 1629 million USD in April 2011. Indonesian major exports are: plywood, textiles, rubber, tin, bauxite, silver, copper, nickel, gold, and coal. Indonesia imports machinery and equipment; chemicals, fuels and food. Its main trading partners are: Japan, European Union, United States and Singapore.

11. Rice Supply

$$RSSt = TRPt + RIMt - EXRt + STRt\text{-}1 \quad \text{..... (11)}$$

The identity equation (11) shows that rice supply (RSSt) is given by the addition of total rice production (TRPt), rice imports (RIMt) minus rice exports (EXRt) and rice stock the previous year (STRt-1).

RESULTS AND DISCUSSION

Factors affecting supply and demand of rice in Indonesia

The results of the estimated behavioral equations are satisfactory and the time series were found to be stationary as their means, variances and co variances remained constant over time so it was not necessary to do a stationary test. The coefficient of determination (R^2) of the different behavioral equations that were estimated with average value being 0.82 is high enough. The highest R^2 value was obtained in the structural equation of domestic demand for rice (DDR) with a value of 0.96 and the lowest R^2 value was obtained in the structural equation of rice imports with a value of 0.29. The average value of the F-statistic is lower than the level of significance $\alpha = 0.05$ which means that the variation of the explanatory variables together in each structural behavioral equation can

explain well the variation in the current endogenous variable. Besides that, the signs and magnitude of the parameter estimates of each structural behavioral equation conforms to the principles of economic theory even though there are some parameter estimates that are not statistically significant.

Based on the results of the Durbin-Watson (DW) statistic, values ranging from 1.64-2.59 are obtained. From the above results, two equations do not exhibit positive autocorrelation while 6 equations exhibit negative autocorrelation. The problem of serial correlation only reduces the efficiency of the estimated parameters and serial correlation does not cause biased estimates so because of that, the results of the parameter estimates are representative enough to explain the phenomenon of the rice model.

The response of domestic demand for rice is inelastic with respect to domestic rice price and this indicates that rice is staple food to majority of population but with a negatively sloping demand schedule in the domestic market. However, the price elasticity of this demand is quite low, which indicates an inelastic demand schedule in the short run. The government purchase price is a major determinant of the domestic rice price. The short-run elasticity of domestic rice price with respect to government purchase price is inelastic while that of total rice production is elastic and this indicates that during harvest periods there will more rice supply making the prices low.

Analysis of Policy Impact

Results of model validation indicate that from the 11 endogenous variables, 6 variables have RMSPE of 20 percent and lower. The Root Means Percentage Error (RMSPE) for paddy harvested area, paddy yield, domestic demand for rice, total urea fertilizer used, total paddy production and total rice production indicate quite satisfactory results. It is important to note that the price variables are the key variables of the model and they are the most crucial in either the base dynamic or policy simulation (Sinaga, 1989).

In Table 1, the impact of the alternative policy simulations in percentage changes and welfare impacts as well are as follows:
Where:
Simulation 1: Increasing Real Government Purchase Price by 20 Percent
Simulation 2: Increasing Irrigated Area by 20 Percent
Simulation 3: Increasing Intensified Area by 20 Percent
Simulation 4: Increasing the Real Government Purchase Price, Irrigated Area, Intensified Area and Real Import Tax by 20 Percent
Simulation 5: Increasing Real Government Purchase Price, Irrigated Area, Intensified Area, Real Rice Import Tax and Decrease Real Price of Urea Fertilizer by 20 Percent

The above five scenarios were chosen because they were the desired ones in that they all led to an increase in paddy production thereby reducing on the rice imports and this is the objective of the government. The chosen scenarios also showed that both the producers and consumers are better off when they are implemented either as single policies or a combination of other policies apart from scenario one.

1. Alternative Policy of Increasing Real Government Purchase Price by 20 Percent

The study revealed that increase in the real government purchase price increased paddy harvested area by 0.58 percent hence increased paddy production and rice production by 2.35 and 2.25 percent respectively (Table 1). Increased paddy production was due to increased paddy productivity by 1.72 percent after simulations were done. This is in line with the main aim and objective of government to increase domestic rice production and decrease rice imports. Rice imports

decreased by 73.51 percent as a result of increased paddy production and rice production because the farmers were encouraged by the farmer prices and as a result increased production.

The real domestic retail rice price increased by 17.57 percent and this caused a decrease in the quantity of rice demanded by 5.56 percent. This policy will increase the real farmer price of un-milled rice and will also increase the real retail domestic rice price. It is also observed that the decrease in the quantity of rice demanded is relatively small compared to the increase in the domestic retail rice price. This shows that rice is still the staple food for the majority of the Indonesian population.

The increased rice production led to a decrease in rice imports and eventually a decrease in the government revenue. Therefore the government has to avail other ways of generating income that can be used to compensate the consumers whose consumer surplus tended to decrease with this policy. The policy of increasing the real government purchase price is biased towards the producer with an increase in producer surplus while the consumer is at a loss with a negative consumer surplus. This policy will decrease the government revenue from rice imports and the net surplus will decrease by Rp 3.7 trillion for that period.

2. Alternative Policy of Increasing Irrigated Area by 20 Percent

Government policy of increasing the irrigated area that is application of farm inputs led to an increase in paddy harvested area by 4.99 percent, paddy yield also reduced by 0.22 percent. The increased paddy area led to increased paddy production by 4.7709 percent and hence increased rice production by 4.77 percent. This policy led to increased real farmer price of un-milled rice by 2.84 percent as observed in Table 1. The increase in rice production did not result in a significant decrease in the domestic retail rice price because the demand for rice is inelastic. The decrease in the domestic retail rice price led to a decrease in the quantity of rice imports by 158 percent. It is observed in the econometric model that the domestic retail rice price influences rice imports. The fact that there was an increase in rice production of 4.77 percent, the rice supply increased by 3.27 percent and a decrease in rice imports does not affect rice supply because it is negligible. With the decrease in rice imports, the government revenue also decreased. In Table 1, it is observed that this policy will benefit both the producers and consumers and society as a whole, will be better because of infrastructural improvement as seen by the positive net surplus of Rp 833.2 billion for the period under study. The improvement in infrastructure is the best policy option for society because it will benefit many people.

3. Alternative Policy of Increasing the Intensified Area by 20 Percent

The government policy of increasing the intensified area whereby there is improvement in infrastructure by 20 percent led to increased paddy harvested area by 0.17 percent, followed by increased paddy yield by 0.87 percent (Table 1). Increased paddy harvested area led to an increase in the paddy production and rice production by 4.50 and 4.51 percent respectively and leading to increased rice stock by 1.62 percent. The policy of increasing the intensified area by 20 percent led to a decrease in real domestic retail rice piece and farmer price of un-milled rice by 0.89. The decreased real domestic rice retail price led to an increase in the quantity of rice demanded by 0.28 percent and the amount of urea fertilizer used increased by 1.2 percent. The rice stock increased by 1.62 percent and this led to a decrease in rice imports by -166.11 percent.

The increase in rice supply led to increased rice exports and a decrease in rice imports. Analysis of the impact of this policy on the welfare of the both the rice producers and consumers indicates that both the producers and consumers gain as indicated by a positive net surplus in Table 1. The decreased rice imports led to a decrease in government revenue but however the net surplus is Rp

3.4 trillion and this indicates that the society as a whole is better with the implementation of this policy.

4. Alternative Policy of Increasing Real Government Purchase Price, Irrigated Area, Intensified Area and Real Rice Import Tax by 20 Percent

The impact of policy combination of increasing real government purchase price, irrigated area, intensified area and real rice import tax by 20 percent is shown in Table 1. This policy led to an increase in the farmer price of un-milled rice by 12.67 percent thereby increasing the paddy harvested area by 5.75 percent and this led to an increase in the paddy production and rice production by 8.3032 percent.

The increase in rice production led to a decrease in rice imports and this shows that domestic rice production influences rice imports. The increase in rice production and a decrease in rice imports led to a decrease in the quantity of rice consumed due to the increase in the domestic retail rice price by 3.87 percent. It is also observed that even though there was an increase in the price of urea fertilizer, the quantity of urea fertilizer used increased. This implies that the amount of urea fertilizer used is not influenced by the price of urea fertilizer and it is one of the components in the intensification program.

This alternative policy combination is biased towards the producer whereby the producer gains with an increase in the producers' surplus while the consumer was worse, because of a decrease in consumer surplus. This policy combination led to a decrease in the government revenue by an amount of Rp 132.6 billion. However, it is also observed that the society as a whole will be better, when this policy combination is implemented and this is shown by the positive net surplus.

5. Alternative Policy of Increasing Real Government Purchase Price, Irrigated Area, Intensified Area, Real Rice Import Tax and Decrease Real Price of Urea Fertilizer by 20 Percent

The impact of policy combination of increasing real government purchase price, irrigated area, intensified area, real rice import tax and decreasing real price of urea fertilizer by 20 percent is shown in Table 1. This policy led to an increase in the farmer price of un-milled rice by 11.25 percent thereby increasing the paddy harvested area by 5.97 percent and this led to an increase in the paddy production and rice production by 9.46 percent.

The increase in rice production led to a decrease in rice imports by 355.47 percent and this shows that domestic rice production influences rice imports. The increase in rice production and increased domestic retail rice price led to a decrease in the quantity of rice consumed due to the increase in the domestic retail rice price by 11.25 percent. It is also observed that even though there was an increase in the price of urea fertilizer, the quantity of urea fertilizer used increased. This implies that the amount of urea fertilizer used is not influenced by the price of urea fertilizer and it is one of the components in the intensification program.

This alternative policy combination is biased towards the producer whereby the producer gains with an increase in the producers' surplus while the consumer was worse, because of a decrease in consumer surplus. This policy combination led to a decrease in the government revenue by an amount of Rp 147.9 billion. However, it is also observed that the society as a whole will be better, when this policy combination is implemented and this is shown by the positive net surplus.

Table 1. Percentage changes of policy simulations, 2002-2008.

(%)

Endogenous Variables	Unit	Label	Policy Simulations				
			1	**2**	**3**	**4**	**5**
Paddy Harvested Area	Ha	HPD	0.58	4.99	0.17	5.75	5.97
Paddy Yield	Ton ha^{-1}	YPD	1.72	-0.22	0.87	2.37	3.23
Rice Imports	Ton	RIM	-73.51	-157.53	-166.11	-318.85	-355.47
Rice Demand	Ton	DDR	-5.56	1.38	0.28	-3.87	-3.56
Real Domestic Retail Rice Price	Rp kg^{-1}	PDRR	17.57	-4.36	-0.90	12.20	11.25
Real Farmer Price of Unmilled Rice	Rp kg^{-1}	FPUR	14.95	2.84	2.41	12.67	12.24
Urea Fertilizer	Kg ha^{-1}	URF	3.96	0.40	1.20	3.33	6.22
Rice Stock	Ton	STR	3.27	8.31	1.62	13.41	15.09
Paddy Production	Ton	TPD	2.35	4.77	4.50	8.30	9.46
Rice Production	Ton	TRP	2.35	4.77	4.50	8.30	9.46
Rice Supply	Ton	RSS	1.57	3.27	0.19	5.11	5.89

(Rp 000)

Welfare Indicators		**1**	**2**	**3**	**4**	**5**
Producer Surplus	ΔPS	18 723 806 600	3 602 129 508	3 052 195 807	16 329 219 670	15 861 192 204
Consumer Surplus	ΔCS	-22 151 314 889	5 385 422 287	1 099 691 689	-15 261 467 672	-14 051 933 797
Government Revenue	ΔGR	-305 911 000	-655 515 000	-691 206 000	-132 682 000	-147 919 000
Net Surplus	NS	-3 733 419 289	8 332 036 795	3 460 681 496	935 069 998	1 661 339 407

CONCLUSION AND POLICY IMPLICATIONS

Irrigated area increase is a major determinant of rice supply and demand because it leads to increased paddy production and relatively stable domestic prices thereby ensuring that the welfare of both the producers and consumers does not deteriorate. Irrigated area takes the form of infrastructural improvement and is the best for society as a whole because they will be better off.

Government purchase price policy is better implemented in combination with other policies like irrigated area, intensified area, rice import tariff and decreasing the real price of urea fertilizer other than being implemented alone so as to be effective. The combination with other policies increases production as well but however, the losers can be compensated.

Rice intensification area which takes the form of improvement in infrastructure impacted on the welfare of both the producers and consumers. Intensification includes plot irrigation, improved rice varieties, transplanting of seedlings with wide spacing, water management, land preparation, fertilization and weeding. Intensified area increases rice productivity and profitability and the society is better off as indicated with positive net surplus.

In order for the government to ensure that the consumer does not get worse off through the increased government purchase price and the rice import tariff, the government should compensate the consumer through increased government programs like the Rice for the Poor, *Beras Miskin* (Raskin) program and market operation and food subsidies. The program of food diversification should also be intensified so as to reduce the over dependence on rice. The government should establish and support new programs aimed at increasing paddy production and paddy productivity for instance allocating more input subsidies like fertilizers so as to increase rice production to ensure rice self sufficiency. The rice import tariff policy should be implemented together with another supporting policy, like policy of increasing irrigated area and intensified area to increase paddy production and this will help to stabilize the domestic retail rice price.

ACKNOWLEDGEMENT

I wish to express my sincere appreciation to the Government of Indonesia for granting me this opportunity for a master's degree scholarship under the Developing Countries Partnership Program. I am heavily indebted to Dr. M. Parulian Hutagaol, chairman of supervisory committee and Professor Bonar M. Sinaga, member of advisory committee and coordinator of the Study Program, without whose guidance, encouragement and support this research would not have been possible. Appreciation to the external examiner, Dr. Yusman Syaukat who contributed immensely to the production of this work.

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