

Analysis of Agricultural Rice Production in Jambi: Study of Acreage Response Under Price Policy Program

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Abstract— The main objective of this research were to analyze the impact of some agricultural investments in rice production, The increasing trend of rice production in Jambi during the years of study (1986-2010) has been resulted from considerable increase in government improving policy programs, such as support price, and input subsidy programs. The variations of acreage, yield, and output have been affected also by the price of output and input such as fertilizer. The more effectiveness between price support policy and input subsidy policy depend on the higher magnitude between the significant coefficients of these two variables. The first policy implication from the findings of this study is that the price support policy is more effective and efficient to increase the acreage. The effect of government support prices for rice is very important in analyzing the acreage response. Since the role of government support prices in this new environment has received very much attention in policy implications. A method of measuring price expectation for analyzing acreage response is used when the influence of price support and market phenomena varies with market conditions. It assumes that the effect of changes in government policies because similar programs for acreage control and price support are likely form of future policies. A method of evaluating support, and acreage restriction is developed and tested to see the impact of changing government programs. The results show that when the support price is much below the expected market price, the truncation effect is negligible and the price support program has only a limited impact on acreage decisions. Alternatively, as the support price levels, the truncation effects become larger, and the resulting impact on acreage decisions is more pronounced.

Keywords— acreage response; rice production; price policy program.

I. INTRODUCTION

In a mixed economy such as Jambi's, rice prices are formed in markets and reflect a combination of government interventions and basic market forces. Rice prices have nearly always been heavily influenced by direct policy interventions, and hence the acreage response decision (1) Pearson et al. 1991). The government can also affect the basic market forces that influence commodity price information. According to Kolawole et al. (2), price policy for inputs directly affects the profitability of growing crops, and hence the supplies available in the market. The basic mechanism used to implement rice price policy have been a floor price, and government controlled international trade in rice to serve as the balance wheel between domestic production and consumption resulting from the respective prices faced by farmers and consumers. Therefore, because of direct government intervention, estimation of acreage supply is complicated by the incidence of several shifts in government agricultural policy during the period of estimation (3) (Guyomard et al. 1996).

In conjunction with the dominant rule of government interventions in rice price policy, this study will employ

reduced form autoregressive expectations models (4) (Keeney. and Hertel. 2008). From the models, the acreage supply model will be estimated by assuming that farmers base short-run acreage decision on the ex-ante rational expectation and variance of per-hectare revenue.

The purpose of this study is to examine the effect of government stabilization programs on rice acreage response. To meet this objective a model is developed which is capable of explaining the acreage response, and the impact of that program. The next section briefly discusses the theoretical framework and empirical model involving rice market sub-model and price program model. The model is then estimated using a combination of standard econometric methods and numerical integration techniques.

II. RESEARCH METHOD

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The research was conducted in Jambi Province, because this region is one of the producers of rice in Indonesia. And research carried out on 2011. Implementation of the study used survey methods and data drawn from secondary data.

Data used in this study are the data year 1986-2010 for the province of Jambi. Data from 1986-2010 are used to capture the economic crisis period that varies with the level of economic crisis are high, medium and small.

A. The Acreage Response Functional Form

Most supply response studies concentrate on the measurement of acreage response due to the high variability of yields. Since production response can always be decomposed of total production, or supply response (Fraser, 1986 and Smith et al. 2009). When between land and new seeds is possible to any significant extent, yield response may be considerable. On the other hand, because actual production levels reflect the influence of uncontrollable variables such as weather, plant disease and infrastructure, basing supply response on production levels is problematic (Villano et al. 2005).

The acreage response equation is

$$A_t = \alpha_0 + \alpha_1 \Phi_t + \alpha_2 \lambda_t + \alpha_3 C_t + \alpha_4 \theta_t + \varepsilon_t \quad (1)$$

where : A_t = acreage per hectare in year t
 Φ_t = expected gross return in year t
 λ_t = expected risk in year t
 C_t = input prices in year t
 θ_t = government farm program in year t
 α_0 = intercept
 $\alpha_1 - \alpha_4$ = parameters
 ε_t = error term

the variables in equation (7) were defined as follows :

a) The Gross Return Variable (Φ_t)

$$\Phi_t = \Sigma P_t \cdot Y_t \cdot A_t \quad (2)$$

where : Φ_t = expected gross return in year t
 P_t = output price in year t
 Y_t = yield per hectare in year t
 A_t = acreage per hectare in year t

(b) Farmers' Expected Gross Return [$E(\Phi_t)$]

$$E(\Phi_t) = \alpha_1 \Phi_{(t-1)} + \dots + \alpha_p \Phi_{(t-p)} + \beta_1 \varepsilon_{(t-1)} + \dots + \beta_q \varepsilon_{(t-q)} \quad (3)$$

where :

$\Phi_{(t-1)}$ = gross return per hectare in year (t-p), which is an auto-regressive (AR) component,
 $\varepsilon_{(t-q)}$ = error term of lagged q year, which is a moving average (MA) component

(c) Risk Variable (λ_t)

$$\lambda_t = [\Phi_t - E(\Phi_t)]^2 \quad (4)$$

(d) Farmers' Expected Risk Variable [$E(\lambda_t)$]

$$E(\lambda_t) = \alpha_1 \lambda_{(t-1)} + \dots + \alpha_r \lambda_{(t-r)} + \beta_1 U_{(t-1)} + \dots + \beta_s \varepsilon_{(t-s)} \quad (5)$$

where : $\lambda_{(t-r)}$ = the risk variable in year (t-r), which is an AR component

$\varepsilon_{(t-s)}$ = error term of risk associated with production lagged s years, which is MA component

In time series analysis, it is important to test the stationary of data. Non-stationary of the time series data has a substantial influence on the final estimated results. According to Clark and Spriggs (1989), if a rime series data are not stationary, any shock, even an unexpected policy shock, will cause a permanent response, and the series will not return to the pre shock level without an equal shock in the opposite direction. In contrast, a stationary time series contains only a transitory responses.

The null hypothesis that crop acreage process is a unit root process was tested against the alternative hypothesis that acreage process is stationary around a linear trend. In other test this hypothesis, the equation was defined as follows :

$$\delta(A_t) = \beta_0 + \beta_1 T + \beta_2 A_{t-1} + \beta_3 \delta(A_{t-1}) + \varepsilon_t \quad (6)$$

where :

$\delta(A_t)$ = the difference acreage between year t and year(t-1)
 T = linear time trend
 A_{t-1} = acreage in year t-1
 ε_t = the error term
 β_0 = intercept
 $\beta_1 - \beta_3$ = parameters

The null hypothesis, in terms of estimated coefficients of equation (12), can be expressed as follows :

$$H_0 : \beta_1 = \beta_2 = \beta_3 = 0$$

If H_0 is not rejected, then, the crop acreage process is a unit root process. Moreover, supply response consists of acreage and yield equations for rice. These equations are specified linearity and estimated by seemingly unrelated regression. Partial adjustment is assumed and thus lagged acreage is included in the model. The acreage equations are :

$$A_t = f(P^*_{t-1}, A_{t-1}, \theta_t, T, \Phi_t) \quad (7)$$

where :

A_t = acreage harvested in year t
 P^*_{t-1} = effective farm price deflated by index the variable cost of production in year t-1
 θ_t = a variable representing the impact of input subsidy and price support program at year t,
 T = linear time trend
 Φ_t = the risk variable in year t

The estimation acreage equations under risk are estimated by ordinary least squares. The Durbin-Watson value is used to test the hypothesis. These results will be used to see how much risk has impact on acreage planted and also about the structural elasticity of planted acreage with respect to risk (Lu et al. 2006) .

III. FINDINGS AND DISCUSSIONS

The main purpose of this study was to identify the supply response of farmers' decision rules for risk and government policy programs. Expected Utility Profit function is used to estimate the hypothetical parameters. This function is subjected to variables with respect to risk and government policy programs to identify the optimal decision and risk

efficient strategies. The key functions used to risk analysis are the lagged production function, and government program effectiveness.

A. Estimation of Lagged Production Function

This study investigated the acreage supply response in existing risk in lagged production function. The parameters of the crop acreage under risk were estimated by the ordinary least squares. In order to test the significance of each parameter, the null hypothesis can be expressed as $H_0 : \beta_1 = \beta_2 = \dots = \beta_n = .0$. the results of estimated parameters of acreage response under risk were listed in Table 2. the Durbin Watson analysis showed that the hypothesis that $\beta_1 = \beta_2 = \dots = \beta_n = .0$ can be rejected. This implies that at least one of the parameters is not equal to zero.

The acreage response were specified linearly, and estimated at two steps. First, farmers' expected gross revenue per hectare and risk variable were identified. Second, the estimated results were used to predict expected gross revenue per hectare and risk. the expected gross revenue variables were specified as an autoregressive-moving average process of Φ_t . The result of ARMA (3,3) was expressed as follows:

$$E(\Phi_t) = \Phi_t^* = 12,8 + 0,8 \Phi_{t-1} + 0,01\Phi_{t-2} + 0,3\Phi_{t-3} - 0,2C_{t-1} - 0,02C_{t-2} - 0,3C_{t-3} \quad (8)$$

The expected risk variables (λ) were specified as an autoregressive-moving average process of $(\Phi_t - \Phi_t^*)^2$. The result of ARMA (3,3) can be expressed as follows:

$$\lambda = 12,3 - 0,5 \lambda_{t-1} + 0,4\lambda_{t-2} + 0,5\lambda_{t-3} - 0,03U_{t-1} + 0,7U_{t-2} - 2,7U_{t-3} \quad (9)$$

Moreover, it suggests from empirical results that economic time series are rarely stationary and thus there is no reason that their associated error will be stationary. In order to estimate a unit root (stationary) for acreage response process, the Dickey-Fuller test was used to check the hypothesis that $H_0 : \beta_1 = \beta_2 = \dots = \beta_n = .0$. The results can be seen in Table 1.

TABLE I
DICKEY-FULLER TEST FOR ACREAGE RESPONSE

	Results
F-test	36,981
Critical Value	4,03
Judgment	reject H_0
Implication	no unit root

These results indicated that rice data have no unit roots. So the data for these variables were not differenced before the acreage response was estimated. After the acreage response equation was specified, the estimated parameters were reported in Table 2. From table 2., the positive parameter on the expected gross revenue, Φ_t^* , was significant at 5% significance level. This indicates that as farmers' expected revenue for rice increases, the rice acreage will increase.

TABLE III
ESTIMATIONS OF ACREAGE RESPONSE UNDER LAGS

	Parameters	Std. Error
Intercept	-7,6341	
Φ_t^*	0,0031***	0,0009
λ	-0,0048**	0,0013
C_1	0,0023	0,0067
C_2	0,0012	0,0011
θ_1	0,0936*	0,0493
θ_2	0,0508**	0,0241
T	0,0021	0,0912
R^2	0,8923	
D.W	2,7824	

- Φ_t^* = expected gross revenue
- Λ = expected risk
- θ_1 = fertilizer price
- θ_2 = pesticide
- η_1 = price support program
- η_2 = input subsidy
- T = linear time trend
- R^2 = adjusted R^2
- D.W. = Durbin-Watson statistics

The parameter on the risk variable, λ , was greater than zero although it is not significant at the 1% significance level. This indicates that farmers are risk averse, and the risk associated with gross revenue increases, the acreage curve will shift to the left.

The parameter of support price programs, η_1 , was greater than zero although it is significant at the 10% significance level. This indicates that support price program have caused any distortions in acreage decisions by shifting the rice acreage response curve to the right.

B. The Impact of Fertilizer and Pesticide Use on Crop Yields

In order to test trade distorting effect of fertilizer and pesticide subsidy program, it is necessary to analyze the impact of fertilizer and pesticide use on crop yields since this program already showed positive impact on yield increasing and encourage to use high yield variety that need more fertilizer and pesticide use per hectare in previous year and time trend, and assumed to be linear in its equations:

$$Y_t = \beta_0 + \beta_1\tau_{t-1} + \beta_2\Phi_{t-1} + \beta_3T + \epsilon_t \quad (10)$$

where :

- Y_t = rice crop yield in year t
- τ_{t-1} = fertilizer use per hectare in year t-1
- Φ_{t-1} = pesticide use per hectare in year t-1
- T = time trend variable
- β_0 = intercept
- $\beta_1 - \beta_3$ = parameters
- ϵ_t = error term

The OLS method was used to estimate the rice yield parameters. The estimated equation was as follows:

$$\delta(A_t) = 4851,3 + 0,087 T + 0,371A_{t-1} + 1,081 \delta(A_{t-1}) \quad (11)$$

(21,9) (0,038) (0,141) (0,2104)

D.W. = 0,5912 $R^2 = 0,8971$

From the equation above, fertilizer and pesticide use per hectare had a positive influence on rice yield since its parameter was positive and significant at the 5 percent significance level. This indicates that increased fertilizer and pesticide use increases rice yield. And the parameter on time trend variable was significantly different from zero at the 1 percent significance level. It indicates that technical change has significant impact on rice yield.

The input subsidy program encourages farmers to use more fertilizer and pesticide which increases yields. Since, by using fertilizer, total output of rice is the product of acreage planted. Therefore, the impact of input subsidy program will encourage farmer to increase their output, and shift the output supply curve to the right. Hence, the input subsidy program causes trade distortion by shifting output supply curve to the right.

IV. CONCLUSIONS AND FUTURE RECOMMENDATIONS

A. Conclusions

In this study, theoretical and empirical models associated with supply response under risk are reviewed. This study presented a framework for analyzing supply response decisions under risk. The importance of considering risk in rice crop framework was illustrated by simulating the acreage models at various price support levels for rice. The model simulation is used to evaluate the effectiveness of government programs. And finally to see the impact of risk on supply response.

The first, the lagged production function was postulated for empirical estimation of expectation variables. The estimated parameters showed that risk variables played an important role for farmers in making decisions. The result also showed that farmers are risk averse. Therefore, government policies have to consider risk management, and dynamic considerations.

Finally, in order to evaluate the effectiveness of this policy especially in government farm program, the risk variables will again give an effect and impact on final result. For instance, eliminating risk will increase the acreage which it means the supply curve will shift to the right.

B. Further Recommendations

From the above conclusions can be recommended that the meta-profit function can be explained that the factor prices associated with rice plants is crucial for farmers to decide what to plant crops so as to provide benefits. The price was a determining factor, is determined from the market and existing government policies. It is recommended that

farmers can overcome the risks it faces, the government is expected to play a role to stabilize the output and input prices and subsidized inputs and price is profitable for farmers.

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