THE ANALYSIS OF SUPPLY RESPONSE OF RICE UNDER RISK IN JAMBI PROVINCE

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Abstracts :
Farmers' supply responsiveness planting rice in Jambi Province was estimated using Meta-Profit analysis function. The objective of study is to analyze rice farmers' supply response. Research was conducted in Jambi Province in the year of 2010. Result showed that farmers' profit planting rice increased because its price increased. Furthermore, its share decreased when its labour wage increased. This implied to farmers to plant rice because rice was relatively more profitable than other plants. The result showed that farmers tended to pushed risk in planting decision. As expexted that irrigation index was also the important significant factor. Following it found that its profit planting rice increased in wet season. This results were consistent with the fact that the water availability was important factor to plant rice. The consistency of previous result, it found that profit to plant rice was the positive determination with irrigation index. This implied that government policy in agriculture had positive impact on technological adoption. The analysis production function suggested that labour and fertilizer elasticities higher than zero significantly. Production rice elasticity by considering the number of labour used was a little bit lower than fertilizer. As expected, it found that rice production elasticity by considering irrigation index was bigger than zero significantly.

Key words : supply response, rice, profit function, risk

I. INTRODUCTION

At the time of Regional Autonomy (decentralization) today, local government seeks to find and exploit the potential of the region in order to increase revenue. As with other areas in Indonesia, the main source of public revenue Jambi is from agriculture, especially rice farming which has become one of the most strategic business nowadays because it can increase farmers' income. Jambi province, which is one of the rice-producing areas in Indonesia, showed improvements in rice production from year to year, this is because of the availability of infrastructure and production facilities for farmers.

The development of this production that while effective in recent years, may be relatively difficult to be repeated in the future (Anonymous, 2008). This is because of economic crisis and financial difficulties which resulted in reduced subsidies for this

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activity. With these conditions, some areas of agricultural policy experts interested in observing the response of supply and demand for inputs in rice farming. Estimation of supply response, such as changes in input use has been reported in several studies (Bapna et al. 1991; David and Barker, 1988; and Guyomard, et al. 1996). But very few have examined the response of supply and input demand in relation to price changes.

In Jambi Province, the same thing with other places, a lot of farm production and investment decisions are made under uncertainty of commodity prices, crop yields, and government policies in agriculture (Anonymous, 2008). The government has been keeping input subsidies (such as fertilizer) and price support policies to improve farm production. This policy is very controversial. In order to evaluate this policy, it is very important to understand the response of farmers to economic stimuli such as factor prices and not prices.

The farmers'responses to price changes for specific products aimed at many conditions, which include applying resources especially land and family labor, plant selection and techniques, opportunities outside labor, the price of the product and the presence of income uncertainty as well as farmers' attitudes towards risk. Further according to Darmawi (2005) also asserted that in any business activity in sector of agriculture or agribusiness, the business is always faced with situations of risk and uncertainty.

The farmers' response to price changes is useful for policy formulation. If farmers respond positively to price movements, supply of rice will be affected by the increase in price. Effectiveness and cost of alternative pricing policies depends on the magnitude and significance of the estimated response.

Knowledge of the impact of other variables on the response of production is important for policy makers. Important variables include input prices, changes in technology, farm management, risk and financial constraints must be considered in studying the response of production for this study is more realistic and useful (Keeney and Hertel, 2008).

The role of the response of agricultural production has gained much attention in empirical studies today. Neoclassical theory of the model of production behavior of farmers in terms of maximum profit has been tested and accepted in the literature (Brennan, 1982). Choi and Helmberger (1993) have demonstrated theoretically that the increased uncertainties resulting price decline in optimal production from farming to compete.

Although many problems in its estimation, production response has a value of better consideration of policy makers in examining the basic program of farming in the province of Jambi to efficiency, the impact of distribution and production improvements. Key considerations in testing the response of production are (a) the production decisions made under ex-ante expectations and (b) many manufacturers are repellent risk (risk aversion) of at least limited income.

If there is risk involved in the production process or input prices and output, the agent assumed to behave as if they maximize expected utility of profits. Depending on the agents risk preferences, the marginal expectation of the input may not balance with the price factor. If an agent is repellent risk and production risk, the imbalance will depend on how risk into the production function and although the input will increase the risk or reduce risk marginally.

The process of agricultural production is generally characterized by sustainable decision because of time lags between the allocation of input and output realization. In the case of rice production in Jambi Province, farmers experience tend to decide crops to be

planted with the availability of information about prices and the development of weather and infestations insecticides in the local area. Finally, farmers will decide the level of input variables such as labor and fertilizer. If constraints are not rational, farmers tend to modify its decision at each stage, depending on any changes to this information.

When all inputs are implemented, not many farmers can work to control the production process. Output level and then determined by a number of exogenous factors such as rainfall, drought, infestation insecticides and pesticides, plant diseases, and other factors that could affect agricultural production. Lack of this control makes it difficult to assess ex-ante supply function, because one can only observe the fact output as the supply function assessment ex-post.

From the above information then can be withdrawn subject matter as follows: "Can supply response of farmers to input prices, output prices, government programs in farming, the price of fertilizer, pesticide price, area harvested and other exogenous variables be explained?"

From the issue and the problems above, the research objectives can be drawn: "Assessing the supply response of farmers to input prices, output prices, government programs in farming, the price of fertilizer, pesticide price, area harvested, and other exogenous variables."

II. LITERATURE REVIEW

Hayami and Ruttan (1971) postulated that changes in the relative price of fertilizer will induce producers to switch to seed varieties with differing fertilizer responsiveness so as to maximize profits with respect to a meta-profit production function. The Meta-profit approach (MPA) developed by Pitt (1983) describes the process of farmers' decision under uncertainty. The meta profit function is defined as an envelope of the indirect profit functions associated with any alternative production technologies. The approach to solving the original profit function model, was popularized by Lau and Yotopoulus (1972). However, the assumption of profit, as opposed to a utility, maximizing objective has been criticized widely (Dillon and Anderson, 1971). Other limitations of the profit function approach include 1) the model is static, 2) actual profits (which must be positive) are used as a proxy for expected profits, and 3) the actual estimation of a profit function is also contingent on different farmers facing different input and product prices. The meta-profit approach may be used to help these problems. However, some approaches can be modified to include expected utility.

The MPA function assumes that a farmer's utility depends upon maximizing an expected profit function subject to output price, input prices, and a set of variable inputs. Thus the function is defined as follows :

$$\text{Max } E[U(\pi)] = E[U\{p, f(x, T, \varepsilon) - cx\}] \quad \text{.....} \quad (1)$$

where :

π = profits
p = output price
x = a set of variable inputs
T = techology used in production
ε = production of uncertainty
c = a set of variable input prices

If the assumption that $f'(.) > 0$ and $f''(.) < 0$ are imposed, and if risk enters in additive form (Pope and Kramer, 1999), the set of variable inputs X* that maximize expected utility of profit above are :

$$X^* = d^*(P, C, T, \theta, \varepsilon) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where :

θ = is moments of production other than mean

upon the substitution of (2) back to (1), the indirect expected utility of profit function can be derived as follows :

$$E[U(\pi^*)] = E[v^*(P, C, T, \theta, \varepsilon)] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

If there is more than one type of technology t, then for the jth technology, the meta-profit function is defined as follows :

$$V(P, C, T, \theta, \varepsilon) = \text{Max}\ \{E[v^*(P, C, T_j, \theta, \varepsilon)]\} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

If there are only two choices of technology, eg. Rice vs. Non-rice or HYV of rice vs. TV of rice, then the linearized technology decision rules are:

$$I^* = \alpha\{E[v^*(P, C, T_1, \theta, \varepsilon)] - E[v^*(P, C, T_2, \theta, \varepsilon)]\} \quad \ldots\ldots\ldots\ldots\ldots \quad (5)$$

where :

α = a parameter

T_1 = technology used in HYV of rice

T_2 = technology used in TV of rice

In general, it assumes that farmers form expectations on variables outside their control and, hence, input choices occur ex-ante to the realization of output. Accordingly, the product supply function is an ex-post supply function, because once production is realized, the only choice for the farmer is to sell at the spot local market price.

The Impact of Incomplete Information on Supply Response

Rice production is made under uncertain prices and yields. Planned production may differ considerably from actual yields due to the vagaries of weather and pests. Likewise, planning prices may also differ considerably from actual prices. Consider the following simple translog Cobb-Douglas Model :

$$\text{Log } f(X) = \log K + \alpha_i \log \pi X_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

where :

K = a constant,

α_i = parameters, i = 1, 2,, …., n

as is well-known, profit maximization in a non-stochastic world yields the fllowing supply function :

$$q = K_s P^{v/1-v} C_1^{-\alpha/1-v} C_2^{-\beta/1-v} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

where :

K_s = $K^{1/1-v} \alpha^{\alpha/1-v} \beta^{\beta/1-v}$

C_i = input prices, I = 1, 2.

V = $\alpha + \beta \leq 1$

Suppose that there is only one production input, and the farmer is risk averse. In addition, it assumed that the production function takes the translog Cobb-Douglas form. In contrast, consider the ex-ante situation, where maximizes the expected utility function

$$E\{U(\pi)\} = E\{U[P.\ F(X, T, Є).\ A - C.\ X.\ A \quad (8)$$

where :
π = profit
P = output price
X = input per hectare used in production
Є = production uncertainty
A = acreage harvested
C = input prices
The first order condition for a maximum is :

$$dE[U(\pi)] / dX = P.f'(X, Є).A - C.A = 0 \quad (9)$$

$$dE[U(\pi)] / dA = P.f(X, Є) - C.X = 0 \quad (10)$$

solving (9) for X and (10) for A, ex-ante input demand, and acreage response functions can be defined as follows :

$$X^0 = X^0(P, C, R, Є) \quad (11)$$

$$A^0 = A^0(P, C, R, Є) \quad (12)$$

Now, consider the ex-post situation (production risk is resolved), where farmer maximizes expected utility profit :

$$E\{U(\pi)\} = P.\ F(X, Є^0).\ A - C.\ X.\ A \quad (13)$$

where $Є^0$ is the realized Є. The first order condition for maximization is

$$dE[U(\pi)]/dX = P.f'(X, Є^0).A - C.A = 0 \quad (14)$$

$$dE[U(\pi)] / dA = P.f(X, Є^0) - C.X = 0 \quad (15)$$

solving for X and A, the optimal input demand, and acreage response functions can be expressed as follows

$$X^* = X^*(P, C, Є^0)A \quad (16)$$

$$A^* = A^*(P, C, Є^0)X \quad (17)$$

Letting X^0 and A^0 be the realized input and acreage, and since X* and A* are the ex-post optimal input, and acreage levels, then one can write the following relation :

$$X^* = X^0 + \lambda X^0, \text{ or } X^* = (1+\lambda)X^0 \quad (18)$$

$$A^* = A^0 + \lambda A^0, \text{ or } A^* = (1+ ή)A^0 \quad (19)$$

where :
λ and ή = "losses" due to the production uncertainty.
From (18-19), the ex-post production function can be written as follows :

$$Q^0 = (1 + \lambda)^{-1} A^0 X^{*\alpha} \quad (20)$$

In other words, the constant term is the only difference between the ex-post and optimal production functions. Since the supply elasticity are directly derived from the production elasticity (7), then the ex-post output supply elasticity represent the optimal output supply elasticity.

III. RESEARCH METHOD

The research was conducted in Jambi Province, because this region is one of the producers of rice in Indonesia. And research carried out from March 2010 until August 2010. Implementation of the study used survey methods and data drawn from secondary data. Data used in this study are the data year 1986-2008 for the province of Jambi. Data from 1986-2008 are used to capture the economic crisis period that varies with the level of economic crisis are high, medium and small.

This method of analysis used in their applications based on the research objectives Meta-Profit Function Model. To study the effect of production scale, the elasticity of production and the production of optimum results can be considered. In this study, translog function for empirical models of the profit function is used. In the profit model, basically the same explanatory variables such as production function is used, unless they are expressed in per-hectare basis.

Empirical model of the profit function can be written as a logarithm of the Cobb-Douglas function of the following:

$$\begin{aligned} LOG\ (\pi_t) = {} & \beta_0 + \beta_1\ LOG\ (P_t) + \beta_2\ LOG\ (L_t) + \beta_3\ LOG\ (X_t) + \beta_4\ LOG\ (F_t) \\ & + \beta_5\ LOG\ (A_t) + \beta_6\ LOG\ (II_t) + \beta_7\ LOG\ (PS_t) + \beta_8\ LOG\ (IS_t) \\ & + \beta_9\ D(SN_t) + \varepsilon_t \quad \ldots\ldots (21) \end{aligned}$$

where:
LOG (πt) = log profit (Rp) in year-t
LOG (Pt) = log output price (Rp / kg) in the year-t
LOG (Lt) = log wage (Rp / ha) in the year-t
LOG (Xt) = log pesticide price (Rp / ha) in the year-t
LOG (Ft) = log of fertilizer prices (Rp / ha) in the year-t
LOG (At) = log harvested area (ha) in the year-t
LOG (IIT) = log index of irrigation in the year-t
LOG (PST) = log support price (Rp / kg) in the year-t
LOG (IST) = log inputs at subsidized prices (Rp / ha) in the year-t
D (SNt) = dummy influence of season, a value of 1 if it rains, and 0 if not
β0 = intercept
β1 - β9 = parameter
εt = error term

The estimated supply function with the sample selection method was tested with two stages (two-stage method). Chi-squared value is used to test the hypothesis. Estimated parameters of the supply function obtained from a two-stage procedure is consistent (Maddala, 1983).

It is known that parameter estimates do not measure the direct effect of one unit change in explanatory variables to change the level of profits from the production of plants or varieties. Parameter estimation can be transformed into partial derivatives which measure the effect of changing one unit of explanatory variables to changes in profits from the production of plants or varieties by using the following formula (Maddala., 1983):

$$d\,\pi_i / d\,Z_{ij} = g(Z_{ij}'\,\beta) * \beta_j \quad \text{.....(22)}$$

where :

π_i = profit

Z_{ij} = dependent variable

g = normal profit function

β_j = parameter

IV. 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 profit function is used to estimate the parameters of the hypothesis. This function is constrained on variables related to risk and government policy programs to identify the optimal decision strategy and risk efficiency. Function keys used for risk analysis is a meta-profit function.

4.1. Optimum Crop Production with Meta-Profit Function

This study examines the response of existing offerings in the functioning of the production profits. The parameters of the expected profit function using a two-stage least squares. In order to test the significance of each parameter, the null hypothesis can be stated as H0: $\beta 1 = \beta 2 = \ldots \ldots = Bn = 0$

The result of optimal parameter estimation of crop production can be seen in Table 4.1. Chi-squared analysis showed that the hypothesis $\beta 1 = \beta 2 = \ldots \ldots = Bn = 0$ can be rejected. This means that at least one of the parameters are not equal to zero. From Table 4.1. can also be seen that the parameters of some explanatory variables are significantly different from zero.

Table 4.1 Optimal Crop Production Estimation

Variable	Parameter	Std. Error
Intercept	19,3374	27,6547
Log Output Price	0,6771***	0,0612
Log Wage	-0,2026**	0,0316
Log Pesticide Price	0,6678	0,5951
Log Fertilizer Price	-0,4402	0,5291
Log Harvest Acreage	0,4039**	0,1844
Log Irrigation Index	0,1048***	0,0379
Log Supporting Price	0,7362	0,6305
Log Input Subsidize	0,1517	0,2533
Seasonal Effect	0,7769**	0,2348
Est. Chi-Squared	478,4	
Chi-Squared (13,0.005)	29,8	
R-Squared	0,8717	

Note : *** = significance level at α 0.01
** = significance level at α 0.05

There should also be noted that the parameters of the log output price is significantly greater than zero. This means that farmers chose to grow rice because rice prices are relatively higher. It was found that the log parameters wage labor is significantly greater than zero. So that a farmer tends to grow rice because of high prices, and the fact that labor costs tend to affect farmers' incomes, and because most farmers still use labor in the family. Can be considered as an indication that farmers are rational decision-maker profits. The high price of rice is one indication that the rice is more profitable. Conversely, because of wage labor is the biggest part of the cost incurred in the production of rice, farm worker wages are higher in regions shows that the rice is relatively quite profitable. In this situation, the appropriate response from the farmers' output price and wage labor could also mean that farmers can maximize the expected utility gains in crop decisions.

It is worth to mention that at this stage be treated as a single crop of rice regardless of various kinds. Therefore, one could argue that, the average cost of fertilizer is not part of the major expenditures in rice production due to the fact that the fertilizer may be one of the government subsidy programs, so the price of fertilizer is not a major determining factor in the decision of the agricultural harvest.

Need to discuss how the irrigation service associated with a decrease or increase the profitability of crop production. Here can be seen that the irrigation index also significantly affect crop choice. Since the presence of relatively good irrigation system can provide better water management, it can be concluded that the better irrigation services in specific areas, the higher the profitability that farmers will benefit from growing rice.

In Table 4.1. seen that the rainy season significantly affect farmers' crop choices. This finding is consistent with the fact that wetland rice requires more water than other crops. In this way, can explain why most of the planted rice during the rainy season, and other crops that require less water, most planted in the dry season. And the result of the price support program indicates that the log of the price support level was not significantly different from zero, despite having a positive value.

It is understood that the estimated parameters listed in Table 4.1 does not directly reflect the effect of a change in one unit of the explanatory variables to changes in the profitability of a farmer to grow rice. The parameters in Table 4.1 can be converted to form the partial derivatives and the results can be seen in Table 4.2. Partial derivative values in Table 4.2. represent the effect of a change in one unit of the explanatory variables corresponding to changes in profitability variable with changes in profitability that farmers would plant rice. Because the explanatory variables are presented in log form, the partial derivative values also represent the value of each elasticity.

Table 4.2. Calculation of Partial Derivatives of Optimal Crop Production

Variable	dπi / dZij
Intercept	0,488841
Log Output Price	0.680731***
Log wage	- 0.716440**
Log Pesticide Price	0.344925
Log Fertilizer Price	0.240501
Log Harvest Acreage	0.719862**
Log Irrigation Index	0,510859***
Log Supporting Price	0.145715
Log Input Subsidize	0.015360
Seasonal Effect	0.052901**

Note: π = profit component,
Z = independent components
*** = significance level at α 0.01
** = significance level at α 0.05

From Table 4.2 above shows that any change in the independent variable changes one unit change in profits to varying degrees, these changes are significant enough, there are not significant

4.2. Rice Production Function Elasticity

The estimated elasticity for rice production functions listed in Table 4.3. R-squared, adjusted for the estimated 2SLS is 0.7834, and F-statistic (9, 13) is 19.437, which is significantly greater than the F-table (9.13, α = 0.01) = 4.19

Table 4.3. Rice Production Function Elasticity

Variable	Elasticity
Intercept	19,3374
Log Output Price	0,6771
Log Wage	0,2026
Log Pesticide Price	0,6678
Log Fertilizer Price	0,4402
Log Harvest Acreage	0,4839
Log Irrigation Index	0,1048
Log Supporting Price	0,7362
Log Input Subsidize	0,1517
Seasonal Effect	0,7769
R-Squared	0,7834
F-Stat. (9,13)	19,437

Note: *** = significance level at α 0.01
** = significance level at α 0.05

As expected, it was found that the elasticity of labor and fertilizer significantly greater than zero. The estimated elasticity of rice in relation to the amount of labor used is 0.2026 and the estimated elasticity of rice in relation to the fertilizer was 0.4402. Results in Table 4.3 show that the fixed input is also an important determinant of production. Not surprisingly, found a high elasticity (0.4839) of the total harvest. One can review the results as an opportunity cost of land.

Elasticity of rice production in connection with irrigation index is significant and greater than zero (0.1048). These results suggest that the quality of irrigation is an important determinant of production. It has been described above that the quality of irrigation to increase the demand for labor and fertilizer, in this section can be seen that irrigation as a fixed factor is also to increase rice production. Furthermore, this can be explained that water availability and management capabilities, either directly or indirectly contribute to higher rice production.

Consistent with previous findings, found that the elasticity of rice production in connection with price support program is positive (0.7362), but not significantly different from zero difference. These results support the concerns of farmers that production is not affected by price support. This result is also supported by the record that the peasant with past experience of production of rice, to formulate expectations of production

V. CONCLUSIONS AND FUTHER RECOMMENDATIONS

A. Conclusions

First of all, it was found that the benefits increase as farmers plant paddy rice price increases. It added that profits grow rice decreases labor costs rise. This implies that farmers have chosen to plant rice because rice is relatively more profitable than other crops. Results show that farmers tend to reject the risk in deciding on investment.

As expected it was found that irrigation index is also a significant determinant of the plant. Subsequently it was found that increased profits grow rice during the rainy season. This finding is consistent with the fact that water availability is an important factor for the rice plant.

Consistent with previous results, it was found that the benefits to growing rice is a positive determinant of irrigation index. This implies a policy of government investment in agriculture has a positive impact on technology adoption.

Production function analysis suggests that the elasticity of labor and fertilizer greater than zero significantly. Elasticity of rice production considering the amount of labor used is slightly lower than in considering the fertilizer.

As expected, it was found that the elasticity of rice production considering the irrigation index is significantly greater than zero. From these findings and previous findings can be concluded that the availability of water and its management contribute to the production of rice.

B. Futher 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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