The Analysis Of Supply Responsiveness Of Jambi’s Rice Farming

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Abstracts: Estimation on supply responsiveness and input demand rice farming in Jambi Province were done using analysis of profit function. The aim of study is to analyze rice farmers’ supply response. Research was conducted in Jambi Province in the year of 2014. Result showed that farmers do maximize their in short term profit and response to price changing efficiently. Real wage changes were estimated to have a bigger influenced on rice profit and supplies than in the real price changes of mechanized land preparation, fertilizer or pesticides. Elasticity supply response of rice considering their price was rather high.

Keywords: supply response, rice farming, profit function and elasticity.
I. Introduction

With the current policy of Indonesian Regional Autonomy (decentralization), every local government is seeking to exploit the potential of its region. Jambi province is one of the major rice producing areas of Indonesia. Jambi and like other Indonesia’s areas, the sector of public job from the agricultural sector, cultivation of rice has become one of the most strategic source of activities now because it will increase farmers’ profit. Province of Jambi becomes one of the rice-producing place in Indonesia, showed better in rice production in the coming year, this is because of the contribution of infrastructure and production facilities for farmers (Anonymous, 2014).

The improvement of this production seemingly effective for last five years, it maybe more difficult to be repeated in the coming year. The development problems became sources problems such as the economic crisis and financial difficulties which resulted in less subsidies. Because of this situation, some experts in agricultural policy interested in studying supply response and inputs demand on rice cultivations. Supply response estimation of rice like input use changes has been showed in several studies (Battese et al, 1998; Dawson and Lingard, 1989). However, very little reported the supply response and input demand in relation to change in price.

Such a study will be important in informing the policy-setting process. It will include consideration of the many decisions facing farmers such as what resources to devote to rice production (land, fertilizer, family labor), what varieties to select and whether to take-up off-farm employment opportunities. In this context, product and factor prices financial constraints, technology, riskiness of the alternatives and attitudes towards risk are important variables (Darmawi 2005; Keeney and Hertel 2008).

Guyomard et al. (1996) reviewed the problems in estimating the supply response using time series data for output supply and demand is part of a system, these estimates
may give inefficient estimates of the relationship with the bidding. So it is better to estimate simultaneously, linkages, output supply and demand equation input. Profit function analysis is an approach to describe the system of output supply and input demand (Olawande et al., 2009).

Jambi Province is a center of rice production in Indonesia with the reality of the use of technology and resources that may vary among farmers. With this condition the profit model that expresses the maximum profit from a farm suitable to estimate the supply response.

II. Literature Review

The convention theory of supply response mostly used time series data and regressed price supplied quantity causing for some lags and shifters in the models. Guyomard et al. (1996) studied the difficulties deeply estimation in this point of view. The big problem in this study is that input demand and supply output become parts of a general system, so that reviewing partially may result estimates inefficiently of the those supply relationship. It is much better, when it estimates the interlinked output supply and factor demand equations simultaneously. The analysis of profit function is much appropriate approach to derive these systems of supply output and factor demand equations simultaneously (Pope and Kramer, 1979).

Model of profit function, expressed by Yotopoulos and Lau (1979), showed the profit maximum of a firm on output prices and inputs variable and fixed factors of production quantities. Therefore, the accommodates reality that prices framework, technology and resources variables may differ among farmers.

The appropriate in a profit function model assumptions are (Yotopoulos and Lau, 1979):
(a) Firm find out to get short-term profits given in maximize the resources and technology every they are operating.

(b) Firms has characterized as price takers by considering its prices got for output and prices gave for inputs and

(c) The production function based on the profit function shows diminishing benefit in the variable inputs scale.

The profit assumption, as on contrary to a utility assumption, aim maximizing has been criticized in general (Salassi, 1995). Even though this assumption is accepted as a working operation for a given bundle of data can be explained statistically on the context of profit function (Battese et al, 1998). Profit function methodology has some limitation. Like, its model static and actual profits (which must be positive) are used as expected profits proxy. Profit function estimation is also correlated on different farmers having different input and prices product. Critically, the different farmers price for the same input or product; not differ to farmer’s storage or sale policies, different quality, etc. nor differ causing from measurement errors.

III. Methodology

Samples of 60 rice farmers were collected in two districts, by using stratified random sampling, with consideration of the widest lowland rice farming and high productivity in Jambi Province. The function of the output of rice production process is expressed as:

\[ Y = a_1X_1 + b_2Z_2 + \exp + D + U \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (1) \]

In meaning of:

- \( Y \) = Output of rice, each farmer (tones)
- \( X_1 \) = Quantity of fertilizer applied (tones)
- \( X_2 \) = Number of days of labor used in land preparation
\[ X_3 = \text{quantity of pesticide applied (kg)} \]
\[ X_4 = \text{number of days of labor used for crop maintenance} \]
\[ Z_1 = \text{ice area (ha)} \]
\[ Z_2 = \text{capital service flow (IRD)} \]
\[ D = \text{range of irrigation scale from 1 to 5 based on the availability of irrigation supplies} \]
\[ \epsilon = \text{error terms} \]

\(a, b, c, \text{ and } d\) are parameters to be estimated under restriction

Broader results used in the Cobb-Douglas of the production process limitations form which can be limited the analysis. For instance, the coefficients elasticity are fixed, using constant shares without level of input, and the substitution elasticity under inputs is the same. So that, this function form continuous, for practical purposes, can be applied with causality (Yotopoulos and Lau, 1979).

The normalized limited profit function, derived from the production function (1), described by Yotopoulos and Lau (1979):

\[ \ln \Pi^* = \ln \alpha + \sum\beta_i \ln P_i + \sum\tau_j \ln Z_j + \delta D + U \ldots \ldots \ldots \ldots \ldots (2) \]

where:

\(\Pi^*\): limited profits, normalized by the price of rice (IDR)

\(P_1\): the price of fertilizer / kg (IDR)

\(P_2\): the price of pesticide / kg (IDR)

\(P_3\): real wages / land preparation (IDR)

\(P_4\): real wages / maintenance (IDR)

\(P_5\): real wages / harvesting (IDR)

\(Z_1\): land area (Ha)

\(Z_2\): capital used (IDR)

\(U\): error terms

\(\alpha, \beta, \tau, \text{ and } \delta\) are parameters to be estimated

To obtain an optimal level of input variables, Shehard-Hotelling lemma concepts used in the case of the Cobb-Douglas restricted profit function:
\[ X_i^* = - \frac{\delta \pi^*}{\delta P_i} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3) \]

Equation (3) was reconstructed and empirically estimated as:

\[ (X_i^* P_i) / \pi^* = \beta_i + V_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4) \]

where

\( X_i^* \) = quantity of input variables

\( V_t \) = error terms

Because the production function assumed in the form of Cobb-Douglas, solutions simultaneous equation (4) and profit function (2) complete the estimated elasticity of demand factors, Zellner's seemingly unrelated regression method completed the efficiency parameters \( \alpha, \beta, \tau, \) and \( \delta \) (Battese et al., 1998).

IV. Results and Discussions

4.1. Profit Maximizing

Important condition to derive the profits function from the production function used is that farmers maximize short term profits. The assumption of validity can be checked directly by using whether \( \beta \) parameters came from function of profit and those came from demand equations factor simultaneously (Battese et al., 1998). If the parameter \( \beta \) is derived from two sets of equations are not significantly different, then the sample average farmer to maximize short term profit, with the availability of technology and resources. Since it is very feasible to estimate profit and demand equations factor simultaneously to force problems of bias equation simultaneously, Battese et al. (1998) using the F statistics for testing the null hypothesis that \( \beta \) derived from two separate sets do not differ significantly.

Battese et al. (1998) explains that by examining Lagrange multipliers, this null hypothesis can also be directly evaluated used in imposing the restricted Aitkens least
squares technique, differing from zero significantly. Otherwise, it did not reject the hypothesis of profit maximization. From estimating result showed that it is not significantly different from zero of Lagrange multipliers, likr the $X^2$ test (Table 1). So that farmers of rice in the area of research hypothesis to maximize profits can not be rejected.

Table 1. Restrictions Test on Parameter $\beta$ Profit Function from Factor Functions

<table>
<thead>
<tr>
<th>Restrictions</th>
<th>Lagrange ($\lambda$)</th>
<th>Multiplier ($t$)</th>
<th>$X^2$ Statistics test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer</td>
<td>0.539 (1,435)</td>
<td>0.342</td>
<td></td>
</tr>
<tr>
<td>Pesticide</td>
<td>0.225 (4,321)</td>
<td>0.538</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>0.102 (4,412)</td>
<td>0.441</td>
<td></td>
</tr>
<tr>
<td>Harvesting</td>
<td>1.218 (3,214)</td>
<td>1.092</td>
<td>5,291</td>
</tr>
</tbody>
</table>

This finding implied that a sample of farmers do maximize expected profit and that explaining difference between these farmers’ use of inputs in rice production are not uncertainty considerations dominantly.

4.2. Supply Output and Input Demand Elasticity

Elasticity of output supply and input demand can be used to see whether one or some parameter changing may influence profit. Parameter estimates of restricted profit function and the elasticity of demand factors can be seen in Table 2. The coefficient is correct in sign, in addition to real price of maintenance, they are greater than zero.
Table 2. Jointly Estimated Normalized Profit Functions and Factor Demand Elasticity

<table>
<thead>
<tr>
<th>Variable</th>
<th>Restricted Estimation</th>
<th>Factor Demand Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>34,126</td>
<td>-0.207** (0.112)</td>
</tr>
<tr>
<td>Fertilizer Price</td>
<td>-0.207** (0.112)</td>
<td>-0.207** (0.112)</td>
</tr>
<tr>
<td>Pesticide Price</td>
<td>-0.208** (0.118)</td>
<td>-0.208** (0.118)</td>
</tr>
<tr>
<td>Labour of Maintenance</td>
<td>-0.135 (0.286)</td>
<td>-0.135 (0.286)</td>
</tr>
<tr>
<td>Labour of Harvesting</td>
<td>-0.346** (0.085)</td>
<td>-0.346** (0.085)</td>
</tr>
<tr>
<td>Land Acreage</td>
<td>0.451* (0.128)</td>
<td></td>
</tr>
<tr>
<td>Modal</td>
<td>0.407* (0.187)</td>
<td></td>
</tr>
<tr>
<td>Irrigation</td>
<td>0.104* (0.098)</td>
<td></td>
</tr>
</tbody>
</table>

Note: ** = significance level at α 0.05  
* = significance level at α 0.10

The rice supply elasticity with its own price based (estimated as Σβ) was estimated close to unity (0.896). The implication, the sample farmers in response to changes in rice prices. For planning purposes, 1% rice price changes, ceteris paribus, would bring a similar change (0.896%) rice supply from Jambi Province.

Estimates explained that 10% real wage increase, will cause approximately 4.81% decrease rice supply, consisting of 1.35% decrease due to plant maintenance, and 3.46% decrease due to reduction in labor used for harvesting. If real wages rise, an adjustment in labor used for maintenance may be part of the increased use of fertilizer.

Estimated price elasticity of demand for fertilizer is 0.207, this means that 10% of the price of fertilizer goes up, causing a 2.07% decrease fertilizer use in the short term. So with profit function exists, will reduce profit by the same proportion. And its also happened for estimated price elasticity of demand for pesticide is 0.208, this means that 10% of the price of pesticide goes up, causing a 2.08% decrease pesticide use in the short term.
The elasticity of output with input considering the land exceeds the temporary capital. So in the size of the farm will have an impact on the profit when compared with the increase in capital intensity of farming.

4.3. Production Elasticity

Through the concept of Duality, there is a correspondence between production and profit functions. The result is an implicit production elasticity can be derived from profit functions. The elasticity of production (bi'and cj') was derived from profit function parameters as follows:

\[ b_i' = - \beta_i (1 - \mu) : \text{for the input variables} \]
\[ c_j = \tau (1 - \mu) : \text{for fixed input} \]

where:
\[ \mu = \Sigma \beta_i, \text{ and} \]
\[ \beta_i \text{ and } T_j = \text{from equation (2) estimation} \]

The elasticity of indirect production (bi 'and cj') and the elasticity of direct production from the production function equation (1) can be shown in Table 3.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unit</th>
<th>MLE Estimation</th>
<th>Indirect Estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td></td>
<td>412.22</td>
<td>-</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>Kg</td>
<td>0.101** (0.004)</td>
<td>0.082</td>
</tr>
<tr>
<td>Pesticide</td>
<td>Kg</td>
<td>0.059** (0.013)</td>
<td>0.044</td>
</tr>
<tr>
<td>Maintenance Labour</td>
<td>Days</td>
<td>0.289** (0.031)</td>
<td>0.063</td>
</tr>
<tr>
<td>Harvesting Labour</td>
<td>Days</td>
<td>0.312** (0.027)</td>
<td>0.304</td>
</tr>
<tr>
<td>Land Acreage</td>
<td>Ha</td>
<td>0.457** (0.041)</td>
<td>0.424</td>
</tr>
<tr>
<td>Modal</td>
<td>IDR</td>
<td>0.015** (0.003)</td>
<td>0.031</td>
</tr>
<tr>
<td>Irrigation</td>
<td>Scale</td>
<td>0.034** (0.005)</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: ** = significance level at \( \alpha 0.01 \)
It is shown that the parameter estimation gives the right in sign and production elasticity are logical and reasonably similar. The similarity between the directly and indirectly production elasticity has two implications. First, it showed equivalently for production and profit production models. As a results we do believe that in the supply elasticity and demand elasticity of rice explained in Table 3. Second, it does not seem simultaneous equation bias to be a problem when estimating the decreasing elasticity from the production function on equation (1).

The directly estimation (1.233) and indirectly estimation (0.948), which decreased elasticity of production showed that decreasing returns to scale is accepted. The production elasticity is explained to land (0.457) is consistent with that reported by Kikuchi and Hayami (1980). The elasticity of production a little low compared to fertilizers to pesticides. It is not strange because farmers are now planting local varieties of response to fertilizers, are also resistant to some pesticides.

V. Conclusions and Recommendations

5.1. Conclusions

The elasticity of supply and demand of farm inputs for rice are estimated using analysis of profit function for a sample of farmers in Jambi Province which has implemented a good cultivation technology. It is assumed in this approach is tested that farmers maximized short term profit, with the availability of technology and resources that remain. Analysis of samples showed that the average farmer maximizes profits by considering the normal price of the input variables,

The analysis also explains that the rice farmers in the area of research in response to price changes efficiently. Initial output is a response to the price of rice. In the input demand, many are sensitive to the wage rate, cost of maintenance / harvesting. The price
elasticity obtained by completing some of the necessary base data to evaluate the alternative policies pricing implications of supply response and demand inputs of rice.

5.2. Recommendations

From study above results recommendation that the profit function can be showed that the prices factor linked with rice cultivation is strategic for farmers to conclude what to plant crops so as to get benefits. The price was an important factor, is explained from the market and existing government policies. It is recommended that farmers can solve the problem it faces, the government is hoped to involve to stabilize the output and input prices and subsidized inputs and price is beneficial for farmers.

References


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