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Relative Efficiency Analysis of Swampland Rice Farming in South Kalimantan, Indonesia

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Abstract: *This research aims to estimate the profit function by farmers as well as analyzing the efficiency of the economy and the price relative to rice farming in two typologies of wetlands are swamps and tidal lowland. The analysis showed that the price of the means of production in the research area is very influential on the profitability of rice farming so that the increase in production means a high price will lead to a decrease in profits, which in turn will lower the level of welfare of farmers. Under optimal conditions where maximum profit is reached, the effect of input prices and the number of input variables remained significant except for the value of the equipment used, based on the value of the coefficient function of input demand of fertilizer, pesticides and labor inelastic to prices while input seeds price-elastic.Farm area of research has decreasing returns to scale, this indicates that the input gain is higher than the increase results. Testing the efficiency of relative prices and relative economic efficiency between the two groups showed that the farm there is significant with 99% confidence level. so that rice farming in tidal land has a price efficiency and economic efficiency is higher than rice farming in swampy wetlands.*
Keywords: *rice farming, the function of profits, business scale, the relative efficiency.*

I. Introduction

Until now, the issue of food security is still an issue of concern in Indonesia in the provision of basic foodstuffs, especially rice with increasing population and rising consumption. In 2015, Indonesia's population is estimated at 255 461 700 inhabitants, while the average rice consumption per capita per year is 113.48 kg in 2011, or 139 kg in the period 2005 - 2010. The production of milled rice in 2012 amounted to 69.05 million tons or approximately 40.05 million tonnes of rice, while the national consumption of about 29-36 million tonnes of rice. Having regard to the national rice production as well as the national rice consumption, it can be said that there is not sufficient surplus to support food security in the long term.

Improved food security is one of the national development objectives. In terms of production, increase food security is sought through increased rice production is mainly produced from rice fields. Considerations underlying this policy is that rice is a staple food of the population had the greatest contribution to the consumption of calories. In South Kalimantan land which has a large area and the potential for development is swampy wetlands. In order for development of land for rice in accordance with the carrying capacity for the sustainability of aquaculture, it is necessary to pay attention to the direction of the development of the economic and ecological interests. Developing a swamp land generally must meet three conditions, namely, technically feasible and acceptable to society, economically feasible and profitable, and does not damage the environment. It is therefore interesting to study about the allocation of the efficient input use and profit analysis of rice farming in the two typologies of wetlands in order to provide policy advice utilization of wetlands as an alternative agricultural land in South Kalimantan.This research aims to estimate the production function and profit function by farmers as well as analyzing the relative economic efficiency in rice farming in two typologies of wetlands are swamps and tidal lowland.

II. Research Methods

2.1. scope of Research

The research was carried out at two agroekosistim wetlands area Kalsel namely tidal wetlands and swampy wetlands. To represent agroekosistim tidal swamp land Banjar regency was chosen to represent the type of land and swampy marsh been Hulu Sungai Utara.

2.2. Data and Data Sources

Research using primary and secondary data. Primary data was collected through a structured interview guided questionnaires with farmers who manage their rice farming in tidal wetlands and swampy. The main criteria farmer selected for the study is the farmers who have experience managing rice farming in tidal land and swampy areas of at least four seasons. While secondary data taken from various institutions (Central Bureau of Statistics Regions; Department of Agriculture; Food Security Agency and other agencies) that are considered relevant and the data is capable of supporting the research activities.

2.3. Mechanical Sampling

The total number of selected villages in this study were 4 pieces village. From each village will be determined randomly sampled farmers proportions *(proportionite random sampling).* Overall the number of samples of farmers as the primary data source is the planned 72 respondents consisting of 36 respondents farmers as a sample for the type of tidal swamp land; and 36 respondents farmers as a sample for the type of swampy wetlands.

2.4. Data analysis

Model analysis used to estimate the factors that affect the rate of profit, business scale and level of economic efficiency relative is a model of profit function Cobb-Douglas derived from models of Cobb-Douglas. Furthermore, to estimate the profit function, return to scale and the level of efficiency do help program SAS 9.

2.4.1. Profit Function Model

Profit function Cobb-Douglas used to determine the relationship between input and output as well as measure the impact of various changes in the price of inputs to production. How profit function Cobb Douglas became famous after being introduced aleh Lau and Yotopoulos (1971) became a concept that could be operationalized to test the relative efficiency in agriculture.

The latest development is the lowering function Cobb Douglas advantage with the technique *"Output Unit Price"* or UOP of *Cobb-Douglas Profit Function,* which is a function which involves the production and production has normalized at a fixed price called *"Normalized Profit Function".*

One of the benefits of the use of this function is that researchers can simultaneously measure the levels of efficiency at different levels or traits. In using the Cobb-Douglas function advantage of this by inserting four input variables and 3 fixed inputs. The shape of the Cobb-Douglas production function is as follows:

$Y = AX_1^{xi} X_Z^{a3\ A2M} X_3 X_4^{a4} Z_1 Z_2^{\beta 1\ \beta 2}$ .... (2.1)

Where :

Y = rice production

X1 = labor

X2 = the number of seeds

X3 = fertilizer

X4 = pesticides

Z1 = land

Z2 = other costs - other

α^1 = coefficient of input variable i

βj j = coefficient fixed inputs

According Yotopoulos and Lau (1971) from the equation (2.1) can be derived profit function UOP (Unit Output Price) as follows:

$In\pi^* = A^{*\beta} \Sigma Z\ \Sigma wi^{ai * j *}$ .... (2.2)

In the form of natural logarithms, equation (2.2) can be written as follows:

$In\pi\ LNA ** = \Sigma\ \alpha\ i * Inwi * \Sigma\ \beta j * InZj$ .... (2.3)

$In\ \pi * Ina * + \alpha =_1 * In\ w_1 + \alpha_2 * in\ w_2 + \alpha_3 * in\ w_3 + \alpha_4 * in\ w_4$

$+ B_1 * In\ Z_1 + \beta_2 *_2 + e0\ Inz$ .... (2.4)

Information :

$_\pi$ * = short-term gains that have been normalized by the price of grain

A * = intercept

W1 * = price of labor is normalized by the price of grain.

W2 * = price of seeds that have been normalized by the price of grain.

W3 * = price of fertilizer which has been normalized by the price of grain.

W4 * = cost of pesticide teiah normalized by the price of grain.

Z1 = input fixed land area

Z2 = input costs still others - others

α * = parameter input variables expected, i = 1, ...5

βj * = parameter fixed output suspected, j = 1, 2

e0 = factor error (standard error)

The demand function input variable *(factor share)* as an input variable contribution to profits can be derived from the Cobb-Douglas function profit (Yotopoulos) which mathematically can be formulated into:

$-W_I X_i / \pi_a = \alpha_i * " + ei;\ i = 1,2,3,4$ .... (2.5)

$Xi = -\alpha_i * " \pi_A / W_i^*$ .... (2.6)

Where :

Wi^* = price of input variables are normalized by the price of corn.

π_a = short-term profits UOP
α_i * " = parameter input demand vartabel Factor share
X_l = number of input values upah.tenaga work in rupiah
X_2 = the number of input values SP-36 fertilizer in rupiah
X_3 = the number of input values of urea in rupiah
X_4 = the number of input values of pesticides in rupiah
ei = error factor
And equation (3.6) can be lowered output supply function as follows:
Y_s * = (1- Σ α_i * ") π_a ...... (2.7)
Equation (3.7) in the natural logarithm, the formulation becomes:
ln Y_s * = ln (1- Σ α_i * ") + ln π_a ...... (2.8)
In Ys * = ln (1- Σ α_i * ") + In A^* + Σ α_i * Inwi * Σ β_i * In Zj Σ α_i^* Σ βj^* In Zj ...... (2.9)
As consideration in resolving the profit function UOP *(Unit Output Price)* wears a simultaneous way is to achieve stochastic specification, where the analysis model has ai * which appears in all the equations. If the case by using the OLS there will be inefficiency and feared the emergence of a correlation between the errors of each equation. For the prediction function UOP profit will be solved by using three models. The use of these three models will be visible correlation between the error of each equation so that it will be obtained an efficient model.

2.4.2. Return to Scale Testing

Testing the return to scale done on the value of k or *Σ* β * *j*. If *Σ* β * *j* = 1 then there is a constant return to scale (CRS). Increasing return to scale (IRS) occurs when *Σ* β * *j*> 1, and scale decline if *Σ* β * *j* <1. Thus return to scale testing can be formulated into the following:
Ho: *Σ* β * *j* = 1 (CRS)
Ha: *Σ* β * *j* ≠ 1 (IRS / DRS)
The wear test F-Test namely:
F arithmetic <F table, then Ho is accepted
F count> F table, then Ho is rejected

2.4.3. Relative Economic Efficiency Testing

To test whether or not there is a similarity of economic efficiency based on the land, then the actual profit function is modified into:
Ln π_a = ln A^{s*} + ζ^G DM + Σ α * ^{i} Ln W * i + *Σ* β * *j* LnXj ...... (2.10)
Model variable input demand function becomes:
-Wi Xi / $\dot{\eta}_a$ = α i * $^{"+}$ $\alpha_1^{*"M}$ DM ...... (2.11)
Where :
$\dot{\eta}_a$ = UOP actual profit
DM = 1 for the dummy variable swampy wetlands
DM = 0 for the dummy variable tidal land
Similarity hypothesis testing the relative economic efficiency into the following:
Ho: ζG = ζ^L = 0
Ha: $\zeta^G \neq 0$ or $\zeta^L \neq 0$
The wear test F-Test namely: F arithmetic <F table, then Ho is accepted
F count> F table, then Ho is rejected

III. Results and Discussion

3.1. Estimation profit function and input demand function

Parameter estimation equation is used UOP profit function *(Output Unit Price)* and *share factor* function equation. Estimation was conducted based on the method SUR *(Seemingly Unrelated Regression)* were found by Zellner (1962). The data in this study using computer tools with SAS 9.1 program. In this case there is a profit function and four (4) common *share factor* function allegedly simultaneously. The dependent variable in the function of profit is profit farming normalized (ð *), being the independent variables include input price variable and fixed inputs.

Input variables used as independent variables include the average wage per worker normalized (W1 *), the price of seeds is normalized (W2 *), the price of fertilizer normalized (W3 *), the normalized cost of pesticides (W4 *). While input remains applicable as independent variables covering land area (Z1) depreciation (Z2) and the outpouring of labor (Z4) and DM showing the location of dummy land / typology of land in a single growing season. The four common share above-mentioned factor is the value of labor power (X1), the value of seed (X2), the value of fertilizers (X3), and the value of pesticides (X4).

Estimation parameters profit function UOP and function of factor share in this study are presented in three models, namely Model 1 uses a single equation OLS *(Ordinary Least Square)*, Model II uses simultaneous equations SUR *(Seemingly Unrelated Regresion)* Zellner without restriction similarity α * = α * "(meaning the actual short-term gains) and Model III uses simultaneous equations method with restriction Zelner α * = α *" (meaning there is maximum short-term profits).

From equation profit function can be derived function of input demand and output supply functions at the same time. Besides the state-level economic scale enterprises *(economies of scale)* can also be derived from the profit equation. Analysis of this profit function estimation using *Output Unit Price Cobb Douglas Profit Function*, is a function or equation that involves the production factor prices and production values have been normalized by the price of rice. This method also bases itself on the assumption that the farmer or entrepreneur is to maximize profits.

3.2. The influence of the price factor of production to the level of profit

Completion profit function performed by the three models. First with OLS (Model I) which is used as a comparison to other models, where each equation (profit function and demand function) resolved on their own. The second model by the method of *seemingly Unrelated Regression* (SUR) where all equations solved simultaneously without restriction similarity $\alpha^*_j \neq \alpha^*_i$ is the condition of optimum allocation of inputs or the achievement of maximum profit where α^*_j is the profit function parameters and $\alpha^*_{j.}$ are the parameters of the demand function. While the third model with methods *seemingly Unrelated Regression* (SUR) with restrictions $\alpha^*_j = \alpha^*_{i.}$ The results of the analysis of these models are presented in Table 1 as follows

Table 1. Advantages Function Estimation Rice on wetlands and low tides in South Kalimantan

variable	Model I (OLS)		Model II (SUR) $\alpha^*_j{}^*_j \neq \alpha\,\alpha^*_i$		Model III (SUR) $\alpha^*_j = \alpha^*_i$	
	Parameter estimate	Pr> | t |	Parameter estimate	Pr> | t |	Parameter estimate	Pr> | t |
intercept	9.341583	<.0001	9.533575	<.0001	9.497539	<.0001
harga_bibit	-0.52325	0.1653	-0.79498	0.0311	-1.31486	<.0001
harga_pupuk	-1.10276	0.0033	-1.18153	0.0014	-0.83254	0.0136
harga_pestisida	-0.81849	<.0001	-0.86526	<.0001	-0.70904	<.0001
upah_tenagakerja	-0.8459	0.0236	-0.82907	0.0219	-0.93891	0.0026
land area	0.47296	<.0001	0.399009	<.0001	0.424655	<.0001
shrinkage	-0.07406	0.4312	-0.07332	0:42	-0.06638	0:46
curahan_TK	0.26368	0.0034	0.225956	0.0089	0.278995	0.0011
DM	0.383838	0.0389	0.484013	0.0077	0.727547	<.0001
R^2	0.83314		0.9247		0.9485	
F count	39.32		17:07		17.8	

Source: Primary Data Processing, 2016

Based on Table 1 it is known that the result of the estimation of the three models were used, each having a calculated F value is greater than the F table with a real level at 99% confidence level that indicates that the specifications of the variables described and explanatory variables included in the model already considered accurate and reliable. Of the value of F can also be concluded that all the independent variables (input) are included in the model jointly affect the independent variable (profit). The coefficient of determination ($R^{2)}$ each of which is greater 80% indicated that the three models are able to explain the total variation of the dependent variable with a high proportion or percentage and the remainder caused by other factors outside the model was built.

Estimation on the profit function model I (OLS) indicates that the 'F count very real (39.23) and the coefficient of determination ($R^{2)}$ amounted to 83.33%. The coefficient of determination 83.33% means that the profit function model *(independent variables)* are able to explain the diversity of approximately 83.33% of the total quantity of profit (UOP), while the remaining 16.672% is explained by other factors (which are not contained in the model). When compared with the model II which also has very real value of F count (17.07) with the coefficient of determination is greater than the model I that is equal to 92.25%, indicating that the use of the model II will yield a more reliable estimate.

By looking at the purpose of model selection to test the null hypothesis based on the estimated parameters are not biased, in this case the criteria of the standard error *(standard errors)*, estimation models II (SUR) looks better than model 1 (OLS). It is proved from the standard error on the model II for all of the parameters are calculated is smaller than the model I, thus giving more significance level. This fact gives an indication that the predicted simultaneously on two different equations using the SUR method gives better results than other methods, resulting in further analysis of the discussion based on the results of the model II (method SUR).

Variable price of seeds that have been normalized turned out to have coefficients that are negative on all models so that there is a negative relationship between the price of seeds with the rate of profit. In the second model of the coefficient of the price of seed by - 0.7949 and real at the level of 99%, with each increase in the price of seed by 10% caused a decline in profits of 7.95%.Variable cost of fertilizer has been normalized also has a coefficient that is negative on all models so that there is a negative relationship between the price of seeds with the rate of profit. The coefficient of fertilizer price - 1.181 and real at the level of 99% in model II, where any increase in price of fertilizer by 10% caused a decline in profit of 11.81%.

For the price coefficient value pesticide and labor costs has a negative correlation with the rate of profit, the price variable pesticides that have been normalized also has a coefficient that is negative on all models so that there is a negative relationship between the price of seeds with the rate of profit. The coefficient of fertilizer price - 0.8653 and real at the level of 99% in model II, where any increase in price of fertilizer by 10% caused a decline in profits of 8.651%. Likewise with variable labor costs have a coefficient of - 0.8291 and real at the level of 99% in model II, where any increase in price of fertilizer by 10% caused a decline in gain of 8.29%. At the cost of the equipment with a p-value of 0.42 at the 90% confidence level did not significantly affect profits for the contribution of farming equipment costs are generally low, while the acreage real effect on the 99% confidence level (p-value <0.0001) this is because with an area of land growing rice production will increase as well so that the total income of farmers will be greater.

The outpouring of labor input parameter is positive, ie, the greater labor input poured out, the greater the profit. The parameter values manpower real tangible effect on the 99% confidence level (p-value <0.0089). Under optimal conditions (Model III) where the maximum profit is reached, the effect of prices of input variables and the number of inputs remained significant except for the value of the equipment used due to differences in the value of the equipment is very small for various scales of production and the contribution value of the equipment to the entire cost required only minor of <10%. According to the table 1 can also be known that rice farming typology tidal swamp land are likely to receive a greater advantage than the rice farming in swampy wetlands. It can be seen from the dummy coefficient is positive for 0.7275 and real at the level of one percent.

3.3. Demand Function Input *(Factor Share)*

Input demand functions also called factor is defined as the share contribution (contribution) an input variable to a profit. Mathematically the demand function input variable *(factor share)* as an input variable contribution to profits can be derived from the Cobb-Douglas function profit. Estimation of demand function in two typology rice farm land in South Kalimantan in details are presented in Table 2 below.

Table 2. Estimation of demand functions rice farm on the marsh and tidal land in South Kalimantan

variable	Model I (OLS)		Model II (SUR) $\alpha^*_j{}^*_j \neq \alpha\,\alpha^*_i$		Model III (SUR) $\alpha^*_j = \alpha^*_i$	
	Parameter estimate	Pr> | t |	Parameter estimate	Pr> | t |	Parameter estimate	Pr> | t |
seedling	-1.38787	<.0001	-1.43741	<.0001	-1.31486	<.0001
Fertilizer	2.36434	0.0084	0.713043	0.2866	-0.83254	0.0134
Pesticide	-1.17318	<.0001	-0.46933	0.0253	-0.70904	<.0001
Labor	-2.52968	0.0053	-0.79792	0.2025	-0.93891	0.0025

Source: Primary Data Processing, 2016

In general, the law of demand explains that the lower the price of an item, the more demand for goods and conversely, the higher the price of an item the less demand for goods, in other words that the relationship between price and demand is inversely proportional.Based on Table 2 above shows that the model I and II model input demand is affected by input prices itself with a negative sign unless the demand for fertilizers, but on the model III where the maximum gain is achieved `all inputs are affected by the price with a sign negatively in accordance with the theory of demand. In conditions of maximum gain parameter value is reached the price of seeds is worth - 1,314 at 99% confidence level (p-value <0.0001) means that any increase in the price of seed by 10% caused a decline in demand for seedlings of 13.13%. Likewise, the price parameters of fertilizers, pesticides and labor, respectively effect on the input request itself with a confidence level of 99% to the value of each parameter is - 0,833; -0.709; and -0.939 which means that any increase in fertilizer prices, by 10% caused a decline in demand for fertilizer by 8.33%. The rise in prices of pesticides by 10% led to lower demand for pesticides by 7.09%, and rising labor costs, by 10% led to a decline in labor demand wage amounted to 9.393%.
Based on the value of the coefficient can also be seen that the demand for inputs of fertilizers, pesticides and labor inelastic to prices while input seeds / seedlings price-elastic.

3.4. Conditions on the business scale rice farming

Conditions scale acquisition *(return to scale)* of a farm needs to be suspected as an important analytical tool for decision making whether a farm should be increased, maintained or reduced scale of its business. The test results by function profit business scale are presented in Table 3 as follows:

Table 3. Testing Scala Business On Rice on wetlands and low tides in South Kalimantan

hypothesis	$\sum_{i=1}^{5} \beta_i^*$	**value F**	**probability**	**decision**
$H_0 : \sum_{i=1}^{m} \beta_i^* = 1$ $H_a : \sum_{i=1}^{m} \beta_i^* \neq 1$	.6369	3.22	.0138	Reject Ho

Source: Primary Data Processing, 2016

Based on the statistical test results in Table 3, it appears that the decision taken is rejecting the null hypothesis means that we reject the hypothesis that the observed rice farming in conditions of *constant returns to scale.*Total regression coefficients of input = 0.6369 which is less than one indicates that rice farming conditions studied on the condition scale declining businesses *(decreas'ng returns to scale).* This fact shows baliwa if all inputs duplicated one will cause increases in rice farming profits with a smaller proportion of one. In other words, that the rate of increase of all inputs is greater than the rate of increase in the rate of profit.

3.5. The level of relative economic efficiency of rice farming in lowland swamps and tidal

The estimation of the relative economic efficiency of lowland rice farming wetlands and tidal done using the Cobb-Douglas function advantages that using a dummy.Technical efficiency tests performed by test dummy variables, whereas to test the efficiency of the price used is estimated the demand function-associated-operation between the two groups of types of land. The results of testing the efficiency relative to both the farming groups are presented in Table 4 below.

Table 4. Relative Efficient Testing Results Rice Farming in the swampy wetlands and tidal land

examination	Technical efficiency relative	Efficiency relative prices	The relative economic efficiency
The null hypothesis (Ho)	$\Omega_0 = \Omega_1$	$\alpha^p{}_i = \alpha^t{}_i$	$\Omega_0 = \Omega_1$ $\alpha^p{}_i = \alpha^t{}_i$
Alternative hypothesis (Ha)	$\Omega_0 > \Omega_1$	$\alpha^p{}_i > \alpha^t{}_i$	$\Omega_0 > \Omega_1$ $\alpha^p{}_i > \alpha^t{}_i$
test scores	28.77	4.96	9.72
probability	0.0001	0.0007	0.0001
Decision	Reject H_0	Reject H_0	Reject H_0

Source: Primary Data Processing, 2016

Hypothesis testing results above show that the technical efficiency of generating real probability value at a level of 95% so that it can be concluded that rice farming which is in the tidal area have higher technical efficiency than rice farming in swampy wetlands. The soil type affect a farmer's behavior in combining resources. Where the regulation of water demand can cause farmers in the tidal area is able to allocate resources to obtain a higher output than the farmers who use the land swampy marsh.Testing the efficiency of relative prices and relative economic efficiency between the two groups showed that the farm there is significant with 99% confidence level. so that rice farming in tidal land has a price efficiency and economic efficiency is higher than rice farming in swampy wetlands.

IV. Conclusion and Recomendation

Conclusion :

1. Production of rice in the research area and significantly influenced significantly by seed, fertilizer, and labor.
2. Production facilities in the study area is very influential on rice farming profits so an increase in production means a high price will lead to a decrease in profits, which in turn will lower the level of welfare of farmers. This is reflected in the estimate of the price of production factors, all of which negatively affect profits.
3. Under optimal conditions (Model III) where the maximum profit is reached, the effect of prices of input variables and the number of inputs remained significant except for the value of the equipment used due to

differences in the value of the equipment is very small for various scales of production and the contribution value of the equipment to the entire cost required only minor of <10%.

4. Based on input demand function coefficient of fertilizer, pesticides and labor inelastic to prices while input seeds / seedlings price-elastic.
5. padi farm the area of research has business scale and rate of increase results m enurun *(decreasing returns to scale).* This indicates that the input gain is higher than the increase of results (profit rate), so that if a farmer wants improved profits, the average cost will also increase with the number of propersi higher.
6. Rice farming in the tidal area have relative technical efficiency, efficiency in relative prices and economic efficiency is relatively higher than i pad farming in swampy wetlands.

Recomendation :

1. Because the prices of means of production in the research area is very influential on the profitability of rice farming so that the increase in prices of production means that high will cause a decrease in profits, the government support for farmers is very necessary, especially with regard to the provision of the means of production, for example, subsidizing the provision of fertilizers and drugs as well as the drugs of the ease in the provision of farm credit ,
2. Given the level of profit achieved manufacturer is not only determined by the size of production but also by the price - the price of input and output then when the growing season has arrived, the government took a controlling role in the smooth distribution of the means of production, especially the availability of fertilizer and other inputs price stability.
3. Based on the result of analysis which concludes that rice farming in a state of *decreasing returns to scale,* efforts to increase profits needs to be done carefully due to the average cost of inputs will also increase with a p r oporsi higher than the increase in keiintungannya.

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