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Productivity Functions And Technical Efficiency, Ineffciency of Rice Field Farming in Muaro Jambi District Jambi Province – Indonesia

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Abstract
This study aims to analyze (1) Functions of productivity and technical efficiency of rice paddy farming inputs, (2) Factors that cause technical inefficiencies of wetland rice farming.Technical efficiency and technical inefficiencies of using production inputs are used by the Kochhakar Productivity Function with Stochastic approach. frontier.The research area was determined purposively, the number of samples was 90 farmers using the Slovin method and sample collection using the Simple Random Smpling method.The research was conducted on 10 March to 10 October 2020. The results showed that the productivity response was simultaneously and significantly affected by the use of production inputs All production inputs have a positive elasticity of productivity. Partially organic fertilizer and liquid insecticide urea have a very significant effect on rice productivity. Use of seeds, SP36 fertilizer, and KCl fertilizer has a significant effect on productivity. rice farming, while labor does not significantly affect rice productivity Technical efficiency is classified as inefficient. Socio-economic factors that reduce technical inefficiencies are farming experience, dependency ratio, activity in farmer groups. Whereas age, land area and distance of land with farm houses increase technical inefficiency. Factors that do not have a significant effect on technical inefficiency are formal education

Keywords : *Efficiency, Ineficiency, Productivity Functions, Technical*

I. INTRODUCTION

Rice is an agricultural commodity that has an important meaning for the population of Indonesia, because it is a staple food of the people of Indonesia. Rice commodities have the main function as a supplier of national food and until now the function has not been replaced by other commodities. The need for rice never goes down, but it always increases according to population growth as the factor that most determines the amount of demand for rice. Therefore the increase in rice production is one of the programs that is prioritized by the government through intensification, extensification, seed, fertilizer and capital assistance for farmers.

The use of certain production inputs will produce maximum output that can be produced from every possible level of production. Each input used is called technical efficiency, while the use of certain production inputs limits the acquisition of maximum production amounts said technical inefficiency. The low efficiency is a reflection of the gap between the average production produced by rice farmers and the maximum production potential that can be produced. The gap occurs because of the socio-economic factors of farmers who do not support so that it influences the results of their farming, where with low capital the community is not fully able to buy inputs with a predetermined amount so that in carrying out their farming they do not get maximum productivity. it means that by using certain cultivation techniques farmers still cannot produce the maximum production.

Research on rice paddy states that the average productivity of rice in Indonesia reaches 7 tons per hectare (Hasibuan, 2015). However, the productivity of rice paddy in Jambi Province has not reached that number. Low productivity figures occur because the use of inputs in rice paddy farming has not been optimal, thus affecting the technical efficiency of rice farming. The use of a production factor is said to be technically efficient if the production factors used produce maximum production (Tasman, A 2008). To produce maximum rice production, it must be supported by adequate facilities and infrastructure. Combination of the use of production inputs influences the technical efficiency of rice field farming. Technical efficiency is closely related to economic inefficiency. Rice paddy farming has not been technically efficient, presumably because of several internal and socio-economic factors which are sources of technical inefficiencies.

II. RESEARCH METHODOLOGY

This research was conducted in Sekernan District, Muaro Jambi Regency. The selected villages are Sekernan Village, Pulau Aro Village and Rantau Majo Village. Sampling is done by Simple Random Sampling Method using random tables, the population is 976 farmers. The sample size was determined by using a formula from Taro Yamane to obtain 90 sample farmers, namely Desa Sekernan 36 farmers, Pulau Kayu Aro Village 29 farmers and Rantau Majo 25 farmers. For productivity functions the level of technical efficiency and technical inefficiencies using a model developed by Kumbhakar (2002) . The functional form

$$yi = \alpha_0 \Pi_{j=1}^{10} X_{ij}^{\alpha j} + \beta_0 \Pi_{j=1}^{10} X_{ij}^{\beta j} . e^{vi} - \gamma_0 \Pi_{j=1}^{10} X_{ij}^{\gamma j} . e^{ui}$$

The above model states that the amount of productivity of rice paddy is influenced by the function of average productivity, function of productivity risk and function of technical inefficiency. In this study the risk of productivity of rice paddy farmers is considered the same so that to analyze the level of technical efficiency and technical inefficiency of productivity of rice paddy can use a model with its functional form:

$$yi = \alpha_0 \Pi_{j=1}^{8} X_{ij}^{\alpha j} - \gamma_0 \Pi_{j=1}^{8} X_{ij}^{\gamma j} . e^{ui}$$

Where :

α_0 Π_ (j = 1) ^ 8 X_ij ^ αj: The average productivity function

γ_0 Π_ (j = 1) ^ 8 X_ij ^ γj.e ^ ui: Technical inefficiency function

Yi: Amount of productivity of paddy rice (kg / ha)
X1: Amount of rice seeds (kg / ha)
X2: Amount of urea fertilizer (kg / ha)
X3: Amount of SP36 fertilizer (kg / ha)
X4: Amount of KCL fertilizer (kg / ha)
X5: Amount of organic fertilizer (kg / ha)
X6: Amount of liquid insecticide (l / ha)
X7: Total workforce (HOK / ha)
X8: Land area of wetland rice farming (ha)
ui: Technical inefficiency assuming i.i.d (0, σu) 2 and u> 0, ui independent of vi.

The expected sign for each parameter is α_1-α_7> 0; β_1-β_7 <0 or β_1-β_7> 0; and γ_1-γ_7 <0 or γ_1-γ_7> 0. The estimation of the model is done using the Maximum Likelihood Estimation (MLE) method.

Analysis of sources of technical inefficiencies uses a model of the effect of technical inefficiencies by Battese and Coelli (1995) in Qomaria (2011):

TI = δ_0 + δ_1 Z_1 + δ_2 Z_2 + δ_3 Z_3 + δ_4 Z_4 + δ_5 Z_5 + δ_6 Z_6 W_i

Where :

TI: Value of technical inefficiency
Z1: Age of farmer {years}
Z2: Farmer's formal education (year)
Z3: Experiences of farmers in paddy fields (years)
Z4: Number of family members (people)
DZ5: Dummy variables Active in farmer groups (active = 1, less active =
0)
Z6: Distance of {meter} houses.
Z7: Land area {acres}
Wi: Random errorterm is assumed to be free and the distribution is cut off normally by N (0, σ ^ 2).

III. RESULTS AND DISCUSSION

A. *Farmer Identity*

The age of farmers is in the range of 27-58 years, averaging 43.5 years. Farmers have a ratio of 4-5 people. Formal education, elementary school as many as 31.25%, junior high school as much as 27.5%, high school as much as 22.5%, D3 as much as 1.25%, S1 as much as 1.25% and 16.25% did not complete elementary school. The experience of cultivating rice paddy ranges from 15-33 years. Most of the experience of farming is 20-27 years at 57.5%. The distance between paddy farming land and the largest farmer's house is 500-1200 meters, 75% of farmers.

B. *Use of Production Inputs on Rice Farming*

The land area ranges from 0.2 - 0.95 ha, on average 0.42 ha per farmer and the variation coefficient (CV) is 12.3%. The use of seeds ranges from 10-15 kg, an average of 12.5 kg / ha and a CV of 9.7%. Urea fertilizers range from 75 - 130 kg, on average 85.4 kg / ha and CV at 20.3%. SP 36 fertilizer ranges from 35 - 70 kg, on average 42.5 kg / ha and CV is 16.7%. KCl fertilizer ranges from 15 - 40 kg, average of 22.5 kg / ha and CV is 17.2%. Organic fertilizers range from 500 - 1,500 kg, on average 820 kg / ha and CV is 32.1%. Insecticides range from 400 to 750 ml, an average of 530 ml / ha and cv of 28.6%. The workforce ranges from 95-110 HOK, an average of 88.3 HOK / ha and CV of 22.3%.

According to Balitbang (2013) and the Center for Rice Research (2015), the recommendations for the use of production inputs are seeds 15-20 kg / ha, urea fertilizer 150 - 250 kg / ha, SP 36 50 kg / ha, KCl 60 kg / ha, 2000 kg organic fertilizer / ha. Prasisika (2007) that the optimal use for insecticides ranges from 1500 - 2500 ml / ha, labor 120.5 - 145.3 HOK / ha and land area of 1.25 ha. This data shows that the use of production inputs in rice farming is all below the recommended number.

C. *Estimating the Productivity Function of Rice paddy Farming*

The results of the estimation of productivity functions can be seen in Table 1 Value of Adj. R2 = 0.8767, means that 87.67% of variation in productivity is able to be explained simultaneously by variable seeds, SP36 urea fertilizer, KCl fertilizer, organic fertilizer, liquid insecticide, and labor while the remaining 12.33% is influenced by other factors outside the model .

Table 1. Results of Estimating the Productivity Function of Rice Field Farming Using the MLE Method, 2020

Variable	Coefficient	Std. Error	z-Statistic	Prob.
LN_X1	0.0746	0.0212	3,5084	0.0321
LN_X2	0.6476	0.0956	6,7700	0.0000
LN_X3	0,1134	0.0433	2,6177	0.0167
LN_X4	0.1096	0.0622	1,7607	0.0254
LN_X5	0.3245	0.0453	7,1542	0.0001
LN_X6	0.2864	0.0201	4,2978	0.0002
LN_X7	0.0316	0.0400	0,7916	0.1673
C	4.1333	0.3370	12,262	0.0000

R-squared	0.877623	Mean dependent var	0,314000	0.314000
Adjusted R-squared	0.856467	S.D. dependent var	0,24212	0.024212
S.E. of regression	0.013452	Akaike info criterion	-5,447243	-5.447243
Sum squared resid	0.011724	Schwarz criterion	-5100431	-5.100431
Loglikelihood -	219.1425	Hannan-Quinn criter.	-5,104523	-5.104523
F-statistic	48.53244	Durbin-Watson stat	1,356263	1.356263
Prob(F-statistic)	0.000000			

Based on the results of the analysis obtained F-stat, amounting to 79.57 with prob. 0.0000 <I = 1.407749βα (0.01) shows different results that are very real, meaning that the production response is simultaneously affected by the use of production inputs. The value of ∑> 1 means that the input-output relationship is in area II of the production curve (Increasing Return To Scale).

The variable urea fertilizer (X2), organic fertilizer (X5) and insecticide (X6) provide a positive sign of elasticity of productivity of 0.86476, 0.3246 and 0.2865. If there is an addition of urea fertilizer, organic fertilizer, and insecticides of 10% each, it will increase productivity by 8.65%, 3.25%, and 2.87% under conditions of other fixed inputs, variable urea fertilizer (prob, 0 , 0000 <α (0.01), organic fertilizer (prob, 0,0002 <α (0,01), and insecticide (prob, 0,00201 <α (0,01). This means the use of urea fertilizer, fertilizer organic, and insecticides partially have a very significant effect on the productivity of rice farming.

Seed variable (X6), SP36 fertilizer (X3) and KCl fertilizer (X4) have positive elasticity values for productivity of 0.0935, 0.1373 and 0.1133, respectively. If there are additional seeds, SP36 fertilizers, and KCl fertilizers of 10% each, it will only increase production by 0.76%, 1.314%, and 1.10%, under conditions of other fixed input usage. Seed variables (prob, 0.0321 <α (0.05), SP36 fertilizer (prob, 0.0167 <α (0.05) and KCl fertilizer (prob, 0.0254 <α (0.05). This means that the seeds, SP36 fertilizer and KCl fertilizer partially have a significant effect on rice farming productivity, while the labor variable (X7) has a value of elasticity to productivity of 0.0517. If there is an additional use of labor by 10%, it will increase productivity by 0, 52% in the condition of the use of other inputs remain Labor variable (prob. 0,167> α (0,05). This means that labor partially has no significant effect on the productivity of rice farming.

The results of Sutawati (2014) regarding the use of seeds, SP 36 and KCl fertilizers have not been optimal and have no significant effect on the productivity of rice paddy farming. The response of production to urea fertilizer, insecticides and labor is positive and very significant. Damayanti (2014), that the use of urea, SP 36, organanic fertilizers and insecticides had a positive and significant effect on the technical efficiency of rice farming. Nurani (2014) that the addition of the use of KCl and SP36 fertilizers was negatively marked by the productivity of rice paddy farming. The addition of urea fertilizer, organic fertilizers and insecticides has a positive and very significant sign of the technical efficiency of rice farming. Firmana (2016) that the elasticity of urea, SP 36, organic fertilizers and insecticides is positive for productivity means that the four production inputs can increase the value of technical efficiency of Prasiska (2007) rice farming, only urea, insecticides and labor have a positive effect and real on increasing productivity of rice farming.

D. Farming Technical Efficiency

Technical efficiency is a reflection of the company's ability to get maximum output from a set of available inputs. Defined as the ratio of actual production from farmers to the technical level of maximum production possibilities. The value of technical efficiency is inversely related to the effects of technical inefficiency. The value of farmers' technical efficiency is categorized as quite efficient if TE> 0.7 and categorized as not efficient if TE ≤ 0.7 (Qomaria, 2011). Table 2 shows that the average technical efficiency of wetland rice farming is 0.6344. This shows that the average productivity achieved by rice paddy farmers is around 63.44% of frontier productivity. The efficiency of using production inputs can still be improved to achieve frontier productivity of around 36.56%. When compared with the research conducted by Firmana (2016), the average technical efficiency of rice farming in Kalibuya Village is 0.899. This shows that the average rice paddy farming in the study area has not been technically efficient and is still below other regions.

Table 2. Technical Efficiency of Rice paddy Farming in Muaro Jambi District

Efisiensi Teknis	Jumlah Petani	Persentase
0,49-0,54	8	8,90
0,55-0,60	45	50,00
0,61-0,66	24	26,60
0,67-0,72	10	11,10
0,73-0,78	3	3,40
Total	90	100
Efisiensi Teknis Terendah	0,5235	
Efisiensi Teknis Tertinggi	0,7656	
Rata-Rata Efisiensi Teknis	0,6344	

Effect of Socio-Economic Factors on Technical Inefficiency of Rice paddy Farming Technical studies that have not been used in the use of inputs are still explained by other factors outside the model which are referred to as irregularities in farming or technical inefficiencies. One of the factors causing not included in the production process is the socio-economic factors in Table 3, showing the value of Adj. R2 = 0.8565, all technical imperfections can be carried out simultaneously by the economic balance variable of 85.65%. F stat values, 44.53 with (prob, 0.0000 <alpha 0.01), and values of discomfort may be used in real terms.

Table 3. Results of Estimated Sources of Technical Inefficiency

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Z1	0.0563	0.0121	4,6323	0.0000
Z2	-0.0029	0.0021	-1,4080	0.2552
Z3	-0.0235	0.0061	-3,8416	0.0114
Z4	-0.0134	0.0066	-2,0168	0.0056
DZ5	-0.0874	0.0026	-32,931	0.0002
Z6	0.0096	0.0020	4,7243	0.0043
Z7	0.0257	0.0056	4,5705	0.0006
C	0.2975	0.0422	7,0423	0.0000

R-squared	0.877623	Mean dependent var	0.314000
Adjusted R-squared	0.856467	S.D. dependent var	0.024212
S.E. of regression	0.013452	Akaike info criterion	-5.447243
Sum squared resid	0.011724	Schwarz criterion	-5.100431
Log likelihood -	219.1425	Hannan-Quinn criter.	-5.104523
F-statistic	48.53244	Durbin-Watson stat	1.356263
Prob(F-statistic)	0.000000		

Age (Z1), has a positive and real effect on technical inefficiencies, meaning that as farmers grow older, technical inefficiencies increase or young farmers are more technically efficient compared to older farmers. This research is in line with Fauziyah (2010) and Saptana (2011) research that increasing age of farmers will reduce productivity as a consequence of reduced work productivity. Formal education (Z2), has a negative sign but does not have a significant effect on technical inefficiency. The results of the Tanjung (2003) study that education has a negative effect on farming technical efficiency.

Business experience (Z3), is marked with a negative and tangible effect on technical inefficiencies. That is, the more experience with more farming, the farmer will allocate the use of inputs more technically efficient. The same thing was obtained by Firmana (2016) that farming experience had an and not significant effect on increasing the technical efficiency of rice farming. Dependency ratio (Z4), has a negative effect on farming technical inefficiencies. The number of family members can affect labor used in rice farming. The results of this study are in line with Saptana's research (2011) which shows that the ratio of the number of working-age household members to total household members has a negative but not significant effect on the technical inefficiency of curly red chili farming in Central Java Province.

Activity in farmer groups (DZ5), has a negative and very real effect on technical inefficiencies. The liveliness of farmers in farmer groups has an impact on increasing technical efficiency. This is in line with the results of Hartoyo's (1996) study that farmer groups have a positive effect on technical efficiency because farmer groups can provide benefits to farmers in terms of knowledge and technology. The distance between the land and the farmer's house (Z6) has a positive and significant effect on rice farming. That is, the farther away the farmer's house from his farm, the technical inefficiency will increase. Land area (Z7) has a positive and real effect on technical inefficiencies of rice farming. A positive sign on the land variable shows that farmers who have large land tend to have a higher level of technical inefficiency Farmers who have narrow land are relatively more technically efficient compared to farmers who have large land because the managerial and capital capabilities of farmers are an obstacle. If farmers have better managerial skills and sufficient capital in farming, smallholders and farmers with large land will have the same level of efficiency.

IV.CONCLUSION AND POLICY IMPLICATIONS

Production response to production inputs (land area, urea, organic fertilizer, SP 36 and insecticides is significant. Actual production inputs used by farmers are not in accordance with recommended dosages. There are gaps in farmers' real production with frontier production. Rice farming has not been efficiently seen from the amount of TE is 0,6344 smaller 0,7 This means that there are still opportunities for increasing production by 36,56 percent The source of technical inefficiencies that influence the response of production other than the use of production inputs is the socio-economic factor of peas. and the distance between the land and the farmer's house increases technical inefficiencies, while the farming experience, the dependency ratio and the activity of farmers in the farmer group reduces technical inefficiencies. The policy for increasing technical efficiency is needed subsidized production facilities that are right at the price. work for farmers and pumping for irrigation. Another policy is to motivate farmers to adopt and innovate technology obtained by farmers through counseling.

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