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by Zainul Hasan

Submission date: 20-Nov-2023 03:15PM (UTC+0700)
Submission ID: 2233986064
File name: Turnitin_REF_V_J._NURUL_AENUNNISA_MIESP_UNDIP_2021_edited.doc (185.5K)
Word count: 4558
Character count: 24244

Economic Efficiency of The Rice Farming Production Factors in Karawang Region

Nurul Aenunnisa[1], Zainul Hasan[2], Nun Maulida Suci Ayomi[3]
[1, 2]Master of Economics, Faculty of Economics and Bussines, Diponegoro University
[3]Master of Agriculture, Faculty of Animals and Agriculture, Diponegoro University.
Jl. Prof Soedarto, SH. Tembalang, Semarang, Central Java.
nurulaenunnisa@student.undip.ac.id

ABSTRACT

During the pandemic the population's need for food is increasing. If the pandemic lasts longer, it is feared that a food crisis will occur, because residents will scramble to stock up on food. This study aims to analyze the efficiency level of rice productivity and the determinants that affect rice productivity to face the food crisis. This study uses secondary data and primary data, obtained from interviews. The data analysis method used is the Cobb-Douglas Stochastic Frontier Production Function approach with the Maximum Likelihood Estimation (MLE) method and multiple linear regression, which is obtained using Stochastic Frontier Analysis and E-Views 8 analysis tools. Production of land area, seeds and pesticides have a significant effect on rice production in Karawang Regency. While the use of production factors of urea fertilizer, NPK fertilizer, SP36 fertilizer and labor did not have a significant effect on rice production in Karawang Regency. The level of technical efficiency in rice farming in Karawang Regency reaches 0.9607 which indicates that rice farming is technically close to efficient. The combination of the use of land area production factors, seeds, urea fertilizer, SP36 fertilizer in rice farming in Karawang Regency has not yet reached the optimal point that is economically efficient. The level of elasticity of production in rice farming in Karawang Regency reaches a value of 1.3971 so that rice production has a scale that is increasing return to scale.

Keywords : Efficiency, *Return To Scale, SFA*

INTRODUCTION

The increasingly widespread spread of the COVID-19 pandemic has prompted the government to do work from home, Physical distancing, regional quarantine which has an impact on changing conditions in all aspects of life, including changes in systems and performance patterns in the sector. food. This change has become a concern for the community in food security because food security is a basic need for everyone, so it is normal for various parties to discuss it.

The availability of food during the COVID-19 pandemic holds important attention because it can affect the food crisis if it is not managed properly. The role of farmers as producers in the availability of food is a dilemma. On the one hand, the pandemic has provided a policy for physical distancing, on the other hand, the pandemic has pushed food needs to remain stable where it is predicted that there will be demand for the same food consumption even though activities in the community are limited.

The basic problem that has become a concern in policy making in the agricultural sector, especially the food sub-sector, is the relatively low level of productivity in some areas. Areas experiencing a decline in food supply, especially rice commodities, are areas that produce lower production than the average value of national production. Therefore,

special interventions are needed in some of these areas to increase rice production to meet food needs.

From a production perspective, farmers have a major role in producing rice productivity. This role is related to the ability of farmers to allocate various inputs of production factors efficiently which is expected so that farmers can obtain maximum results in rice farming, where as if farmers are at a low level of efficiency of production factors, farmers still have not maximized production results in their farming (Rivanda, Nahraeni, & Yusdiarti, 2015a). The level of efficiency that reaches the maximum will have an impact on farmers' income. The less precise combination and number of production factors will have an impact on the low output produced or high production costs incurred (Miftachuddin, 2014). Many research findings show that the productivity of rice farming in some parts of Indonesia is still not efficient (Ayomi, Setiawan, & Santoso, 2017; Miftachuddin, 2014; Putra, Antara, & Oka Suardi, 2018; Rivanda, Nahraeni, & Yusdiarti, 2015b). Meanwhile, research findings from (Kusnadi, Tinaprilla, Susilowati, & Purwoto, 2011a) show that the productivity of rice farming in Java is efficient. The difference in the findings of this study is, of course, based on various factors of production.

Many factors affect the efficiency of rice farming productivity. Production input factors in the form of seeds, fertilizers, and labor are factors that can increase agricultural productivity (Putra et al., 2018; Rivanda et al., 2015a; Suharyanto, 2015b). Meanwhile, according to Listiani, Setiadi, & Santoso, (2019a); Marwah, (2012) hese variables do not have a significant effect on the productivity of rice farming.

In terms of productivity, in 2019 Karawang Regency was in sixth place after Majalengka Regency. Of course this is contrary to the level of rice production in Karawang Regency which ranks second. From this problem, it certainly becomes a big question, whether the rice production system in Karawang Regency has reached efficiency? Can Karawang Regency become one of the Regencies whose production system can be adopted for areas that are still below the national average production?.

Meanwhile, in the midst of the Covid-19 pandemic, apart from causing a health crisis and an economic crisis. there is another fundamental problem, namely the food crisis. Due to social restrictions and social interaction patterns have changed drastically. As a result, the distribution chain pattern is hampered on all fronts, including food. The findings of (Jusriadi et al., 2020) research that Indonesia is threatened with a food crisis due to the stock of rice reserves controlled by the Government through the Logistics Affairs Agency (BULOG) is only available for a few months. Plus, many people then stockpile food just in case when the pandemic continues.

Based on the above problems, efforts to mitigate the food crisis are urgently needed through increased production. The measure that can be done is with production efficiency. Thus, efficiency is the most important thing to note. This study tries to break down several variables into more specifics, one of which is

fertilizer, into NPK, UREA, and SP36. The description above encourages researchers to analyze production factors including land area, seeds, urea fertilizer, NPK fertilizer, SP36 powder, pesticides and labor on production results and analyze the efficiency level of rice farming production factors in Karawang Regency in mitigating the food crisis.

METHODS

The research was conducted in March 2020 after the Covid-19 pandemic was detected in Indonesia. This research was conducted in three sub-districts with the highest rice production in Karawang Regency in 2017, namely Tirtamulya, Banyusari, and Kota Baru Districts. Sources of data in this study using primary data and secondary data. Where the primary data obtained through the survey method. The survey was conducted by means of farmer interviews guided by a questionnaire. The questionnaire submitted includes farming data. Number of samples in primary data collection based on Quota Sampling withdetermination of respondents purposive. In addition to primary data, this study also uses secondary data collected from agencies or institutions including the Indonesian Central Statistics Agency.

The analysis used in this study is to measure production efficiency which consists of technical efficiency, allocative efficiency and economic efficiency. Technical efficiency is done by using the production function Stochastic Frontier Cobb-Douglas. The production function Stochastic Frontier Cobb-Douglas is easier to use by transforming it in the form of a linear regression equation which is converted into a linear double log. If the value of the form of the equation $e^p = 1$ then the production activity is in a condition of Constant Return to Scale, if $e^p > 1$ then production activity is in Increasing Return to Scale condition, if $e^p < 1$ then production activity is in Decreasing Return to Scale condition. In the production function, the factors that are expected to affect production in this study are land area, number of seeds, amount of urea fertilizer, amount of NPK fertilizer, amount of SP36 fertilizer, amount of pesticides, HOK of labor. By entering 7 relevant variables into the stochastic frontier equation, the following equation can be written:

$$\ln Y = \ln a + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + v_i u_i$$

Where: Y = Rice Production (tons/Periode)
X_1 = Land Area (ha/Periode)
X_2 = Seed (Kg/Periode)
X_3 = Urea Fertilizer (Kg/Periode)
X_4 = NPK Fertilizer (Kg/Periode)
X_5 = Fertilizer SP36 (Kg/Periode)
X_6 = Pesticide (L/Periode)
X_7 = HOK Labor (Days/Periode)
$v_i u_i$ = error term.

To answer the value of technical efficiency, it can be done byanalysis tool using the Stochastic Frontier Analys software (SFA) version 4.1C. processing results software SFA according to (Mukhlis, 2020)will give an estimate of a variance from the expected parameter, which is close to 1, which means the error value comes from the inefficiency factor. The results of the software frontier produces an estimate of the value of the MLE and OLS likelihood logs which according to (Akkaya, 2016) reveals a good value when the MLE probability value is> OLS and it

can be interpreted that this value is in accordance with the conditions that occur in the field. And if the error term has a small value, it means that the inefficiency value is normally distributed.

In addition to testing technical efficiency, then allocative efficiency analysis can be used with mathematical calculations in accordance with Afriani et al., (2018) theory, namely as follows:

$$\frac{NPMx1}{Px1}=\frac{NPMx2}{Px2}=\frac{NPx3}{Px3}\ldots\ldots\frac{NPMxi}{Pxi}=1$$

The interpretation of the results of the allocative efficiency analysis can be categorized as follows: NPMxi/Pxi = 1, then the use of production factor x_i has achieved allocative efficiency economically. NPMxi/Pxi > 1, then the use of production factor x_i has not achieved allocative efficiency economically. NPMxi/Pxi < 1 , So the use of the factor of production x_i is not economically allocative efficiency. From the results of technical efficiency and allocative efficiency, it will then produce economic efficiency. Afriani et al., (2018) revealed that economic efficiency is the result of multiplying all technical efficiency with allocative efficiency of all input factors and economic efficiency will be achieved if both (technical and allocative) efficiency are achieved. Systematically can be expressed as follows:

$$E^e = E^t . E^a$$

Where: E^e = Economic Efficiency
E^t = Technical Efficiency
E^a = Allocative efficiency,

Knowing the effect and relationship, then analyzed using F test and test using multiple linear regression analysis tool with software Eviews 8. Where the F test is used to simultaneously determine the effect of production factors (land area, number of seeds, amount of urea fertilizer, amount of NPK fertilizer, amount of SP36 fertilizer, amount of pesticides, HOK Labor) on rice production. and t-test is used to determine the relationship between each variable.

RESULTS AND DISCUSSION

General Description of Respondents

The results of the study showed that of the 90 farmer respondents, 31.11% were aged between 41-50 years, 28.89% were farmers aged 31-40 years, and 25.56% were farmers aged 51-60 years. And the average farmer respondents are 49 years old. farmers with 49 years of age are still in productive age so that farmers can still maximize their productivity.Yuliana, Ekowati, & Handayani, (2017) revealed that the age of the farmer will affect the physicality of an farmer in carrying out farming activities. Kusnadi, Tinaprilla, Susilowati, & Purwoto (2011) also revealed that farmers who are younger than 60 years will produce more efficient farming and the age of farmers aged ta will reduce efficiency so it is necessary to increase the regeneration of young farmers so that rice farming production will be higher. Farming in Karawang Regency is dominated by farmers aged 41-50 years due to the view of farmers there that they expect their children not to work as farmers.

Karawang Regency is an industrial center area so that young people have a high interest in working in the industrial sector compared to working as farmers.

The education level of 53.33% of respondents is at the level of final primary school education (SD). This shows that farmers' education is dominated by low education so that it becomes a problem in increasing production. Conditions in the field of farmers with low education generally find it difficult to adapt to new technologies. Yuliana et al., (2017) revealed that the level of education of farmers greatly influences the behavior patterns of farmers and the application of more modern agricultural technology. Kusnadi et al., (2011) argue that there is a need for the government's role in handling farmers' education and knowledge where higher education will affect the mindset, which will be more open in receiving all information, easier to adapt and increase technology adoption. So that it can increase the value of efficiency in agriculture In Kabupaten Karawang, people think that working as a farmer does not require a high level of education. Education is not a qualification to become a farmer, but in fact education is a factor that affects the increase in farmer productivity.

The duration of farming from the research respondents showed that the length of the rice farming business was 32.22%, dominated by farmers who had been farming for 31-40 years. This shows that the dominance of rice farming in Karawang Regency has had a lot of experience and has been said to be an expert in the field of farming because it has exceeded the age of 10 years. Yuliana et al., (2017) revealed that farmers who have been farming for more than 10 years have good experience and knowledge in running their farming. Suharyanto (2015) also revealed that the business experience possessed by farmers can be an opportunity for farmers to use production inputs in an efficient manner.

The Relationship of Production Factors to Rice Farming Production Results in Karawang Regency

Table 1. F Test Results

	Value
F-Statistic	426.0880
Prob (F-Statistic)	0.000000

Source: Primary Data, 2020.

Table 2. Output Efficiency Stochastic Frontier Analysis

	Coeffisient	Standard Error	t-Ratio
Beta 0	1.0095	0.0191	1.1083
Beta 1	0.7071	0.0028	0.9745
Beta 2	0.1835	0.0215	0.8494
Beta 3	-0.0813	0.1590	-0.8094
Beta 4	-0.0039	0.9495	-1.1559
Beta 5	-0.0830	0.2041	-0.6041
Beta 6	-0.0258	0.0352	-0.4678
Beta 7	0.3146	0.0532	0.5678
Likehood MLE		0.7853	
Likehood OLS		0.6180	
Mean Efficiency		0.9607	

Source: Primary Data, 2020.

The results of the analysis to determine the relationship between production factors (Xi) and production yields (Y) were carried out using theefficiency production function Cobb-Douglas. Where estimate the regression model as follow:

$Ln(Y) = 1.0095 + 0.7071*Ln(X_1) + 0.1835*Ln(X_2) - 0.0813*Ln(X_3) - 0.0039* Ln(X_4) - 0.0830*Ln(X_5) - 0.0258*Ln(X_6) + 0.3146*Ln(X_7)$

Results of regression processing with software Eviews 8 shows that the adjusted R value of^2 0.9732 or a percentage of 97.32%. The interpretation of this value is that the seven independent variables included in the regression model can explain the diversity of production with a value of 97.32%, the remaining 2.68% is the value of other independent variables that are not examined or are outside of the seven established models. Rente, (2015) in his research Produce that coefficient of determination (Adjusted $R^{2)}$) Reached the 0,861 This suggests that 86 % variety of rice production described by independent variables in the model.) Simultaneously the production factors (land area, number of seeds, amount of urea fertilizer, amount of NPK fertilizer, amount of SP36 fertilizer, amount of pesticide, and labor HOK) on rice production in Karawang Regency were carried out by testing the F test with a 95% confidence level.

The results of the F analysis test showed that the significance value of Prob (F-Statistic) was 0.000000. Prob value (F-Statistic) < =5% or 0.00 <0.05. and the calculated F value > from F table or 426.0880 > 2.11 From these results it can be concluded that simultaneously the production factors of land area, number of seeds, amount of urea fertilizer, amount of NPK fertilizer, amount of SP36 fertilizer, amount of pesticides and HOK of labor affect rice productivity in Karawang Regency with a confidence level of 95%. Research result Ellyta & Hironimus (2016) the use of the same area of land production factor , the seed , fertilizer urea , fertilizer npk , fertilizer sp36 , pesticides and labor produce count the F > F value table and value of lacking significance of 0.05 So that it can be in interpretation that simultaneously had have real impact on the volume of production Rustam (2013) also said the simultaneously land, seeds, fertilizer urea, fertilizer npk, fertilizer sp36, pesticides and labor significant impact on produce.

The results of the partial correlation analysis based on table 2 can be seen that the significance of the production factor of land area has a value of 0.0028, this value shows the value of sig. Land area <0.05 (α=5%) means that the production factor of land area has an influence on rice production. Land for farmers in Karawang Regency is generally leased land that is cultivated by farmers, but there are still many farmers who own private land. The average land area of farmers in Karawang Regency in this study is 5.022 Ha. The average land area in Karawang Regency is classified as high land area. Juliyanti & Usman (2018) revealed that farmers who use wider farming land will produce higher production and thus the income and welfare of farmers will increase. Ayomi, Setiawan, & Santoso (2017) revealed that land area is the main capital in rice farming if without land area, farmers will not be able to do rice farming. Land area is also a determining factor and greatly determines the production yield in rice farming.

The number of seeds used by farmers in Karawang Regency is approximately 15,333 kg/ha on average. The result of the significance of the partial correlation of seed production factors on rice production has a value of 0.0215. This value indicates that the value of sig. Seed <0.05 (α=5%) which means that seed production factors have an influence on rice production. Mita, Haryono, & Marlina (2018) which revealed that the factor of the number of rice seeds has a significant contribution to the success of rice production. Listiani, Setiadi, & Santoso (2019) states that the use of high rice seeds will increase production yields in rice so that farmers' income will increase.

Fertilizer is one of the determining factors in rice production. Good fertilizers are natural fertilizers but the fertilizers used in rice farming in Karawang Regency on average use chemical fertilizers including urea, NPK fertilizer and SP36 fertilizer. The average urea fertilizer used in rice farming in Karawang Regency is 123.6842 Kg/Ha. Farmers in Karawang Regency tend to use fertilizer doses that are not evenly distributed and do not comply with government recommendations. The fertilizer recommended by the government is 250 kg/ha (Siallagan, Chalil, & Jufri, 2014). Excessive doses will have a negative effect on rice farming production. The result of the urea fertilizer production factor on the rice production yield has a partial correlation significance of 0.1590. This value indicates that the value of sig. Urea fertilizer > 0.05 (α=5%) which means that the urea fertilizer production factor has no effect on rice production. The significance of the partial correlation of NPK fertilizer production factors on rice production has a value of 0.9495. This value indicates that the value of sig. NPK fertilizer > 0.05 (α=5%) which means that the production factor of NPK fertilizer has no effect on rice production. The significance of the partial correlation of SP36 fertilizer production factors on rice production has a value of 0.2041. This value indicates that the value of sig. SP36 fertilizer > 0.05 (α=5%) which means that the production factor of SP36 fertilizer has no effect on rice production. The use of urea, NPK and SP36 fertilizers if used excessively will reduce the level of production this is due to the inappropriate use of which is not adapted to the conditions of plant needs. This is in accordance with the opinion of Listiani et al., (2019) revealed that fertilizers are useful for increasing rice production but fertilizers that are not as recommended will affect the results of rice farming. Lingga & Marsono (2013) revealed that the use of good and appropriate fertilizers must consider the dose, method of use, and efficacy for plants. Handling of fertilizers must be adjusted to the needs of the plant.

Pesticide factors in rice farming production in Karawang Regency generally use liquid and solid chemical pesticides. The type of pesticide used by each farmer is different. Farmers use pesticides according to the needs of the condition of the fields being cultivated. Pesticides are used when rice is attacked by nuisance organisms such as pests and weeds. The significance value of the partial correlation of pesticide production factors on rice production has a value of 0.0352. This value indicates that the value of sig. pesticide <0.05 (α=5%) which means that pesticide production factors have an influence on rice production. Khansa Agatha & Wulandari (2018)

revealed that pesticides have an effect on productivity. Pesticides have the power to help increase production by reducing pests by preventing and attacking pests so that production losses can be minimized. Praditya and Syafrial (2017) revealed that the use of pesticides in the long term can reduce farm productivity.

Labor is the most important production factorsoke in rice farming. In Kabupaten Karawang, workers generally do not have special qualifications and labor in rice farming. The significance value of the partial correlation of labor production factors on rice production has a value of 0.532. This value indicates that the value of sig. Labor <0.05 (α=5%) which means the labor production factor is not significant but has an effect on rice production. Silviana and Weriantoni, (2019) revealed that the labor factor in his research had insignificant results on rice production. In the production of rice farming, the labor factor does not have the same value from each production (Marwah, 2012). The labor factor itself is an important factor in the production of rice farming (Suratiyah, 2015).

Technical Efficiency

Results of analysis processing software Stochastic Frontier Analysis , the results are shown in Table 2. Based on table 2, the likelihood value of MLE > OLS with a value of 0.7853 > 0.6180. And the Standard error value is dominated by small values. This means that the value is in accordance with the proper conditions in the field and the inefficiency value is normally distributed. This is in accordance with the opinion of (Akkaya, 2016) who revealed that a good value is when the likelihood value is MLE>OLS and it can be interpreted that this value is in accordance with the conditions that occur in the field. And if the value of the error term has a small value, it means that the inefficiency value is normally distributed.

The average value of technical efficiency from the analysis results is 0.9607. This value indicates that the average technical efficiency of rice farming in Karawang Regency is 96%. So it can be concluded that farming in Karawang Regency has indicated that it is technically close to efficient. Factors of production can be said to be efficient in technical efficiency when the production factors used have produced maximum production output.

Economic Efficiency

Table 3. Results of Mathematical Analysis of Economic Efficiency

Variable	Xi	Bi	Pxi	NPMXi	NPMXi/PXi
Land Area	5.0222	0.707065	3,000,000.0000	3,855,268.2625	1.2851
Seeds	15.3333	0.183475	10,964.2857	32,666.0968	29.8849
Urea Fertilizer	123.6842	0.081297	1,878.9474	17,999.1272	9.5794
NPK Fertilizer	150.5556	0.003884	2,447.4359	706.4373	0.2886
SP36 Fertilizer	117.4419	0.083002	2,350.0000	19,353.4499	8.2355
Pesticides	4.1644	0.025814	867,222.2222	169,742.0416	0.1957
Labor	28.0000	0.312568	2,800,000.0000	305,687.4935	0.1092

Sources: Primary data, 2020

The results of mathematical calculations obtained results of economic efficiency which can be seen in table 3. Based on the results of the economic efficiency analysis, it can be seen that the comparison value of the marginal product of production factors (NPMXi) with the price of production factors (PXi) of land area, seeds, urea fertilizer, SP36 fertilizer has a value of PNMXi/Pxi > 1. Land, seeds, urea

fertilizer, SP36 fertilizer in rice farming in Karawang Regency have not yet reached the optimal point that is economically efficient, so these factors must be added. And the comparison value of the marginal product of production factors (NPMXi) with the price of production factors (PXi) of NPK fertilizers, pesticides and labor has a value of PNMXi/Pxi < 1. This means that the combination of the use of production factors of NPK fertilizers, pesticides and farm labor in Karawang Regency is said to be economically inefficient or the production factor has exceeded the optimal so that it must be reduced in its use. In order to reach an allocative efficient point in rice farming in Karawang Regency, it is necessary to add the production factor of land area, seeds, urea fertilizer, SP36 fertilizer and it is necessary to reduce the production factor of NPK fertilizer, pesticides and labor.

Return to Scale

Based on the results of the previous analysis, it can be seen that the Cobb-Douglas function states that each independent variable coefficient is the elasticity value of the dependent variable. Based on tables 2 and 3, it is known that the sum of the coefficient values produces a number of 1.3971 in rice farming in Karawang Regency. This production scale is as increasing return to scale.This means that each addition of a factor input will produce an item in a higher proportion. In his interpretation that each additional factor input by one percent, it will increase an output by 1.3971%.

CONCLUSION

In general, Karawang Regency can be used as a pilot district in Indonesia to mitigate the food crisis. The level of rice production in Karawang Regency is technically efficient. However, in terms of economic efficiency, there are several variables that need to be considered for the reduction of production factors on NPK fertilizers, pesticides and labor. In addition, several things can be concluded as follows:

1. Simultaneously the use of production factors of land area, number of seeds, amount of urea fertilizer, amount of NPK fertilizer, amount of SP36 fertilizer, amount of pesticide and HOK of labor affect rice production in Karawang Regency with a confidence level of 95%.
2. Partially, the use of land area production factors, seeds, and pesticides has a significant effect on rice production in Karawang Regency. While the use of production factors of urea fertilizer, NPK fertilizer, SP36 fertilizer and labor did not have a significant effect on rice production in Karawang Regency.
3. The level of technical efficiency in rice farming in Karawang Regency reaches 0.9607 which indicates that rice farming is technically close to efficient.
4. The combination of the use of land area production factors, seeds, urea fertilizer, SP36 fertilizer in rice farming in Karawang Regency has not reached the optimal point that is economically efficient, so these factors must be added. And the combination of the use of production factors of NPK fertilizers, pesticides and farm labor in Karawang Regency is said to be economically inefficient or production factors have exceeded optimal so that their use must be reduced.

5. The level of elasticity of production in rice farming in Karawang Regency reaches 1.3971 so that production has a scale that is increasing return to scale.

SUGGESTIONS

Rice farming in Karawang Regency can increase the use of production factors of land area, seeds, urea fertilizer, SP36 fertilizer and reduce the use of fertilizer production factors NPK, pesticides and labor in an effort to improve the farming carried out. The area of land will affect the scale of farming which will then affect the level of efficiency or not in farming (Putra et al., 2018).

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