International Journal of Research and Review
Vol.8; Issue: 1; January 2021
Website: www.ijrrjournal.com
Research Paper *E-ISSN: 2349-9788; P-ISSN: 2454-2237*

Technical Efficiency Analysis of Organic Rice in Perbaungan District, Serdang Bedagai Regency

Indra Cahyadi[1], Iskandarini[2], Dan Rahmanta[2]

[1]Postgraduate Students Department of Agribusiness, Faculty of Agriculture at Universitas Sumatera Utara, Indonesia.
[2]Postgraduate Lecturer Department of Agribusiness, Faculty of Agriculture at Universitas Sumatera Utara, Indonesia.

Corresponding Author: Indra Cahyadi

ABSTRACT

The objectives of this study were (1) to analyze the factors that influence the production of organic rice, (2) to analyze the efficiency level of organic rice farming and (3) to analyze the factors that affect the efficiency of organic rice production. The method of determining the research location is purposively. The number of samples was 33 farmers. The data used is during one growing season. The first, second and third hypotheses were analyzed with the Cobb Douglas stochastic frontier analysis production function. The results of the analysis showed that the variables of land area, seeds, and labor had a significant effect on rice production. The results of the calculation of organic rice farming showed an average technical efficiency (ET) of 0.84, and the factors affecting the level of technical efficiency were the dummy position in the farmer group members and the number of training.

Key words: *Organic rice, Production Function, Cobb Douglas, stochastic frontier analysis, Technical inefficiency.*

INTRODUCTION

North Sumatra is one of the provinces where most of the population lives from agricultural businesses. Serdang Bedagai Regency is the second largest rice and rice producer in North Sumatra after Deli Serdang Regency (BPS North Sumatra, 2020). Serdang Bedagai Regency is one of the areas that has the potential for the development of organic agriculture and several organic rice farmer groups have been formed.

The development of organic rice technology takes time, so what farmers are currently doing is reducing the dosage in the use of inorganic materials in organic farming. The results of interviews with organic rice farmers in Tanah Merah Village and Lubuk Bayas Village, Perbaungan District Serdang Bedagai Regency, show that the average productivity of organic rice reaches 5.6 - 6.2 tons / ha, while inorganic rice averages only 5.2 ton / ha. However, there are still many farmers who are reluctant to switch from inorganic farming to organic farming, even though local consumer demand for organic rice is quite high. The risks that will be faced by farmers in the transition process from conventional (inorganic) to organic rice cultivation are one of the reasons why farmers are reluctant to start organic rice cultivation. Organic rice production will experience a decrease in the amount of production at the beginning of cultivation, but entering the 5th year the increase in production will be higher than conventional rice (Prayogo, 2010).

The average rice production in Serdang Bedagai Regency in 2018 was 5.86 tonnes / ha (BPS, 2019) which is still lower than the potential productivity of rice of 8-10 tonnes/ha. Based on the data, it can be seen that there are opportunities that have not been exploited by farmers. The existence of various obstacles, such as the use of inputs that have not been optimal due

to a lack of knowledge, is one of the reasons why farmers have not reached production efficiency.

Based on the problems formulated, the objectives of this study are:

1. Analyzing the factors that affect organic rice production
2. Analyzing the efficiency level of organic rice farming
3. Analyzing the factors that affect the efficiency of organic rice production

METHODOLOGY

Research sites

The location was chosen purposively, namely in Serdang Bedagai Regency, North Sumatra Province as one of the rice production centers. This research includes the stages of activities, namely: the stage of research preparation, data collection and analysis of research data.

Production Function Analysis

To analyze the model developed by Just and Pope (1979), the functional form of organic rice farming is:

$$y_I = \alpha_0 \Pi_{j=1}^{6} X_{ij}^{\alpha j} + e^{vi} - e^{ui}$$

Where:

$\mathbf{y_i}$ = Organic Rice Production (kg)
$\mathbf{X_1}$ = area of organic rice land (ha)
$\mathbf{X_2}$ = Seed (kg)
$\mathbf{X_3}$ = Labor (HOK).
$\mathbf{X_4}$ = Organic Pesticide (lt)
$\mathbf{X_5}$ = Liquid Organic fertilizer (lt)
$\mathbf{X_6}$ = manure (kg)
$\mathbf{v_i}$ = error term which indicates the uncertainty of production assumed to be i.i.d $(0, \sigma_u^2)$,
$\mathbf{u_i}$ = technical inefficiency assuming i.i.d $(0, \sigma_u^2)$, and u> 0, ui independent of vi.

The model estimation is done using the Maximum Likelihood Estimation (MLE) method.

Analysis of the level of technical efficiency using the equation TE = 1 – TI.

Technical Inefficiency Analysis

Analysis of the causes of technical inefficiency using the technical inefficiency effects model developed by Battese and Coelli (1995) in Coelli et al. (1998):

$$ui = \delta_o + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + W_i$$

Where:

ui = value of technical inefficiency.
$\mathbf{Z_1}$ = Age, measured in years.
$\mathbf{Z_2}$ = Education, measured by the unit length of formal education of farmers (years).
$\mathbf{Z_3}$ = dummy the position of farmer in farmer groups (0 = member of farmer groups, 1 = committee of farmer group)
$\mathbf{Z_4}$ = Number of family members (person)
$\mathbf{Z_5}$ = Amount Family Dependents (person)
$\mathbf{Z_6}$ = Amount of agricultural extension (times)
$\mathbf{Z_7}$ = Amount of agricultural training (times)
$\mathbf{Z_8}$ = Farming experience, measure by the unit length of farming organic rice (years)
δ = parameter that will be suspected
Wi = random error term is assumed to be independent and its distribution is cut off normally by N $(0, \sigma_u^2)$.

The expected sign for each parameter has an effect on inefficiency are negative, except δ_5 is positive

RESULTS AND DISCUSSION

Characteristics of Sample Farmers

Households used as samples are farmer households that do organic rice farming. Based on the results of interviews with sample farmers about some of the characteristics of farmers and their families, which are presented in Table 1. The average age of the heads of families of organic rice farmers is 50 years. This age structure shows that in the research area the farmers are still classified as productive. The average number of family members is 3 people, and this is categorized as a small family with a maximum number of dependents of 3 people with an average of 0.4 people.

Tabel 1. Characteristics of organic rice farmers in Perbaungan Distric, 2020

Variable	Min	Max	Average	Std
Age of Head Family	30	67	49,5	10,3
Education of Head Family	5	12	9,9	2,4
Number of productive family members	0	9	2,7	1,9
Amount Family Dependents	0	3	0,4	0,9

Activity in Extension

Although no one has received a bachelor's degree in formal education, the farmers continue to learn to increase their farming experience, namely through counseling and training in the field of organic rice. Farmers in Perbaungan District have received counseling on organic rice because all farmers are members of farmer groups. On average, farmers get 8 times extension. Based on the results of interviews, the information obtained by farmers from extension activities was about cultivation technology, the benefits of manure, making compost and vegetable pesticides.

In addition to counseling, farmers also participated in training activities on organic rice, including SLPHT, CSA, SLI, Permaculture, organic rice cultivation, eco-enzyme, land management, making compost and organic pesticides, biogas, rice breeding and *mina padi*. On average, farmers attend the training 3 times.

Membership in Farmer Groups

All organic rice farmers in the study area are members of the farmer groups. Benefits that are obtained by group members in farmer groups are collective agricultural input, savings and loan facilities, counseling and training. The position of the farmers in the farmer group is as chairman, committee member and group member.

Owner of Farm Land

The most important natural resource in agricultural cultivation is the land of farmers in the Perbaungan sub-district in cultivating organic rice using their own land. Based on the area of land tenure, in the study area the area of land cultivated for organic rice crops ranged from 0.08 hectares to 1 ha with an average of only 0.23 ha. Not all land owned by farmers is cultivated organically, but some are cultivated conventionally, because they still feel that the yield is less than organic, many of the neighboring rice fields are less cooperative in doing organic farming. Meanwhile, there are farmers who remain optimistic in cultivating organic rice because they reduce the use of chemical fertilizers and chemical pesticides, have health awareness, are cheaper and in harmony with nature, are environmentally friendly, maintain soil fertility and a higher selling price.

Production and Productivity

The average production and productivity of organic rice in Perbaungan District were 1.12 tons and 4.93 tons / ha, respectively. There are differences in production and productivity obtained from interviews with farmers due to differences in the use of production factors, where the results achieved are basically the resultant work of many factors, both controllable and uncontrollable factors.

Based on research data, the highest productivity of dry grain of organic rice in Perbaungan is in the range of 3-5 tons / ha, which is 91 percent. Only 6 percent more than that. The average productivity of organic rice is 4.9 tons / ha, indicating that the productivity of organic rice can still be increased according to its potential.

Production Function Analysis

The model used to estimate the production function of organic rice farming at the research location is the Cobb-Douglas stochastic frontier production function model. The log likelihood function value with the MLE method obtained is 11.63. This value is greater than the log likelihood function value with the OLS method of 2.47. This shows that the production function using the MLE method is good and

in accordance with the conditions in the field.

Tabel 2. Estimation of Cobb-Douglas Type Frontier Stochastic Production Function of Organic Rice in Perbaungan Distric, 2020

Variable	Coefficient		t-ratio
Intercept	8,42E+00		45,95***
Land (X_1)	-9,61E-10		-5,96***
Seed (X_2)	9,43E-01		8,10***
Labor (X_3)	-9,37E-10		-4,30***
Organic Pesticide (X_4)	1,22E-10		0,51
Liquid Organic Fertilizer (X_5)	1,59E-10		1,06
Manure (X_6)	-6,70E-11		-0,31
Sigma-square	0,1		
Gamma (γ)	0,89		
Log-likehood function OLS	2,47		
Log-likehood function MLE	11,63		
LR test of the one - sided error	18,31		

**** Sig at α 0,001*

The model of the stochastic frontier production function for organic rice farming in Perbaungan District based on Table 2 can be written with the following equation:

$$\ln Y = 8,42 - 9,61E - 10lnX1 + 9,43E - 1lnX2 - 9,37E - 10lnX3 + 1,22E - 10\,lnX4 + 1,59E - 10lnX5 - 6,70E - 11lnX6 + vi - ui$$

The predictor variable on the MLE estimation results that has a significant effect on a positive coefficient value is seed (X2). Variable area of land (X1) and labor (X3) are variables that have a negative and significant effect on organic rice production in Perbaungan District. The addition of the use of seed inputs will significantly increase the production of organic rice at the level of α = 0.001. The results of this study are the same as research by Astuti et al (2019), Jakiyah and Nurhidayah (2019), Saragih et al (2017), Lubis (2015), Gultom et al (2014) and Tinaprilla et al (2013) which state that seeds have a positive contribution to increasing the efficiency of organic rice production. Based on the coefficient value, each additional 1 percent seed input with the assumption of cateris paribus will increase rice production by 0.94 percent. In fact, the average farmer uses 23.60 kg / ha of seed, which is lower than the recommended seed use of 25 kg / ha. Rational organic rice farmers will also choose to increase the quantity of organic rice seeds in order to increase the production of cultivated organic rice. This is in accordance with conditions in the field which indicate that seeds have a vital effect on the production of a farm, where seeds determine whether the yield of organic rice will be good or not, and determine the level of productivity. Therefore, increasing the number of quality seeds to increase productivity is needed, because superior seeds are more responsive to fertilizers and have high potential production.

The land variable (X1) has a significant negative effect on the increase in organic rice production. An additional 1 percent input for land area, assuming cateris paribus (other fixed input), will reduce organic rice production by the value of elasticity or land area coefficient, namely 9.61E-10 percent. This is because organic rice production will experience a decrease in the amount of production at the beginning of cultivation, but entering the 5th year the increase in production will be higher than conventional rice (Prayogo, 2010). Other than that if you increase the land area without increasing the number of seeds used as input, the most influencing effect on production will reduce the resulting production. This finding is different from the results of empirical research conducted by Jakiyah and Nurhidayah (2019), Saragih et al (2017), Lubis (2015), Gultom et al (2014), Khairizal and Amin (2014), Nurani (2014) and Tinaprilla et al. (2013) which states that land area has a positive effect on production. Organic rice farmers in the research location belong to the category of marginal farmers, namely those who own land with a scale of less than 0.2 ha with an average of 0.23 ha. Ownership of land area that is classified as low is a crucial consideration for rational farmers who want to increase the production of cultivated organic rice. Thus, if you want to increase production by increasing the use of cultivated land, you must pay attention to the use of seeds as the main variable that needs to be considered in increasing organic

rice production in Perbaungan District, in addition to considering the condition of the surrounding land whether using organic farming systems or not.

The labor variable (X3) has a negative and significant effect on organic rice production. This means that every 1 percent additional workforce with the assumption of cateris paribus, will reduce organic rice production by -9.37E-10 percent. The results of this test are in accordance with conditions in the field which indicate that the use of labor is excessive. The actual use of TK is 192 HOK / ha on average, exceeding the recommended number of laborers of 159 HOK / ha. The results of this study reinforce the empirical findings of several previous researchers, namely Jakiyah and Nurhidayah (2019), Sholeh (2016) and Khairizal and Amin (2014) who also found the same results, namely labor factors have a negative effect on organic rice production. Meanwhile Saragih et al (2017), Gultom et al (2014), and Nurani (2014) in their research result that an increase in labor can still increase production.

Variables of organic pesticides (X4), liquid organic fertilizer (X5) and manure (X6) did not have a significant effect on organic rice production. This means that the addition or reduction of vegetable pesticides, liquid organic fertilizers and manure does not significantly affect the production of organic rice or its production remains. This indicates that the use is relatively uniform among farmers and is close to the ideal recommended dosage.

The variance / sigma-square value shows the distribution of the error term inefficiency (ui), if the value is small, it means (ui) is normally distributed. The sigma-squared value in this study is 0.1, so it can be concluded that the error term in the organic rice production function in the study area is normally distributed. Meanwhile, the parameter γ indicates whether there is an inefficiency effect in the model. If the value of approaches the number 1, the error term only comes from the effect of inefficiency and if the value is close to the number 0 then all error terms contained in the production function model come from the noise factor. The value of respondent farmer in Table 12 is 0.89, which means that 89 percent of the error term in the production function is caused by the inefficiency effect of the respondent farmer and the remaining 11 percent is caused by noise effects such as climate, weather, pests and diseases. The same thing is shown in the value of the generalized Likelihood Ratio (LR). The generalized Likelihood Ratio value of the organic rice production model is 18.31 which is greater than the Kodde and Palm α 5 percent of 14.85. This shows that organic rice production is influenced by technical inefficiency factors of farmers.

Technical Efficiency Factors

The technical efficiency in this study uses a stochastic frontier production function model with an input side approach. The results of the study indicated that the achievement of the level of technical efficiency in organic rice farming in Perbaungan District was high. The results of the stochastic frontier analysis showed that the maximum value of the technical efficiency of organic rice farmers as a whole in Perbaungan District was 0.97 and the minimum value of technical efficiency was 0.37. Meanwhile, the average technical efficiency value of respondent farmers is 0.84, which means that the average respondent farmer in the study area can improve their technical efficiency in producing organic rice by 16 percent by improving factors that significantly affect efficiency, such as land area, seeds, and labor. Based on the results of the research that has been done, the target focus of increasing organic rice production in Perbaungan District can be directed by improving the technical skills of organic rice farmers and farm managerial capabilities. The distribution of the technical efficiency values for organic rice in Perbaungan District is presented in Figure 1.

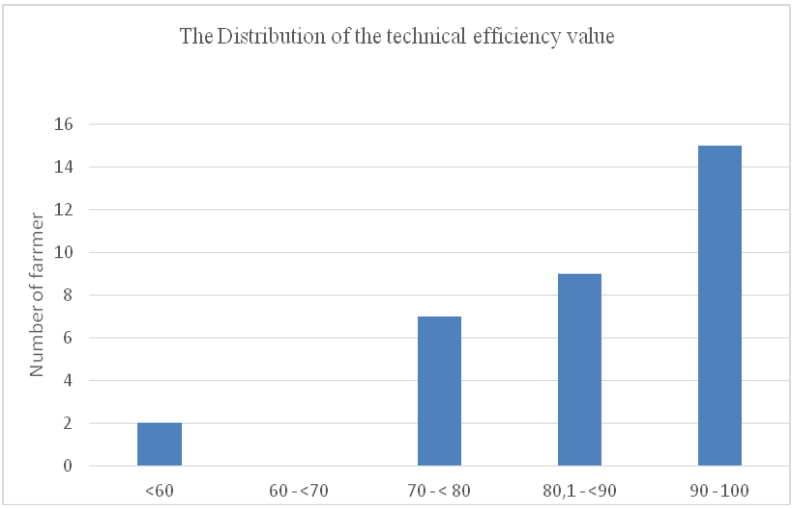

Figure 1. The distribution of the technical efficiency values for organic rice in Perbaungan District, 2020

Technical Inefficiency Factors

The factors that influence the level of technical inefficiency of farmers in Perbaungan District were estimated using the stochastic frontier production function model. The results of the analysis in Table 3 show that only the dummy positions of the farmers in the farmer groups and the amount of training have a significant negative effect on the level of technical inefficiency.

Table 3. Technical Inefficiency Estimation of Organic Rice Farming in Perbaungan District

Variable	Coefficient	t-ratio
Kontanta	1,15E+00	1,30
age (Z_1)	-3,72E-10	-0,72
Education (Z_2)	-3,23E-10	-0,05
Position in Farmer group (Dummy) (Z_3)	-1,86E-09	-1,79**
Number of productive family members (Z_4)	-3,70E-09	-1,30
Amount Family Dependents (Z_5)	-9,04E-10	-1,23
Agriculture Extension (Z_6)	-2,96E-09	-0,42
Agriculture Training (Z_7)	-6,62E-10	-1,43*
Farming experience (Z_8)	3,58E-03	0,30

*** Sig at α 0,05 * Sig at α 0,1*

Farmers who take charge of farmer groups will have a higher level of efficiency than farmers who only act as members of farmer groups. This is due to the fact that the farmers who are in charge are active members in farmer groups so that they have more information to increase their level of technical efficiency. In addition, there is a moral demand for the management to be an example for other members of the farmer group of success in farming. This is in accordance with research conducted by Abbeam et al (2017), Samarphita (2016), Abiwiera and Dadson (2016) and Kuwornu et al (2013), which states that farmers who are members of farmer groups will increase their technical efficiency.

The amount of training also has a significant negative effect, this shows that the more farmers get research, the more technical efficiency levels will be increased. The training obtained by farmers is training on organic rice, including SLPHT, CSA, SLI, Permaculture, organic rice farming, eco-enzyme, land management, composting and vegetable pesticides, biogas, rice breeding and *mina padi*. On average, farmers attend 3 times of the training. This training improves farmers' knowledge and skills in organic rice cultivation so that it can be applied in farming and in the end can increase technical efficiency. The results of this study are in accordance with research conducted by Arimbawa and Widanta (2017), namely that training has a direct effect on productivity, which in turn will increase technical efficiency. Training is an effort to develop human resources. Training

is also an educational process that aims to remember the special abilities or skills of a person or group of people. Education and training are something that must be done by organizations, because this can be seen as investment. Regular education and training will improve capabilities and skills and productivity. Transfer of knowledge can be informal, sharing of information and experiences, training and mentoring. This intensive training and mentoring affects the technical efficiency of farming, because it can increase farmers' knowledge about the optimal use of input to produce maximum output (Ulpah et al, 2018).

CONCLUSIONS AND SUGGESTIONS

Conclusion

1. The seed variable (X2) has a significant effect with a positive coefficient value, while the variable land area (X1) and labor (X3) have a negative and significant effect on organic rice production in Perbaungan District.
2. The maximum value of technical efficiency for organic rice farmers as a whole in Perbaungan District is 0.97 and the minimum value for technical efficiency is 0.37. Meanwhile, the average technical efficiency value of the respondent farmers was 0.84, which means that on average, the respondent farmers in the study area could improve their technical efficiency in producing organic rice by 16 percent.
3. Dummy position of farmers in farmer groups and the amount of training have a significant negative effect on the level of technical inefficiency.

Suggestions

1. Based on the analysis of the factors that affect the production function, the limiting factor is seed input. To increase productivity on available technology, it can be done by increasing the use of seeds and focusing on the use of superior seeds
2. Land use can be increased accompanied by the use of appropriate seeds in accordance with the recommended recommendations
3. The use of labor can be reduced to save costs
4. Providing training can be given to farmers to improve technical efficiency of organic rice farming
5. It is hoped that the information received by management and members of farmer groups will not be different in order to increase technical efficiency
6. There is a smooth transfer of technology and information from management to members.

REFERENCE

1. Abawiera WC, Dadson AV. 2016. Technical Efficiency of Maize Farmers in Ghana. Discourse Journal of Agriculture and Food Scienses, Vol. 4(3):17-30.
2. Abbeam GD, Abban BAA, Dinkoh SA. 2017. Off-Far, Participation and technical Efficiency Among Smallholder Farmers in The Northern Region, Ghana. APSTRACT Vol 11 (1-2):35-44.
3. Arimbawa, PD dan Widanta AABP. 2017. Pengaruh Luas Lahan, Teknologi Dan Pelatihan Terhadap Pendapatan Petani Padi Dengan Produktivitas Sebagai Variabel Intervening Di Kecamatan Mengwi. E-Jurnal EP Unud Vol 6(8): 1601-1627
4. Astuti, LTW, Daryanto A, Syaukat Y, dan Daryanto HK. 2020. Technical Efficiency of Shallot Farming in Central Java Province: Stochastic Frontier Modelling. IJPSAT Vol 13(2): 222-232
5. Badan Pusat Statistika Provinsi Sumatera Utara. 2020. Produksi Padi dan Beras Organik Kabupaten/Kota Provinsi Sumatera Utara tahun 2019. Sumatera Utara
6. Badan Pusat Statistika Kabupaten Serdang Bedagai. 2020. Kabupaten Serdang Bedagai dalam Angka tahun 2019. Kabupaten Serdang Bedagai
7. Badan Pusat Statistika Kabupaten Serdang Bedagai. 2020. Kecamatan Perbaungan dalam Angka tahun 2019. Kabupaten Serdang Bedagai
8. Coelli TJ, Rao DSP and Battese GE. 1998. An Introduction to Efficiency and Productivity Analysis, Kluwer-Nijhoff, Boston.JP, Orazem F. 1984. Production

Economics. John Wiley & Sons, Inc, New York.
9. Gultom L, Winandi R, dan Jaroh S. 2014. Analisis Efisiensi Teknis Usahatani Padi Semi Organik di Kecamatan Gombong, Bogor. Informatika Pertanian, 23(1) : 7 – 18
10. Jakiyah U dan Nurhidayah S. 2019. Efisiensi Eknomi Usahatani Pado Irganik di Kabupaten Tasikmalaya. Jurnal Hexagro, 3(1) : 41 – 50.
11. Just ER, Pope RD. 1979. Production Function Estimation and Related Risk Consideration. American Journal of Agricultural Economics, 6(2) : 276 – 284.
12. Khairizal dan Amin A M. 2014. Analisis Efisiensi Faktor Produksi usahatani Padi Sawah SRI Organik dan anorganik di Desa Kelayang Kacamatan Rakit Kulim Kabupaten Indragiri Hulu. Jurnal Dinamika Pertanian, 22(3) : 271 – 282
13. Kuwornu JKM, Amoah E, Seini W. 2013. Technical Efficiency Analysis of Maize Farmers in The Eastern Region of Ghana. Journal of Social and Development Sciences Vol 4(2): 84-99.
14. Lubis S L. 2015. Analisis Produksi dan Efisiensi Padi Organik di Desa Lubuk Bayas Kecamatan Perbaungan Kabupaten Serdang Bedagai. Tesis. Departemen Agribisnis. Universitas Sumatera Utara
15. Nurani L E. 2014. Analisis Efisiensi Teknis Padi Organik di Kabupaten Bogor. Tesis. Sekolah Pascasarjana. Institut Pertanian Bogor
16. Prayoga A. 2010. Produktivitas dan Efisiensi teknis Usahtani Padi Organik Lahan Sawah. Jurnal Agro Ekonomi, 28(10) : 1 – 19.
17. Samarpitha A, Vasudev N, dan Suhasini K. 2016. Technical, Economic amd Allocative Efficiencies of Rice Farms in Nalgonda District of Telangana State. Economic Affairs. 61(3): 365-374
18. Saragih F L, Indah P N dan Widayanti S. 2017. Analisis Efisiensi Faktor-faktor Produksi Usahatani Padi Organik dengan padi Anorganik di Desa Sumber Ngepoh Kecamatan Lawang Kabupaten Malang. Berkala Ilmiah Agribisnis AGRIDEVINA, 6(1) : 43 – 54
19. Sholeh M S. 2016. Efisiensi Teknis Usahatani Padi dengan Sistem tanam Jajar Legowo di Desa Dasok Kecamatan Pademawu Kabupaten Pamekasan. Jurnal Pemikiran penelitian Pendidikan dan Sains, 4(1) : 55 – 64
20. Tinaprilla N, Kusnadi N, Sanim B, Hakim B D. 2013. Analisis Efisiensi Teknis Usahatani Padi di Jawa Barat Indonesia. Jurnal Agribisnis, 7(1) : 15 – 34.
21. Ulpah A, Tinaprilla N, dan Baga L M. 2018. Jurnal Pengkajian dan Pengembangan Teknologi Pertanian, Vol. 21(3) :259-275

How to cite this article: Cahyadi I, Iskandarini, Rahmanta D. Technical efficiency analysis of organic rice in Perbaungan District, Serdang Bedagai Regency. *International Journal of Research and Review*. 2021; 8(1): 175-182.

******