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COMPARATIVE ANALYSIS OF PRODUCTION EFFICIENCY OF ORGANIC AND INORGANIC RICE FARMING

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Abstract

Production efficiency is an important indicator for evaluating the effectiveness of agricultural production activities in achieving optimal output and profitability. This study aims to analyze production levels, factors affecting organic and inorganic rice production, and the efficiency levels of both farming systems. A quantitative approach was employed involving organic and inorganic rice farmers in Sawit District. Samples were selected using simple random sampling, consisting of 59 organic farmers and 59 inorganic farmers. Data were collected through interviews. Production analysis was conducted using the Cobb–Douglas production function with multiple linear regression. Technical efficiency was analyzed using the stochastic frontier production function through *Stochastic Frontier Analysis* (SFA), while allocative and economic efficiency were assessed using input–output price comparisons and combined efficiency measures. The findings indicate that organic rice production exceeds inorganic rice production on average. Land area, seeds, and fertilizer significantly affect production, whereas pesticides and labor do not. Both farming systems approach efficiency, although organic rice farming demonstrates higher technical efficiency but has not yet achieved allocative and economic efficiency.

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INTRODUCTION

Agriculture is one of the main sectors that supports people's lives, because the agricultural sector is the livelihood of the majority of the Indonesian population (Fadlli & Bowo, 2018). One of the roles that a country plays in the economic development of a country is the agricultural sector as a contributor to the country's foreign exchange sources (Nadziroh, 2020). The agricultural sector holds great potential to increase the country's GDP if developed. In addition, the agricultural sector is expected to be the leader sector (Aji, 2019). Increased productivity through technological change (plant intensification, mechanization, hybrid seeds, more efficient use of water, energy, fertilizers) will result in higher value products (Golan & Kohli, 2013).

Agriculture sector there are four sub agriculture sub horticulture, sub plantation, sub food crops and sub Forestry. sub food crops in Central Java are widely planted in various regions, one of which is in Boyolali regency. Food crops grown in the district such as rice, corn, soybeans and tubers, but of these crops rice is a daily staple food of the people in Boyolali. If you look at the data from the rice crop production from year to year is still quite low and decreased compared to other regions, so it is necessary to increase productivity of rice yields in the Boyolali district as below.

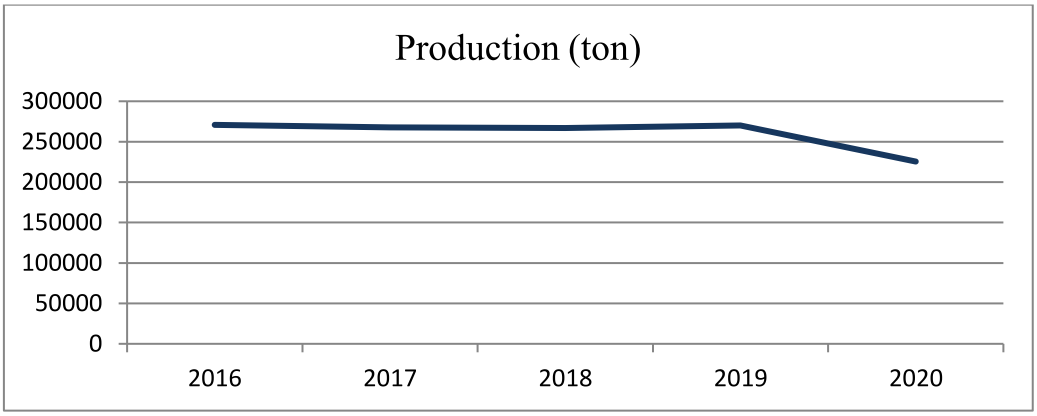

Figure 1. Rice production in Boyolali regency
Image Source: BPS Jawa Tengah, 2020

Although the production in Boyolali regency is quite low compared to other districts, the potential of Boyolali regency in developing rice production is (1) agricultural land area increased from 2019 to 2020 by 1008.84 ha (2) in addition to conventional rice farming(inorganic) several districts have begun to develop organic rice production, namely Sawit, Banyudono and Teras districts. (3) Boyolali regency itself has a total organic land area of 109.48 ha of SNI certified and 149.18 ha of non-certified ICS, while for conventional land of 47,760.01 ha.

Sawit district is a district that has the most extensive inorganic wetland area of 1 275.25 ha but the production rate is lower than the production in Banyudono District and Teras District which has less land area than the inorganic land area in Sawit District. In addition, there is also a district of Sawit organic rice production where in the District of Sawit itself organic land area has been certified SNI of 78.93 ha. the level of organic rice productivity in Sawit sub-district tends to decrease so that it cannot meet the supply in

Cooperatives and cannot meet customer needs while the production land area increases as in the following table.

Table 1. Organic Rice Production in Sawit District

Year	Land Area (ha)	Production(kg)
2019	78,46	439.670
2020	78,53	445.951
2021	78,93	471.075
2022	78,93	464.794

Source: Data APOB, 2022

Efficiency is an economic concept used to measure the extent to which the level of use of resources in a process. In the production process, often the measure of the efficiency of the use of inputs in the form of factors of production is the most important thing. Where the more economical the use of production inputs, the more efficient the production activities will be. Next Utama et al., (2016) concluded efficiency as the minimum utilization of resources in order to achieve optimum results. Farrell, (1957) mention that efficiency can be divided into three, namely technical efficiency, price efficiency (allocative), and economic efficiency.

The purpose of this study was to analyze the level of organic and inorganic rice production in the Sawit Sub-District of Boyolali regency, analyze the influence of production factors on organic and inorganic rice production in the Sawit Sub-District of Boyolali regency, analyze organic and inorganic rice farming seen from the level of efficiency (technique, Price, and economy) in the Sawit Sub-District of Boyolali regency.

METHODS

This type of research approach is quantitative research to analyze the level of production and efficiency in organic and inorganic rice in the District of Sawit Boyolali. The population in this study is all organic and inorganic rice farmers who have been registered as members of the Boyolali Organic Farmers Association (APOB). The sample in this study was determined through a simple random sampling technique. Based on each group of organic and inorganic farmers, a sample of 59 farmers will be determined. It is based on Borg, et al (2007) which states that for experimental and comparative research a minimum sample of 30 respondents is required for each group to be compared.

Independent variables in this study are land area (ha), seeds (kg), fertilizer (kg), pesticides (L) and labor (HOK) while the dependent variable is the amount of production. Data collection techniques used are interview techniques, and observation. Interview technique is used to obtain descriptive data about the problems faced by farmers and farmers as well as used to obtain data on production, production costs, selling prices, and income. Observation techniques were used to obtain data on the characteristics and methods used by farmers. In this study, there are two steps of analysis, namely production analysis and efficiency analysis of each organic and inorganic Rice data and then compared.

Production Analysis

Production analysis in this study refers to the Cobb-Douglass production function by using multiple linear regression analysis, so that the regression model can be written as follows.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \mu$$

Where
Y = Production
β = coefficient
X1 = land area
X2 = seeds
X3 = fertilizer
X4 = labor
X5 = pesticides
μ = error

Efficiency Analysis

1) Technical Efficiency

To measure the level of technical efficiency using Stochastic Frontier Analysis. The following is a model of the equation according to Aigner et al in Sucihatiningsih (2013).

$$\ln(Yi) = Xi\beta i + \nu i + \mu i$$

Where
ln(Yi) = output logarithm value
Xi = number of inputs
βi = estimated parameters
νi = random error / random variable
μi = positive random variable

The ratio of input observation output to potential output, indicated by the frontier function of the existing input so that the value of technical efficiency (TE) can be formulated as follows.

$$TE = \frac{Yi}{\exp{(Xi\beta)}} = \frac{\exp{(Xi - \mu i)}}{\exp{(Xi\beta)}} = \exp{(-\mu i)}$$

2) Allocative Efficiency (Price)

According to Nicholson (2002), price efficiency is achieved when the ratio of the marginal productivity value of each input (NPMxi) to the price of the input is equal to 1. Yangs ama statement is also put forward by Soekartawi (2016) with the following mathematics formula.

$$\rightarrow \quad \frac{NPM_x}{P_x} \Rightarrow 1 \qquad \frac{bYP_x}{X} = Px \qquad \frac{bYP_x}{XP_x} = 1$$

Where
B = Elasticity
Y = Production
PY = production Price Y
X = number of factors of production X
PX = price of factor of production X

Based on the equation above, the calculation of price efficiency is as follows.

$$EH = \frac{NPM1 + NPM2 + NPM3 + NPM\ 4 + NPM5}{5}$$

According to Soekartawi (2001) continued that in actual circumstances the above equation is not always equal to 1, often occurs as follows:

a. If the efficiency coefficient, it means that the use of inputs can be said to be efficient.

b. If the coefficient of efficiency > 1, it means that in the use of inputs cannot be said to be efficient so that the input must be added.

c. If the efficiency coefficient < 1, it means that the use of inputs is not efficient so in this case the use of inputs must be reduced.

3) Economic Efficiency

Economic efficiency is a combination of technical efficiency and price efficiency. The following mathematical formula according to Soekartawi (2001).

EE = ET x EH

Where

EE = Economic Efficiency

ET = Technical efficiency

EH = price efficiency (allocative)

RESULT AND DISCUSSION

Production

Every farmer has the hope that every harvest can produce maximum rice production by using existing land. Various efforts are made by farmers to obtain maximum results such as paying attention to the selection of superior seeds, the concentration of fertilizers and pesticides used. The following is a table of production and input factors of organic and inorganic rice production in Sawit Sub-District.

Table 2. Production and Use of Organic Rice Production Inputs

No	Description	Land area (ha)				Total	average	conversion of 1 ha of land
		0.16	0.18	0.2	0.3			
1	Frek	5	12	21	21	59		
2	Production (kg)	5000	13600	29450	36500	84550	1344.05	6281.6
3	Total land area (ha)	0.8	2.16	4.2	6.3	13.46	0.23	1.0
4	Seeds (kg)	30	83	177	216	506	8.58	37.6
5	Fertilizer kg)	760	2875	6625	7850	18110	306.95	1345.5
6	Pesticides (l)	2.45	6	11.45	12.85	32.75	0.56	2.43
7	Labor(HOK)	48	132	278	331	789	13.37	58.6

Source: Primary Data, 2023 (processed)

Table 3. Production and Use of Inorganic Rice Production Inputs

No	Description	Land area (ha)				Total	average	conversion of 1 ha of land
		0.16	0.18	0.2	0.3			
1	Frek	3	20	18	18	59		
2	Production (kg)	3050	23480	24500	31300	82330	1395.42	1433.5
3	Total land area (ha)	0.48	3.6	3.6	5.4	13.08	0.22	1.0
4	Seeds (kg)	19	133	150	192	494	8.37	37.8
5	Fertilizer kg)	530	4165	5315	6145	16155	273.81	1235.1
6	Pesticides (l)	1.5	10	9.65	10.2	31.35	0.53	2.39
7	Labor(HOK)	27	193	239	296	755	12.80	57.7

Source: Primary Data, 2023 (processed)

Based on the table above, it is known that the average land used by organic rice farmers in Sawit Sub-District is 0.23 ha with production reaching 1433.05 kg while the average land used by inorganic farmers is 0.22 ha with production reaching 1395.42 kg. Thus, the area of organic rice is slightly wider by 0.1 compared to the area of inorganic rice so that the production results are also higher with the use of more production factors as well.

To determine the relationship between variables used multiple linear regression analysis using Eviews version 9. Based on the results of multiple linear regression tests, it can be concluded that the independent variables of land area, seeds, and fertilizers have a significant effect on production, while pesticides and Labor do not have a significant effect. The value of the coefficient of double determination (R-Squared) is 0.90 which means that 90% of organic rice production is influenced by land area, seeds, fertilizers, pesticides, and labor while 10% of it is influenced by other factors outside this study. While the value of the coefficient of double determination (R-Squared) in inorganic rice is 0.91 which means that 91% of inorganic rice production is influenced by land area, seeds, fertilizers, pesticides, and labor while 9% is influenced by other factors outside this study.

Table 4. Results of Multiple Regression Analysis of Organic and Inorganic Rice

Variables	Padi Organik		Padi Anorganik		Description
	Beta	Nilai Sig	Beta	Nilai Sig	
Constant	5.644090		7.093038		
Land area (X1)	0.275353	0.0031	0.560767	0.0000	Significant effect
Seeds (X2)	0.415540	0.0009	0.159057	0.0386	Significant effect
Fertilizer (X3)	0.155947	0.0217	0.132809	0.0000	Significant effect
Pesticides (X4)	-0.037162	0.4856	-0.062236	0.2102	No significant effect
Labor (X5)	0.086545	0.3325	-0.048694	0.3952	No significant effect
R-Square Value	0.907900		0.911845		

Source: Primary Data, 2023 (processed)

Production factors in the form of land area in organic and inorganic rice partially significant positive effect on output in the form of production. Based on the influence of these production factors, the influence of land area on inorganic rice production is greater than the influence of land area on organic rice production. The relationship of land area with positive production results and significant effect in accordance with previous research such as the results of research conducted by Baihaqi et al., (2022) and Azwar et al., (2019) which says that the amount of rice production is influenced by the area of land used.

In an effort to increase rice production will be successful if the seeds used are of good quality and in sufficient quantities so that the seeds are also an important production factor. Based on the influence of these production factors, the influence of seeds on organic rice production is greater than the influence of seeds on inorganic rice production. The results showed that seed variables have a significant positive influence on the production of organic and inorganic rice, it is in line with research Hariono (2022) and Sularso & Sutanto (2020).

In addition to land and seeds, fertilizer is also a production factor that is no less important where fertilizers are designed to complement plant nutrients that are already in the soil (Olaniyi & Ojetayo, 2011). Fertilizer application aims to stimulate plant growth and production, but the use of fertilizers that are less than the recommended dose can cause disruption of plant growth and production is not optimal (Noer et al., 2018). The relationship between fertilizer production factors with the results of organic and inorganic rice production is positive and significant effect in accordance with previous research such as the results of research conducted by Hilalullaily et al., (2021) which states that efforts to increase rice production will be achieved when considering the increase in inputs in the form of fertilizer used.

Pesticides are materials used to reduce crop pest attacks, however, excess pesticides can destroy beneficial organisms in the rice field environment (Hashimi et al., 2020). The results showed that pesticide variables have no significant effect on organic and inorganic rice production. The relationship between pesticide variables with production is a negative relationship. Pesticides have no significant effect on the production of organic and inorganic rice in the District of Sawit due to the use of pesticides that are not in accordance with the needs of rice crops. Based on the results showed that the average use of pesticides in the study area of 2.43 l/ha for organic rice and 2.39 l/ha for inorganic rice. The difference in the dose of pesticide use has no real effect on rice productivity because pesticides are used adapted to pests and diseases as well as the needs of the field (Walis et al., 2021). The use of pesticides is considered to have exceeded the limit required by the plant so that it resulted in a decrease in rice production.

Labor has no significant effect on the production of organic and inorganic rice in the District of Sawit, Boyolali regency. The relationship between Labor and organic rice production showed positive results because basically the use of Labor varies depending on the number of farmers who will hire it so that in other words, if adding labor can increase production although not significantly. Then for Labor Relations and inorganic rice production results have a negative relationship. this can occur because the amount of Labor use in inorganic rice production activities has exceeded the limit of the needs needed so that it results in a decrease in rice production. In addition, the majority of workers hired by inorganic rice farmers are aged 45 years and over so less productive in managing rice fields. Labor has no significant effect on the production of organic and inorganic rice in the District of Sawit because farmers in the field use different amounts of labor in accordance with the needs of landowners who should be able to do it themselves often farmers increase the number of workers without considering the results of production and increased costs but only more efficient in time but often do not increase their production.

Efficiency Analysis

Efficiency is the ratio of output to input in the form of factors of production. According to Farel and Timer in Sucihatiningsih (2013) said that efficiency can be divided into three, namely technical efficiency, price (allocative) and economical.

1) Technical Efficiency

Based on the calculation of technical efficiency with software Stochastic Frontier Production Function version 4.1 C obtained technical efficiency of organic rice production in the District of Sawit amounted to 0.9996, while for the average technical efficiency of inorganic rice farming in the District of Sawit amounted to 0.9544. both farms are close to technically efficient, but the average technical efficiency of organic rice farming is higher than the average technical efficiency of inorganic rice farming.

The farm can be said that it has not been able to combine production factors efficiently because the efficiency coefficient is less than 1. Organic and inorganic rice production in Sawit Sub-District has not been efficient due to the use of inputs in the form of land use, seeds, fertilizers, pesticides and the amount of labor that is not appropriate. The results of this study in line with the results of research from Pudaka et al., (2018) and Noer et al., (2018).

2) Allocative Efficiency

Based on the results of calculating the coefficient of price efficiency of all the use of organic rice production factors of -1.00 and the price efficiency of the use of inorganic rice production factors of -12.23. Both show a number less than one, meaning that the use of factors of production in rice farming in the District of Sawit Boyolali inefficient price. According to Soekawarti (2001) said that if coefficient price is less than 1 then the input needs to be reduced. Price inefficiency is caused by the use of pesticides and excessive labor inputs that make the costs incurred even greater. In addition, the price of pesticides that tend to be expensive, in addition to the lack of understanding and mentoring resulted in the use of pesticides that can reduce production.

3) Economic Efficiency

Economic efficiency is the result of a combination of technical efficiency and price efficiency. A production activity can be said to achieve economic efficiency when technical efficiency and price efficiency have been achieved first. Based on the calculation of economic efficiency coefficient obtained by -1.00 for organic rice and -11.67 for inorganic rice. This shows that economically organic and inorganic rice farming in the Sawit District of Boyolali regency has not been efficient because the calculation results are less than 1. This condition occurs due to farmers who have not been able to combine production factors of land area, seeds, fertilizers, pesticides and labor at a fixed price of production factors, so that rice production has not been maximized. The results of this study are in line with research (Arifin et al., 2018) which examines the production and income in rainfed rice fields and analyzes their efficiency, it is said that the use of rice farming inputs in rainfed rice fields is technically efficient and not yet efficient in price and economics.

CONCLUSION

This study demonstrates that organic rice farming in Sawit District, Boyolali Regency, achieves slightly higher production than inorganic rice farming under comparable land conditions. Land area, seeds, and fertilizer significantly influence rice production in both farming systems, whereas pesticides and labor do not. Organic rice farming also exhibits higher technical efficiency than inorganic farming, although neither farming system has yet achieved allocative or economic efficiency due to the suboptimal use of production inputs, particularly pesticides and labor.

The findings contribute to the literature on agricultural production efficiency by showing that organic rice farming can achieve higher technical efficiency while maintaining competitive production levels. Practically, the results suggest that improving input allocation, particularly reducing excessive pesticide and labor use, is essential for enhancing allocative and economic efficiency. Policy support through farmer training and agricultural extension services can further improve the sustainability and profitability of rice farming.

This study is limited by the inclusion of only five production input variables and the use of samples drawn exclusively from members of the Boyolali Organic Farmers Association (APOB), which may limit the generalizability of the findings. Future research should incorporate broader socio-economic, institutional, technological, and environmental variables, expand the study to different regions, and employ longitudinal data to better capture changes in production efficiency over time. Additionally, integrating environmental sustainability indicators with economic efficiency measures would provide a more comprehensive evaluation of organic and inorganic rice farming systems.

REFERENCES

Aji, E. N. (2019). Analisis Efisiensi Produksi Industri Mikro Kecil Batik di Kota Pekalongan Tahun 2016. *Indicators : Journal of Economic and Business*, *1*(1), 15–21. https://doi.org/10.47729/indicators.v1i1.47

Arifin, Wahditiya, A. A., Nirawati, & Biba, M. A. (2018). Efficiency and income of rice farming in rainfed lowland. *International Journal of Scientific and Technology Research*, *7*(2), 52–55.

Azwar, T. S., Noor, T. I., & Ernah, E. (2019). ANALISIS EFISIENSI USAHATANI PADI SAWAH LAHAN RAWA DI KABUPATEN CIAMIS (Suatu Kasus di Kecamatan Lakbok Kabupaten Ciamis). *Mimbar Agribisnis: Jurnal Pemikiran Masyarakat Ilmiah Berwawasan Agribisnis*, *5*(2), 276. https://doi.org/10.25157/ma.v5i2.2264

Baihaqi, A., Prasmatiwi, F. E., Rosanti, N., Agribisnis, P., Pertanian, F., & Lampung, U. (2022). Analysis of Production Efficiency and Revenue of the Legowo Jajar Rice

Business in Kramatwatu District, Serang Regency. *Jurnal Ekonomi Pertanian Dan Agribisnis (JEPA)*, *6*, 1236–1246. https://doi.org/10.21776/ub.jepa.2022.006.04.3

Fadlli, A., & Bowo, P. A. (2018). Efisiensi Faktor - Faktor Produksi Usaha Tani Ubi Kayu di Kabupaten Pati. *Efficient: Indonesian Journal of Development Economics*, *1*(3), 191–199. https://doi.org/10.15294/efficient.v1i3.27879

Golan, A., & Kohli, H. (2013). ASEAN Dynamism: Agricultural Transformation and Food Security. *Global Journal of Emerging Market Economies*, *5*(1), 3–21. https://doi.org/10.1177/0974910112469267

Hashimi, M. H., Hashimi, R., & Ryan, Q. (2020). Toxic Effects of Pesticides on Humans, Plants, Animals, Pollinators and Beneficial Organisms. *Asian Plant Research Journal*, *August*, 37–47. https://doi.org/10.9734/aprj/2020/v5i430114

Hilalullaily, R., Kusnadi, N., & Rachmina, D. (2021). Analisis Efisiensi Usahatani Padi di Jawa dan Luar Jawa, Kajian Prospek Peningkatan Produksi Padi Nasional. *Jurnal Agribisnis Indonesia*, *9*(2), 143–153. https://doi.org/10.29244/jai.2021.9.2.143-153

Nadziroh, M. N. (2020). Peran Sektor Pertanian Dalam Pertumbuhan Ekonomi Di Kabupaten Magetan. *Jurnal Agristan*, *2*(1), 52–60. https://doi.org/10.37058/ja.v2i1.2348

Nicholson, W. 2002. Mikroekonomi Intermediate. Jakarta: Erlangga.

Noer, S. R., Zakaria, W. A., & Murniati, K. (2018). Analisis Efisiensi Produksi Usahatani Padi Ladang Di Kecamatan Sidomulyo Kabupaten Lampung Selatan. *Jurnal Ilmu-Ilmu Agribisnis*, *6*(1), 17. https://doi.org/10.23960/jiia.v6i1.17-24

Olaniyi, J. O., & Ojetayo, A. E. (2011). Effect of fertilizer types on the growth and yield of two cabbage varieties. *Journal of Animal & Plant Sciences*, *12*(2), 1573–1582. http://www.m.elewa.org/JAPS/2011/12.2/5.pdf

Pudaka, D. L., Rusdarti, & Prasetyo, P. E. (2018). Efficency Analysis of Rice Production and Farmers' Income in Sengah Temila District Landak Regency. *Journal of Economic Education*, *7*(1), 31–38. http://journal.unnes.ac.id/sju/index.php/jeec

Hariono. (2022). Factors Affecting Organic And Non-Organic Rice Production In Muara Bulian District Batanghari Regency. *Jurnal Ilmiah Multidisiplin Indonesia (JIM-ID)*, *1*(01), 1–7. https://doi.org/10.58471/esaprom.v1i01.127

Soekartawi. 2001. Agribisnis Teori dan Aplikasinya. Jakarta: PT. Raja Grafindo Persada.

Soekartawi. 2016. Analisis Usahatani. Jakarta: UI-Press

Sucihatiningsih D.W.P. 2013. Metode Analisis Efisiensi Produksi dan Pengambilan Keputusan Bidang Ekonomi Pertanian. Semarang: UNNES Press

Sularso, K. E., & Sutanto, A. (2020). Efisiensi Teknis Usahatani Padi Sawah Organik Di Kabupaten Banyumas. *Jurnal Agribisnis Indonesia*, *8*(2), 142–151. https://doi.org/10.29244/jai.2020.8.2.142-151

Utama, A. P., Wahyono, H., & Witjaksono, M. (2016). *Efisiensi Pengambilan Keputusan Sumber Daya Ekonomi Konsumsi Produksi Mahasiswa*. *1*(4), 712–716.