Agriprimatech
Vol. 8 No. 2 Oktober 2025 e-ISSN : 2621-6566

EFFICIENCY ANALYSIS OF RICE (*ORYZA SATIVA* L.) FARMING BUSINESSES SIJAMBI VILLAGE, DATUK BANDAR DISTRICT TANJUNG BALAI CITY

Suci Fadilla[1], Nelfita Rizka S[2], Depari[3], Emma Fadhilah[4], Abraham Ismail Pulungan[5]

[1,2,3,4,5] *Universitas Nahdlatul Ulama, Sumatera Utara*
Email: emmaagribisnis@gmail.com

ABSTRACT

The purpose of this study is to determine the level of efficiency in the use of production factors in rice farming, to analyze the income levels obtained by farmers, and to provide input in the form of strategies and recommendations for farmers to improve their productivity and efficiency in the future. This research employed a descriptive quantitative method with a survey approach. Data were collected directly from farmers through interviews using questionnaires, and supplemented with secondary data from relevant institutions. The respondents were rice farmers in Sijambi Village, selected based on specific criteria. The collected data were then analyzed using the Cobb-Douglas production function model to measure the extent of efficiency in the use of production factors, as well as income analysis to determine farmers' profitability. The results show that farmers in Sijambi Village are generally quite efficient in utilizing production factors, particularly in the use of labor and fertilizers. However, inefficiencies were still found in the use of seeds and land management. The income levels obtained by farmers were relatively profitable, although there remains room for improvement to achieve more optimal results. The study recommends the adoption of modern agricultural technologies, the enhancement of farm management skills, and greater institutional support to increase rice production efficiency in the study area.

Keywords: *Efficiency, rice farming, production factors, farmers' income, Tanjungbalai City*

INTRODUCTION

Rice is a major staple food commodity in Indonesia and plays a strategic role in maintaining national food security. Most Indonesians rely on rice as their primary source of carbohydrates, so the demand for rice continues to increase in line with population growth and changing consumption patterns (Zaifah, 2022). Rice farming at the farmer level has its own dynamics, as its success is influenced not only by land availability but also by skills in managing production factors such as seeds, fertilizers, labor, and the use of agricultural technology. Efficient use of production factors is key to increasing crop yields and farmer incomes (Pipih et al., 2020).

Frequently encountered problems include limited land, suboptimal use of inputs, and limited access to modern technology. These conditions make it difficult for some farmers to achieve maximum efficiency. Therefore, an in-depth study of rice farming efficiency is needed to determine the extent to which productivity can be increased (Arfiansyah et al., 2024).

The Concept of Efficiency in Farming

Efficiency is a measure of the extent to which inputs are optimally used to produce a specific output. In the context of farming, efficiency can be seen in how farmers utilize production factors to achieve maximum yields at relatively low costs (Selfianus & Anggriani, 2024). According to production economics theory, there are three types of efficiency: technical efficiency, allocative efficiency, and economic efficiency. Technical efficiency relates to a farmer's ability to use inputs to produce output. Allocative efficiency relates to a farmer's ability to choose input combinations that align with market prices. Economic efficiency, on the other hand, is a combination of the two (Terpadu et al., 2023).

Production Factors in Rice Farming

The main production factors in rice farming include land, labor, seeds, fertilizers, and pesticides. Land serves as a planting medium, labor drives cultivation activities, seeds determine potential yields, fertilizers increase soil fertility, and pesticides protect plants from pests and diseases (Zaifah, 2022). The quality and quantity of production factors used will determine the level of farming productivity. For example, the use of superior seeds can increase crop yields, while balanced fertilization can maintain long-term soil fertility (Pipih et al., 2020).

Farming Income

Farmers' income is calculated from the difference between revenue and production costs. Revenue comes from rice sales, while costs include expenses for seeds, fertilizer, labor, and other production inputs. The level of efficiency significantly impacts the income received by farmers. Farmers who are able to manage inputs efficiently tend to earn higher incomes. Conversely, excessive or inappropriate use of inputs can result in losses even if the harvest is substantial (Arfiansyah et al., 2024).

Cobb-Douglas Production Model

In agricultural research, the Cobb-Douglas production function is often used to analyze the relationship between inputs and outputs. This model explains the contribution of each production factor to crop yields. Furthermore, this model can also be used to measure the level of technical efficiency (Selfianus & Anggriani, 2024). According to this theory, if the addition of one input results in a greater increase in output, then that input is considered efficient. However, if increasing inputs no longer significantly increases output, a condition of diminishing returns occurs (Terpadu et al., 2023).

Constraints in Rice Farming

Some constraints faced by farmers include limited capital, fluctuating fertilizer prices, pest and disease attacks, and climate change. These constraints often reduce farmers' ability to achieve optimal efficiency (Amalia et al., 2025). Government support in the form of fertilizer subsidies, agricultural extension, and agricultural equipment modernization programs is essential to help farmers improve their efficiency. Without such support, farmers will struggle to compete in increasingly complex market dynamics (Terpadu et al., 2023). By understanding efficiency theory, production factors, and the constraints faced, this research is expected to make a significant contribution to increasing the productivity and welfare of rice farmers. Furthermore, the research results can serve as a reference for policymakers in formulating food security strategies at the local and national levels (Keriting et al., 2025).

This research is expected to provide a realistic picture of the condition of rice farming in Sijambi Village, Datuk Bandar District, Tanjungbalai City. Furthermore, the results can also serve as a basis for formulating more effective strategies to increase farmer efficiency and income (Nurwansyah et al., 2023).

METHODS

Research Location

The research location was purposively selected in Sijambi Village, Datuk Bandar District, Tanjungbalai City. This location was chosen because the area is one of the rice production centers in Tanjungbalai City, and the majority of its population earns a living as rice farmers. Therefore, this location is considered representative for research on rice production efficiency (Lestari et al., 2023).

Research Methods and Census

This study employed a quantitative descriptive method with a survey approach. The respondents were rice farmers in Sijambi Village, selected using a census method, meaning all farmers who met the research criteria were sampled. The data collected consisted of primary and secondary data. Primary data was obtained through direct interviews using questionnaires, while secondary data was obtained from relevant agencies such as the Central Statistics Agency (BPS), the Department of Agriculture, and other literature (Deras & Gultom, 2023).

Analysis Method

The analysis methods used in this study are as follows:

1. Cobb-Douglas Production Function Analysis

This model is used to estimate the parameters of the rice production function in natural logarithmic form (Adistya et al., 2024):

$$\ln Y = \alpha_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + v_i - u_i$$

Description:
- Y = Rice production (kg)
- X1 = Land area (Ha)
- X2 = Seed (Kg)
- X3 = Fertilizer (Kg)
- X4 = Labor (HOK)
- X5 = Pesticide (Liter)
- X6 = Other agricultural chemicals
- α = Intercept
- β1,β2,...,β6 = Regression coefficient
- vi = Error term
- ui = Random variable representing the technical inefficiency of farmer i

2. Technical Efficiency Analysis

The technical efficiency of rice farming is estimated using the formula:

$$TE_i = \frac{y_i}{\hat{y}_i} = \exp(-u_i)$$

Information:
- yi = Actual output
- yi^ = Potential output
- TEi = Technical efficiency level of farmer i

3. Analysis of Factors Influencing Technical Inefficiency

To analyze the factors that influence technical inefficiency, a regression model is used with the equation:

$$TE = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4$$

Description:

- TE = Technical efficiency
- Z1 = Farmer's age (years)
- Z2 = Formal education level (years)
- Z3 = Farming experience (years)
- Z4 = Participation in farmer groups (dummy)
- δ = Regression coefficient

RESULT AND DISSCUSSION

The respondents in this study were all rice farmers in Sijambi Village, Datuk Bandar District, Tanjungbalai City, selected using a census method. The majority of respondents were male, with average land holdings relatively small, ranging from 0.25 to 0.50 hectares. Based on age data, most respondents were in their productive years, aged 30–55, thus offering significant potential for farming activities. In terms of education, most respondents had a junior high school (SMP) or senior high school (SMA) education, with only a small number having completed college. The average family size is 3–4 people, with approximately two dependents per farming household (Baihaqi et al., 2022).Rice farming costs in Sijambi Village consist of fixed costs and variable costs. Fixed costs include land taxes, equipment depreciation, and land rent. Variable costs include the purchase of seeds, fertilizers, pesticides, and labor wages. These variable costs constitute the largest component incurred by farmers each planting season (Sularso et al., 2019). Rice productivity at the study site averaged 4,800–5,200 kg/ha of harvested dry grain (GKP). With an average selling price of Rp 5,000–Rp 5,300/kg, farmers earned approximately Rp 24,000,000–Rp 27,000,000 per hectare per planting season. After deducting production costs, which average Rp 10,000,000–Rp 12,000,000 per hectare, net income for farmers ranged from Rp 14,000,000–Rp 16,000,000 per hectare per planting season. This indicates that rice farming in Sijambi Village is relatively profitable (Sularso & Sutanto, 2020).

STOCHASTIC FRONTIER PRODUCTION FUNCTION OF RICE FARMING

Based on the results of the analysis using the Cobb-Douglas production function through the Stochastic Frontier Analysis (SFA) approach, it was found that the production factors that significantly influenced rice productivity were land area, seed use, fertilizer, and labor. Meanwhile, pesticide use did not significantly impact production increases. This was because during the research planting season, plant pest infestations (OPT) were relatively low, so pesticides were only used for preventative purposes (Hilalullaily et al., 2021).The analysis also showed that labor had a negative impact when used excessively. Labor use exceeding the recommended dose (around 60 HOK/ha) actually reduced production efficiency. Conversely, land and superior seeds contributed significantly positively to rice production (Saputra et al., 2024).

The log likelihood value obtained from the Maximum Likelihood Estimation (MLE) method was greater than that from the Ordinary Least Squares (OLS) method, indicating that the SFA model better suited field conditions. The sigma-squared (σ^2) parameter is significant at the 1% confidence level, indicating production variation caused by technical inefficiency. Meanwhile, the gamma (γ) value approaches 1, indicating that almost all output variation is influenced by technical inefficiency factors that farmers can control, rather than solely by random factors such as weather or pest attacks (Arfiansyah et al., 2024). From the frontier production function estimation results, it can be concluded that the most determining production factors in rice farming in Sijambi Village are superior seeds, land area, and fertilizer. Meanwhile, technical efficiency can still be improved through better labor management and optimizing the use of production inputs according to recommended dosages (Selfianus & Anggriani, 2024).

SOURCES OF TECHNICAL INEFFICIENCY

Table 1. Sample Characteristics by Education in Sijambi Village, Datuk Bandar District

No	Education Level Percentage (%)	Number (people)	Percentage (%)
1	Didn't graduate elementary school	3	6,38%
2	Graduate Eelementary School	21	44,68%
3	Junior High School	8	17,02%
4	Senior High School	10	21,28%
5	Bachelor	4	8,51%
6	SLTTP	1	2,13%
	Total	47	100%

Table 2. Sample Characteristics According to the Number of Dependents in

No	Number of Dependents	Number of Samples (people)	Percentage (%)
1	1–2 people	18	51,42%
2	3–4 people	12	34,28%
3	5–6 people	5	14,29%
	Total	35	100%

Sijambi Village, Datuk Bandar District

Table 3.Sample Characteristics According to Farming Experience in Sijambi Village, Datuk Bandar District

No	Farming Experience	Number (people)	Percentage (%)
1	5–20 tahun	26	74,28%
2	21–35 tahun	6	17,14%
3	36–70 tahun	3	8,58%
	Total	35	100%

Table 4. Results of Technical Efficiency Test Using Cobb-Douglass Production Function

Variabel	Coefisien B
Constant (Y)	5.036
Land Area	0.882
Seeds	-0.344
Fertilizer	0.410
Pestiside	-0.070
Labor	0.320
Average	0.240

Tabel 5. Return to scale

Variable	Regression Coefficient	Unit Average	MVP	*Return to scale*
Land Area (X1)	0.882	0,64	0,0058	*Decreasing Retrun to Scale*
Seeds (X2)	-0.344	24	0,1401	*Decreasing Retrun to Scale*
Fertilizer (X3)	0.410	257	0,0095	*Decreasing Retrun to Scale*
Pestiside (X4)	-0.070	1,61	0,0454	*Decreasing Retrun to Scale*
Labor (X5)	0.320	66	0,0075	*Decreasing Retrun to Scale*

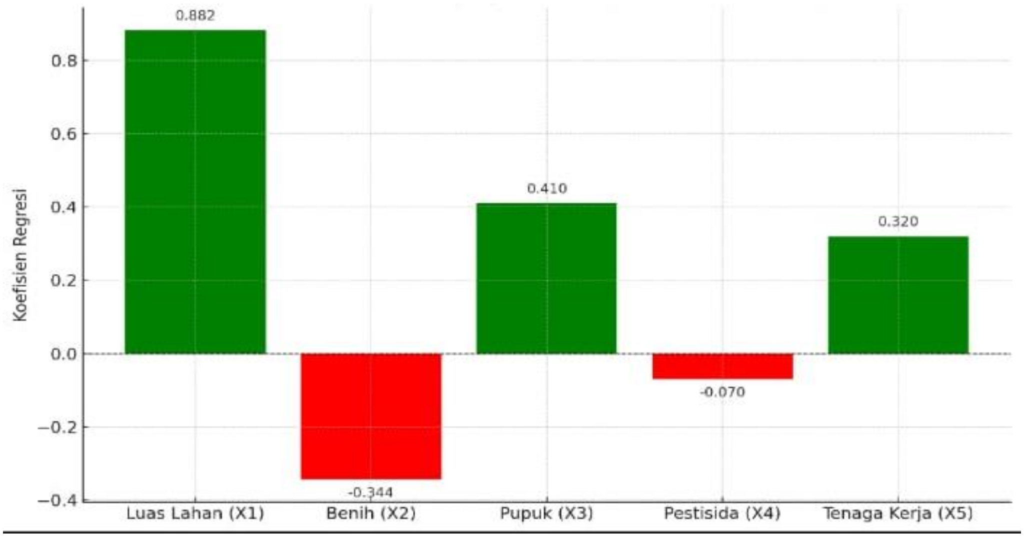

Figure 1. Graph of Regression Coefficients for Each Production Input.

Tabel 6. Efficiency of Rice Farming Factors

Production Factor	MVPxi/Pxi	Explanation
Land Area x1	0,0096	Not efficient
Seeds X2	0,0058	Not efficient
Fertilizer X3	0,0369	Not efficient
Pestiside X4	0,0281	Not efficient
Labor X5	0,0001	Not efficient
Average	0,0161	Not efficient

Based on the calculations, it can be seen that, on average, lowland rice farming in Sijambi Village is not yet price efficient. This means that the marginal product value (MVP) is still not balanced with the prices of production factors, so farmers are unable to achieve the maximum profit they should. The calculations show an average price efficiency value of 1.083, indicating that lowland rice farming is still not price efficient. Therefore, increasing output is necessary to achieve price efficiency (Deras & Gultom, 2023).

More specifically, the price efficiency calculation for the production factor of land area yielded a MVPxi/Pxi value of 0.0096, indicating that its use is not price efficient. In this context, land area efficiency is measured based on the land rental costs incurred by local farmers (Adistya et al., 2024). For the production factor of seeds, the price efficiency value (MVPxi/Pxi) was recorded at 0.0058, less than one. This indicates that seed use in lowland rice farming is still not price efficient.

Similarly, for the fertilizer production factor, the price efficiency value (MVPxi/Pxi) was 0.0369, also lower than one. This condition confirms that fertilizer utilization in lowland rice farming in Sijambi Village, Datuk Bandar District, has not yet achieved the desired level of price efficiency (Baihaqi et al., 2022). The analysis results show that the MVPxi value for pesticide use is less than 1, at 0.0281. This indicates that pesticide use at the study site is inefficient. Furthermore, the MVPxi/Pxi calculation for the labor production factor is also less than 1, at 0.0001, indicating that labor use in the study area is inefficient. This condition indicates that the labor used in a single rice production process has not yet achieved efficiency (Sularso et al., 2019).

Based on the MVPxi/Pxi calculation for all rice farming production factors, the price/allocative efficiency value is 0.0161. This figure confirms that rice farming in Sijambi Village, Datuk Bandar District, is still inefficient in terms of price. Therefore, increased production output is needed to achieve price efficiency, thereby maximizing farmers' profits (Sularso & Sutanto, 2020).

The analysis shows that several factors influence technical efficiency, namely farmer age, education level, farming experience, and land area. The estimation results show that farmers' formal education has a negative and significant effect, meaning that the higher the farmer's education level, the lower the level of technical inefficiency. This indicates that education plays a significant role in improving farmers' ability to absorb new technologies, understand information related to rice cultivation, and make informed decisions regarding the use of production inputs (Sularso et al., 2019).

Farming experience also influences technical inefficiency. Although the average farmer in Sijambi has a long experience (more than 10 years), most of this experience is still dominated by conventional farming systems. Therefore, their ability to apply modern and efficient farming techniques is limited. In other words, greater experience does not necessarily translate into increased efficiency if it is not accompanied by increased knowledge and new skills (Sularso & Sutanto, 2020).

Farmer age does not significantly influence technical inefficiency. Young or old age is not a primary determinant in farm management, as what matters more is the extent to which farmers have access to appropriate agricultural knowledge and technology. While productive-age farmers do have greater energy and enthusiasm, without adequate managerial skills, yields will be suboptimal (Hilalullaily et al., 2021). Furthermore, land area also contributes to variations in technical inefficiency. Farmers with larger plots of land tend to have more efficient business scales because they can utilize inputs optimally. Conversely, limited land often limits input use proportionally, potentially reducing efficiency (Saputra et al., 2024).

In general, the average technical efficiency of rice farming in Sijambi Village is in the range of 0.75–0.80, meaning farmers have achieved approximately 75–80% of their maximum production potential. This indicates that there is still a 20–25% opportunity to increase production yields through optimizing input use (Zaifah, 2022). Thus, it can be concluded that formal education, quality experience, and good land management are key factors in reducing technical inefficiency. Therefore, the recommended strategy is to increase farmer capacity through extension services, training in modern agricultural technology, and government support in providing more effective production facilities (Pipih et al., 2020).

CONCLUSION AND SUGGESTIONS

Conclusion

1. Production factors such as seeds, manure, liquid organic fertilizer, liquid organic KCl fertilizer, and nutrients have been shown to have a positive effect on increasing rice farming productivity in Sijambi Village. Conversely, labor usage negatively impacted productivity, while pesticide use had no significant effect on yield.
2. The technical efficiency level of rice farming at the study site varied between 0.50 and 0.99, with an average value of 0.78. This indicates that, in general, rice farming in Sijambi is technically efficient, but there is still an opportunity to increase production by 22% through optimizing the use of production inputs and improving farm management.
3. The source of technical inefficiency is primarily influenced by the farmer's level of formal education. The higher the farmer's education, the lower the level of technical inefficiency. Conversely, membership in a farmer group actually increases technical inefficiency because some farmers are less active in group activities. Therefore, education and active participation of farmers in farmer groups are key to increasing production efficiency.

Recommendations

1. Farmers need to optimize the use of superior seeds and organic fertilizers (manure, POC, and liquid organic KCl) according to recommended dosages to maximize productivity.
2. Labor utilization should be adjusted to actual field needs to avoid wasteful costs and reduce technical inefficiencies.
3. Regional governments and related agencies need to provide training and mentoring for farmers, particularly regarding the application of modern agricultural technology and farm management.
4. Improving the quality of formal and non-formal education (extension and training) for farmers is crucial so they can manage their farms more efficiently and adapt to technological developments.

REFERENCES

Adistya, A., Nurmalina, R., & Tinaprilla, N. (2024). Determinan Keputusan Petani Mengelola Usahatani Padi Di Lahan Suboptimal. *Forum Agribisnis*, *14*(2), 41–49. https://doi.org/10.29244/fagb.14.2.41-49

Amalia, A., Fahraini, F. I., Azahra, E. F., Pamela, V. Y., & Eris, F. R. (2025). Sistem Penanganan dan Budidaya Pascapanen Bunga Telang Di Kecamatan Serang, Kota Serang. *Jurnal Ilmu Pertanian Tirtayasa*, *7*(1), 441–448. https://doi.org/10.33512/jipt.v7i1.32947

Arfiansyah, D. N., Anggraeni, D., & Saleh, K. (2024). Analisis Efisiensi Penggunaan Input Produksi Usahatani Padi Sawah (Oryza sativa L.) Di Desa Sukajaya Kecamatan Pontang Kabupaten Serang. *Jurnal Ilmu Pertanian Tirtayasa*, *6*(2), 429–440. https://doi.org/10.33512/jipt.v6i2.26808

Baihaqi, A., Prasmatiwi, F. E., & Rosanti, N. (2022). Analysis of Production Efficiency and Revenue of the Legowo Jajar Rice Business in Kramatwatu District, Serang Regency. *Jurnal Ekonomi Pertanian dan Agribisnis*, *6*(4), 1236–1246. https://doi.org/10.21776/ub.jepa.2022.006.04.3

Deras, S., & Gultom, M. (2023). Efesiensi Usahatani Padi Sawah Pada Musim Hujan dan Musim Kemarau. *Jurnal Agriust*, *3*(1), 32–37. https://doi.org/10.54367/agriust.v3i1.2581

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

Keriting, M., Kasus, S., Kecamatan, D. I., Pratiwi, W., Pancawati, J., Budiaji, W., & Mulyati, S. (2025). *ANALISIS EFISIENSI PRODUKSI USAHATANI CABAI BAROS , KABUPATEN SERANG) Analysis of Production Efficiency of Curly Red Chili Farming (Case Study in Baros District , Serang Regency)*. *18*(1), 81–99.

Lestari, S. P., Handayani, S., Aryani, E., & Kristina, M. (2023). Efisiensi Teknis Usahatani Padi Organik Di Provinsi Lampung. *Jurnal Ekonomi Pertanian dan Agribisnis*, *7*(3), 1169. https://doi.org/10.21776/ub.jepa.2023.007.03.22

Nurwansyah, I., Ilsan, M., & Amran, F. D. (2023). ANALISIS EFISIENSI ALOKATIF PENGGUNAAN UNSUR PRODUKSI USAHATANI PADI SAWAH TADAH HUJAN (Studi Kasus di Desa Limampoccoe, Kecamatan Cenrana, Kabupaten Maros). *Wiratani: Jurnal Ilmiah Agribisnis*, *4*(2), 160. https://doi.org/10.33096/wiratani.v4i2.196

Pipih, P., Aliudin, A., & Saleh, K. (2020). Efisiensi Penggunaan Input Produksi Usahatani Padi Sawah Antara Sistem Irigasi Teknis Dan Sistem Pompanisasi. *Jurnal Agribisnis Terpadu*, *13*(1), 68. https://doi.org/10.33512/jat.v13i1.6898

Saputra, I. W. O. P. J., Mutisari, R., Wisyawati, W., & Nugroho, C. P. (2024). Analisis Efisiensi Teknis dan Pengaruh Adaptasi Perubahan Iklim terhadap Usaha Tani Padi (Oryza Sativa) di Desa Randuagung. *Jurnal Ekonomi Pertanian dan Agribisnis (JEPA)*, *8*, 1004–1016. https://doi.org/10.21776/ub.jepa.2024.008.03.15

Selfianus, & Anggriani, Y. (2024). Analisis Faktor Faktor Yang Mempengaruhi Produksi Dan Pendapatan Petani Padi Sawah (Oryza Sativa L) Di Desa Legu Woda Kecamatan Magepanda Kabupaten Sikka. *Jurnal Biogenerasi*, *10*(1), 339–346. https://doi.org/10.30605/biogenerasi.v10i1.4670

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

Sularso, K. E., Sutanto, A., Cahyono, B. I., & Arimurti, N. H. (2019). Efisiensi Alokatif Usahatani Padi Organik Lahan Sawah Di Kabupaten Banyumas. *JSEP (Journal of Social and Agricultural Economics)*, *12*(3), 1. https://doi.org/10.19184/jsep.v12i03.14303

Terpadu, J. A., Murgas, E. M., Natsir, M., Studi, P., Fakultas, A., Universitas, P., Makassar, M., Studi, P., Fakultas, A., Universitas, P., Makassar, M., Studi, P., Fakultas, A., Universitas, P., & Makassar, M. (2023). *Efisiensi Frontier Usahatani Bawang Merah*. *16*(2), 118–133. https://jurnal.fp.umi.ac.id/index.php/agrotekmas/article/view/399

Zaifah, F. (2022). *40375-149797-1-Pb*. *7*, 57–69.