Factors Affecting the Production Risk of Organic Rice in Kulonprogo Regency, Special Region of Yogyakarta, Indonesia

Eni Istiyanti[1,*], *Mona* Fairuz Ramli[2] and *Muhammad* Naufan Firmansyah[1]

[1] Department of Agribusiness, Faculty of Agricultura, Universitas Muhammadiyah Yogyakarta, Indonesia
[2] Department of Marketing, Faculty Business and Science Management, Kolej Universiti Islam Perlis, Malaysia

Abstract. The organic farming system is an all-natural agricultural system without chemical substances. However, the organic farming system should consider several concerning factors, particularly the chosen fertilizer. Since organic fertilizers are low in nutrients, they must be used in greater amounts. Similarly, using plant-based insecticides for pests and disease control can be quite slow. The present study analyzes the levels and factors affecting organic rice farming production risk. The research was conducted in Kulonprogo Regency as a pioneer of organic farming with certified farmer groups from the Organic Certification Institute. The data collection uses a census approach; all members of the farmer groups, totaling 88 farmers, were the research respondents. The level of production risk of organic rice is analyzed using the Coefficient of Variation model (CV). Meanwhile, the factors affecting the production risk of organic rice are evaluated using the production function of Just and Pope's production risk model and Cobb-Douglas's natural logarithmic form. The production risk of organic rice for farmers with owned and non-owned land is in the low category. Meanwhile, land area and status can affect the production risk of organic rice. The wider land employed for organic rice farming, the greater the production risk. Farmers in Kulonprogo Regency should continue to use organic rice farming because the production risk is low.

1 Introduction

The organic farming system is an agricultural system that uses natural ingredients without chemicals. This agricultural system must pay attention to the principles of ecology, health, justice, and its impact on the environment [1]. An organic farming system is an agricultural system that does not use synthetic chemical inputs and only uses natural ingredients in the form of organic matter or organic fertilizers. Providing organic fertilizers to reduce inorganic fertilizer usage can result in the same growth and yield as using 100% inorganic fertilizer [2]. Organic farming offers environmental advantages such as improved land management and the absence of environmental contamination. This system focuses on the nutritional, health,

* Corresponding author: eniistiyanti@umy.ac.id

and economic value of products of targeted consumers, prioritizing the quality rather than rice [3]. Organic rice is a solution for people seeking to consume food products with minimal chemical content [4].

Organic rice production in Indonesia is currently constrained by several obstacles, such as farmers' limited comprehension of organic principles, inconsistent availability of high-quality and sufficient quantities of organic rice, the need for certification to ensure product authenticity, and a lack of market stability [5]. The extent of organic rice production is significantly impacted by the knowledge connected to farming organically. The level of organic rice production is strongly influenced by the knowledge related to organic farming. A previous study reported that 59.2% of farmers in Temon District have high knowledge of organic farming, 40% have moderate knowledge, and 0.8% are still lacking knowledge [6].

The production of organic rice in Indonesia is currently insufficient to meet the demands of the community. In 2018, the total land area allocated to organic farming in Indonesia was 251,630.98 hectares, which accounted for around 3.1% of the country's overall agricultural land area of 8,087,393 hectares. Meanwhile, the land area for organic rice commodities was 53,974.19 hectares [7]. Indonesia's total rice harvest area in 2018 was 11,377,934.44 hectares [8]. Based on this data, the harvested area of organic rice is only about 5% of the total rice area. Efforts have been made to expand the area of organic rice.

Agriculture is a sector that is often faced with uncertain natural risks. Risk has a close relationship with uncertainty because of the lack of information on conditions that will occur. The definition of risk comprises three major elements: (a) the fact that risk is an incident, (b) a certain probability rate of happening, and (c) the fact that it can result in certain losses if it does occur. The production risk of rice farming in the dry season is lower than in the rainy season [9]. The risk of production of paddy is also higher on non-owned land than land with self-owned status [10]. Organic fertilizers contain lower nutrients than chemical fertilizers, which are needed in larger quantities. Controlling pests and plant diseases using plant-based pesticides also takes longer because the eradication power of plant-based pesticides is lower than chemical pesticides. This situation can lead to a risk of decreased production due to pest and disease attacks.

The aim of this study is to determine the level of production risk and analyze the factors that influence production risk in organic rice farming in Kulonprogo Regency, Special Region of Yogyakarta.

2 Research method

The study was carried out in the Nanggulan District of Kulonprogo Regency, considering that this area is a pioneer of organic farming. Furthermore, the research location has three farmer groups (Srijati, Tegal Mulyo, and Jatingarang Lor farmer groups) which have received official certification from the Organic Certification Institute (*Lembaga Sertifikasi Organik* or LSO) for rice production land since 2020. The data were collected using the census method for all members of the three farmer groups, totaling 88 farmers, as respondents. This study includes primary data collected through interviews with respondents using questionnaires, as well as secondary data obtained from relevant institutions such as the Indonesian Central Statistics Agency (*Badan Pusat Statistik* or BPS), Agriculture Service, Agricultural Training Center (*Balai Penyuluhan Pertanian* or BPP), and Farmer Groups.

The first objective of this study is to determine the level of production risk of organic rice using the coefficient of variation formulated in Equation (1).

$$CV = \frac{\sigma}{\bar{y}} \tag{1}$$

$$\sigma=\sqrt{\frac{(y-\bar{y})^2}{n}} \quad (2)$$

where, *CV* was the coefficient of variation; σ was Standard deviation of organic rice production; $\bar{Y}$ was the average of organic rice production

If the coefficient of variation (*CV*) is more than 0.5, the farm being analyzed has a considerable risk of farmer losses. Conversely, if the *CV* is less than 0.5, the farm is categorized as low risk, or farmers will always make a profit or reach the breakeven point [11].

The research used the Just and Pope model equation to measure production risk, which includes a production function and a production variance function. The most used production function in Just and Pope's production risk model is the Cobb-Douglas production function in natural logarithmic form [12].

In analyzing factors affecting organic rice production using the Cobb-Douglass production function, values conversion into natural logarithms was performed (Equation 3).

$$Ln\ Y = Lnb_0 + b_1\ Ln\ X_1 + b_2\ Ln\ X_2 + b_3\ Ln\ X_3 + b_4\ Ln\ X_4 + b_5\ Ln\ X_5 + b_6\ Ln\ X_6 + b_7\ Ln\ X_7 + b_{ls}\ D_{ls} + e \quad (3)$$

The factors affecting production risk are analyzed using the Cobb-Douglas production function, where the residual error (e^2) is the dependent variable, and the use of production factors (*X1-X7*), and land status is the independent variable. Therefore, the obtained mathematical formula is written in Equation 4.

$$Ln\ e^2 = Ln\ \beta_0 + \beta_1\ Ln\ X_1 + \beta_2\ Ln\ X_2 + \beta_3\ Ln\ X_3 + \beta_4\ Ln\ X_4 + \beta_5\ Ln\ X_5 + \beta_6\ Ln\ X_6 + \beta_7\ Ln\ X_7 + \beta_{ls}\ D_{ls} + u \quad (4)$$

Y = The organic rice production (kg)
e^2 = Organic rice of Production risk (residual square)
b_0, β_0 = Intercept
b_n, β_n = Coefficient of regression (n = 1, 2…7)
X_1 = Land area(ha)
X_2 = Seed (kg)
X_3 = Solid organic fertilizer (kg)
X_4 = Liquid organic fertilizer (l)
X_5 = Organic pesticide (kg)
X_6 = Family labor (working days)
X_7 = non-family labor (working days)
Dls = Land status dummy (0 = not owned, 1 = own)
u = term error

The present study employed the F-test (Equation 5) to ascertain the overall effect of the production factor on the production risk of organic rice.

$$F_{count} = \frac{R^2(k-1)}{(1-R^2)(n-k)} \quad (5)$$

Description, R^2 was determination coefficient, k was variables number; n was samples number

H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_{ls} = 0$, factor of production ($X$) together does not significantly influence the production risk of organic rice.

H_1: one of β_i or $\beta_{ls} \neq 0$, indicating that the factor of production (X) together significantly effects on the production risk of organic rice production.

Criteria for decision-making:
If the F_{count} is more than the $F_{table\ (k-1,\ n-k)}$, then the H_0 is rejected, indicating that the production factor (*X*) has significant effects on the production risk of organic rice.
If the F_{count} is less than the $F_{table\ (k-1,\ n-k)}$, then there is insufficient evidence to reject H_0, indicating that the production factor (*X*) does not have a significant effect on the production risk of organic rice.

The impact of each production factor on production risk is assessed by the use of the t-test, based on the following hypothesis:
H_0: $\beta_i = 0$, suggests that the production factors (i) have no significant effect on the production risk of organic rice.
H_1 : βi or $\beta_{ls} \neq 0$, it indicates that the factor of production (i) have a significant effect on the production risk of organic rice.

$$T_{count} = \frac{\beta i}{S(\beta i)} \quad (6)$$

Description:
β_i = Coefficient of regression
$S(\beta_i)$ = Standard deviation of β_i

Decision-making:
If t_{count} is more than t_{table}, therefore, H_0 is rejected, indicating that the i-th production factor exerts a statistically significant influence on the production risk of organic rice.
If t_{count} is less than the t_{table}, then there is not enough evidence to reject the null hypothesis (H_0), and the i-th production factor does not have significant effect on the production risk of organic rice.

3 Results and discussion

3.1 The characteristics of organic rice farmers

The respondents in this research included 88 farmers who are members of an organic rice farmer group in Kulonprogo Regency have the characteristics illustrated in Table 1.

Table 1. The characteristics of organic rice farmers in Kulonprogo Regency

Characteristic	Frequency (person)	Percentage (%)	Characteristic	Frequency (person)	Percentage (%)
Age (years)			**Number of family members (person)**		
29 – 40	3	3.41	1 – 3	50	56.82
41 – 52	20	22.73	4 – 6	35	39.77
53 – 64	34	38.64	7 – 9	3	3.41
65 – 76	30	34.09	**Land Area (m^2)**		
>76	1	1.14	300 – 2,500	67	76.14
Education			2,600 – 4,800	11	12.50
Elementary School	22	25.00	4,900 – 7,100	8	9.09
Junior High School	9	10.23	7,200 – 9,400	2	2.27
Senior High School	46	52.27	**Land Status**		
College	11	12.50	Owned	67	76.14
Farming organic rice experience (years)			Rent	5	5.68
1 – 3	9	10.23	Profit Sharing	16	18.18
4 – 6	24	27.27			
7 – 9	38	43.18			
≥10	17	19.32			

The result displays that 65% of organic rice farmers in Kulonprogo Regency are of productive age (< 65 years) [13]. Farmers of productive age tend to excel at work and have different ways of thinking when managing their farms, and they are more courageous in making decisions [14]. The average age of organic rice farmers is 59 years, and they fall into the old age category. Therefore, non-family workers perform some of the heavy labor in organic rice farming, including clearing the field, planting, and harvesting. The age of organic rice farmers in Kulonprogo Regency is younger than the age of semi-organic rice farmers in Bantul Regency (60.8 years) [15] but is relatively older than organic rice farmers in Thailand with an average age of 57 years [16], and organic rice farmers in Nepal, namely 45 years [17].

Based on the education level, almost 50% of organic rice farmers have completed formal senior high school education. The education level of organic rice farmers is no different from that of organic rice farmers in Bantul Regency [18] but is relatively higher than organic rice farmers in Thailand, with mostly elementary school graduate farmers [16]. The level of education also influences farmers' ability to accept and implement various innovations in farming development. Farmers or agricultural extension workers can obtain knowledge and skills in organic rice farming through farmer group activities. In agriculture, farmer groups serve three primary purposes: they offer spaces for education, work as production units, and foster teamwork [19].

One factor influencing farmer performance was their experience in employing farming techniques [20]. The average organic rice farming experience was seven years, ranging from one year to a maximum of thirteen years. Farmers have acquired knowledge of the optimal techniques for farming organic rice over an extended duration.

Based on the number of dependent family members, 56.82% of organic rice farmers have dependent family members in the range of 1-3 people. Apart from that, 39.77% of organic rice farmers have dependent family members in the range of 4-6 people, and 3.41% of organic rice farmers have dependent family members in the range of 7-9 people. The substantial number of family members will influence the use of labor in the family to help farmers run organic rice farming. Most organic rice farmers have family members of 1-3 people, which differs from organic rice farmers in Thailand, where most families comprise 4-6 people [16].

Based on the land area used in organic rice farming, 76.14% of farmers use land in the 300 – 2,500 m^2 range, with an average area of 2,027 m^2 per farmer. The area of organic rice farming land in Kulonprogo is narrower than that in Malang Regency, with an average of 4,800 m^2 [21], and Sleman Regency, with an average of 3,900 m^2 [22]. Based on land ownership status, 76.14% of farmers use personal land to run organic rice farming, 5.68% employ rented land, and 18.18% use other people's land with a profit-sharing system. The profit-sharing system allows the landowner to get half of the production without paying any costs for his farming activities, while the sharecroppers get half of the production by covering all costs incurred during the farming process. The land ownership status of organic rice farmers in Kulonprogo Regency is similar to that of organic rice farmers in Malang Regency [21] and Bantul Regency, Special Region of Yogyakarta [15].

3.2 The production risk

The production risk of organic rice in Kulonprogo was analyzed using the coefficient of variation (CV). Table 2 presents the analytical findings of the coefficient of variation according to land status.

Table 2 shows that the coefficient of variation in organic rice production on owned land exceeds that on non-owned land, indicating that the production risk related to organic rice farming on owned land is greater than non-owned land. Farmers who use their land tend to be willing to take risks because using private land gives them the confidence to invest [23].

The coefficient of variation of organic rice production with land owned by farmers themselves or land not owned by farmers, regardless of the land status, was less than 0.5, suggesting a low-risk classification. The findings of this study align with the production risk of organic rice in Gowa Regency, South Sulawesi Province [24], but contradict that in Alue Merbabu Village [11]. The negligible production risk of organic rice in Kulonprogo Regency shows that almost the same amount of rice is produced for the same land area, and the process is based on the organic rice Standard Operational Procedure (SOP). Farmers have implemented all stages of the production process contained in the SOP. Extended implementation of organic rice farming has lower production risk [25].

Table 2. The coefficient of variation of organic rice production in Kulonprogo Regency

Description	Land Status	
	Owned land	Non-owned land
Average production of organic rice (kg)	1246.91	1238.10
Production standard deviation (kg)	96.46	89.77
Coefficient of variation	0.077	0.073

Farmers must anticipate the production risk in organic rice to prevent them from experiencing significant losses [26]. Organic rice farming, being a budding industry, presents inherent risks, as exemplified in Northern Nigeria, where the primary sources of risk in rice production are mostly technological and financial [27]. Farmers have encountered some risks, including adverse weather conditions, climate change, pest infestations, and challenges accessing loan money [26].

3.3 The production function in organic rice

The Cobb-Douglas production function can be used for analyzing the factors impacting organic rice production, with organic rice production as the dependent variable and the independent variables consist of land area, seeds, solid organic fertilizer, liquid organic fertilizer, organic pesticides, family labor, non-family labor and land status. The results of analysis of Cobb-Douglass production function are presented in Table 3.

Table 3. Analysis of factors affecting organic rice production in Kulonprogo Regency

Variable	Regression coefficient	T-ratio
(Constant)	0.665***	-3.006
Land area (X_1)	1.011***	35.389
Seed (X_2)	-0.009**	-2.158
Solid organic fertilizer (X_3)	0.005	1.095
Liquid organic fertilizer (X_4)	-0.001	-0.137
Organic pesticides (X_5)	-0.003	-0.450
Family labor (X_6)	-0.044**	-2.028
Non-family labor (X_7)	-0.023	-1.115
Land status (D)	-0.005	-0.279
R-square	0.992	
F-critical	1225.78***	

Information:
*** = Significant at an error rate of 1%
** = Significant at an error rate of 5%

The obtained coefficient of determination is 0.992, indicating that 99.2% of the variance in organic rice production can be explained by the independent variables (land area, seeds, solid organic fertilizer, liquid organic fertilizer, organic pesticides, family labor, outside family labor, and land status). Meanwhile, 0.8% of the variation was caused by other factors

excluded in the model, such as farming experience, level of farmer's education, climate change, and irrigation systems. The analysis of variance indicates that all production factors considered (land area, seeds, solid organic fertilizer, liquid organic fertilizer, organic pesticides, family labor, outside family labor, and land status) influence organic rice production.

The regression coefficients that have a positive value are land area and solid organic fertilizer, while those that have a negative value are seeds, liquid organic fertilizer, labor within the family, labor outside the family, and land status. The production factor of land area significantly affects organic rice production with a regression coefficient of 1.011. The result indicates that a 1% increase in land area results in a 1.011% increase organic rice production. This situation aligns with a previous study that reported the influence of land on rice production in Madiun Regency [28]. Farmers can add more land by renting or using other land by profit sharing. According to [29], land area is one of the crucial factors affecting the production amount; the wider the land used for farming, the higher the production.

The production factors of seed and labor in the family have a significant effect, but the regression coefficient is negative, which means that if seed or labor in the family is increased partially, organic rice production will decrease. The production factors of solid organic fertilizer, liquid organic fertilizer, organic pesticides, labor outside the family, and land status do not significantly affect organic rice production. A constant of 0.665 implies that the minimal organic rice production by farmers was 0.665 kg.

3.4 Analysis of factors affecting the production risk

Factors influencing the production risk of organic rice were analyzed using the Cobb-Douglass production function with Just and Pope approach. The dependent variable is production risk, measured using residual squares from production function, and the independent variables consist of land area, seeds, solid organic fertilizer, liquid organic fertilizer, organic pesticides, the family labor, outside family labor and land status. The analysis results of factors that influence production risk are presented in Table 4.

Table 4. The factors influencing production risk of organic rice in Kulonprogo Regency

Variable	Regression coefficient	T-ratio
(Constant)	0.051	-1.117
Land area (X_1)	0.900*	1.691
Seed (X_2)	-0.060	-0.767
Solid organic fertilizer (X_3)	0.110	1.331
Liquid organic fertilizer (X_4)	0.150	0.752
Organic pesticides (X_5)	-0.034	-0.319
Family labor (X_6)	0.576	1.436
Non-family labor (X_7)	0.445	1.176
Land status (D)	7.929***	23.418
R-square	0.894	
F-ratio	83.014***	

Information:
*** = Significant at an error rate of 1%
* = Significant at an error rate of 10%

According to Table 4, the coefficient of determination (R^2) was 0.894, indicating that 89.4% of the variability in the dependent variable production risk, can be explained by the independent variables: land area, seeds, solid organic fertilizer, liquid organic fertilizer, organic pesticides, family labor, non-family labor, and land status. The remaining 10.6% is explained by other variables not included in the model (i.e., climate change, pets and diseases, and nutrient or soil conditions). The variance analysis showed an F-ratio of 83.014, while the

F-table value of 2.610 was at a 1% error rate. Independent variables, including land area, seeds, solid organic fertilizers, liquid organic fertilizers, organic pesticides, family labor, non-family labor, and land status, significantly influenced production risk. Equation 7 illustrates the mathematical formula for the production risk function.

$$Ln\ e^2 = Ln\ 0.051 + 0.900\ LnX_1 - 0.606\ LnX_2 + 0.110\ LnX_3 + 0.150\ Ln\ X_4 - 0.034\ Ln\ X_5 + 0.576\ Ln\ X_6 + 0.445\ Ln\ X7 + 7.929\ D_{ls} \quad (7)$$

The T-test was used to determine the impact of each independent variable on the dependent variable. The regression coefficient for the land area was 0.900, significant at a 10% error rate. The findings indicate that land increases by 1% while other factors remain constant, resulting in a 0.9% rise in production risk. The broader the land used for organic rice farming, the greater the production risk. The result is in line with a previous study [29], which stated that land area significantly affected the production risk of organic rice in the Special Region of Yogyakarta [12]. However, another research [31] found that the wider the organic rice farming area, the smaller the risk. Therefore, organic rice farmers in Kulonprogo can increase organic rice production by expanding their land but must apply appropriate farming methods to minimize risks.

The dummy variable of land status value is d=1 for owned land and d=0 for non-owned land. The land status regression coefficient was obtained at 7.929 and was significant. The obtained value shows differences in production risk in various land statuses. The production risk on owned land is higher than on non-owned land, such as land rented and profit-sharing. These findings corroborate a previous study [32], which found that farmers who own their land are more inclined to take risks due to the security of land ownership. The present study found that 76% of organic rice farmers in Kulonprogo Regency use owned land for farming.

The regression coefficient for seed use is -0.606 and is not significant. If seed use is increased and other factors remain constant, the production risk of organic rice tends to decrease. This situation aligns with previous research [33], which found that adding seeds can reduce the risk of rice farming production in West Tanjung Jabung Regency. If the quality of the seeds is enhanced, the production risk will decline, and production will rise naturally [34]. Regarding organic rice seeds in Kulonprogo Regency, several sample farmers utilized self-produced seeds. Most farmers use the Ciherang and Inpari 32 seed varieties with “Jajar Legowo” planting system. Furthermore, the farmers were a tendency to pay less attention to the quality of the seeds, making it a production risk for organic rice.

Solid organic fertilizer has a regression coefficient of 0.110 and has no significant effect. The findings suggest that adding more solid organic fertilizer can maintain the same levels of other productivity parameters. The findings of this study display a tendency to increase the production risk of organic rice. It is in line with [34] that applying organic fertilizers in sufficient quantities did not affect production in the short term but boosted production and reduced the risk in the long term. The regression coefficient for liquid organic fertilizer is 0.150 and does not affect the risk of organic rice production. If the use of liquid organic fertilizer is increased while other production factors remain constant, there is a tendency to increase the risk of organic rice production. A different situation occurs in the Yogyakarta Special Region Province, where liquid organic fertilizer has a natural effect and reduces production risks [12].

The organic pesticide regression coefficient is -0.034 and has no significant effect at an error rate of 10%. Therefore, if the use of organic pesticides is increased, production risks tend to decrease. Similarly, a prior study [35] found that organic insecticides had no significant impact on farming production or production risk due to the uncertain composition of the active components. Organic pesticides were suspected not significantly to affect production or production risk.

The magnitude of the regression coefficient for family labor is 0.576, with no significant effect on the production risk of organic rice. If the use of family labor increases, the production risk of organic rice tends to increase. The regression coefficient for non-family labor is 0.445 and has no significant effect at an error rate of 10%. Thus, it can be interpreted that increasing non-family labor tends to increase the production risk of organic rice in Kulonprogo. Intensive use of labor (both family and non-family) is related to efforts to overcome the risk interactively by managing farming seriously [36]. Hence, adding labor could reduce the production risk of farming.

Acknowledgment. The author expressed thanks to the Research and Innovation Institute of Universitas Muhammadiyah Yogyakarta for providing financial assistance for this research. The authors express gratitude to the organic rice farmers in Kulonprogo Regency for their participation in this research.

4 Conclusion and recommendation

The production risk of organic rice for farmers utilizing either owned or non-owned land is in the low category. Simultaneously, land area, seeds, solid organic fertilizer, liquid organic fertilizer, organic pesticides, labor within the family, labor outside the family, and land status influence the production risk of organic rice. Partially, only land area and land status influence the production risk of organic rice. The larger the land for organic rice farming, the higher the production risk. Organic rice farming on owned land was more risky than non-owned land (rent and profit sharing). Farmers in Kulonprogo Regency should continue to use organic rice farming because the production risk is low category.

References

1. H. Mayrowani, Forum Penelit. Agro Ekon. **30**, 91 (2016)
2. A. P. Lestari, J. Agron. Vol.13 No.1, **13**, 38 (2009)
3. A. Prayoga, Agro Econ. J. **28**, 1 (2010)
4. I. Kurniawan and R. Malia, J. Agrosciene **6**, 30 (2016)
5. M. Arbi, T. Thirtawati, and Y. Junaidi, JSEP (Journal Soc. Agric. Econ. **11**, 22 (2018)
6. R. Rusiyah, D. S. Widiatmoko, and T. Yunianto, Maj. Geogr. Indones. **26**, 190 (2016)
7. Organic Institut, Yayasan Alifa, and Kombas.id, *Statistik Pertanian Organik Indonesia 2019* (Aliansi Organis Indonesia, Bogor, 2020)
8. BPS dan BPPT, *Ringkasan Eksekutif Luas Panen Dan Produksi Beras Di Indonesia Tahun 2018* (Badan Pusat Statistik, Jakarta, 2018)
9. R. Rama, Nurliza, and E. Doloroza, J. Soc. Econ. Agric. **4**, 29 (2016)
10. S. Suharyanto, J. Rinaldy, and N. Ngurah Arya, Agrar. J. Agribus. Rural Dev. Res. **1**, 70 (2015)
11. F. H. Saragih, Hanisah, and F. Alham, IOP Conf. Ser. Earth Environ. Sci. **715**, (2021)
12. E. Sholihah, I. Irham, and M. Masyhuri, Habitat **29**, 92 (2018)
13. E. Kurniawati and C. Sugiyanto, J. Ekon. Dan Pembang. Indones. **21**, 41 (2021)
14. S. Aprilyanti, J. Sist. Dan Manaj. Ind. **1**, 68 (2017)
15. E. Istiyanti, S. U. Badriyah, and R. R. Rachman, E3S Web Conf. **316**, 02038 (2021)
16. C. Panpakdee, B. Limnirankul, and P. Kramol, For. Soc. **5**, 631 (2021)

17. R. K. Adhikari, J. Agric. Environ. **12**, 97 (2011)
18. N. Rahmawati and T. Triyono, Agrar. J. Agribus. Rural Dev. Res. **3**, (2017)
19. S. Hadi, A. N. Akhmadi, and H. Prayuginingsih, J. Penyul. **15**, 154 (2019)
20. M. Mandang, M. F. L. Sondakh, and O. E. H. Laoh, Agri-Sosioekonomi **16**, 105 (2020)
21. M. Saikhu, Agriekstensia **16**, 355 (2017)
22. E. Istiyanti, A. Huda Aditya Darmawan, and K. Keothoumma, E3S Web Conf. **444**, 02025 (2023)
23. E. Istiyanti, L. Rahayu, and Sriyadi, Int. Food Res. J. **25**, 173 (2018)
24. A. Sulili, I. Summase, D. Rukmana, P. Diansari, P. C. Arwinia, Indrastuti, and Muhardi, IOP Conf. Ser. Earth Environ. Sci. **681**, (2021)
25. J. Mariyono, Bisnis Birokrasi J. **21**, (2014)
26. M. Asbullah, T. D. Hapsari, and S. Sudarko, JSEP (Journal Soc. Agric. Econ. **10**, 35 (2017)
27. Y. O. Obadoba and U. A. Umar, J. Mek. 1 (2019)
28. R. Dewati and L. R. Waluyati, Agro Ekon. **29**, 161 (2019)
29. A. G. Onibala, M. L. Sondakh, R. Kaunang, and J. Mandei, Agri-Sosioekonomi **13**, 237 (2017)
30. B. S. Radjit, Y. Widodo, N. Saleh, and N. Prasetiaswati, IPTEK Tanam. Pangan **9**, 51 (2014)
31. T. M. Prihtanti, **1**, 34 (2015)
32. Hartati and A. Rasyid, *Petunjuk Teknis Perkandangan Sapi Potong* (2007)
33. Yardha, E. Wahyudi, and A. Wafi, IOP Conf. Ser. Earth Environ. Sci. **715**, (2021)
34. A. G. Tahir, J. Sos. Ekon. Pertan. **8**, (2011)
35. M. D. Rahayu and Y. Yuliawati, Ziraa'Ah Maj. Ilm. Pertan. **45**, 45 (2020)
36. Saptana, A. Daryanto, H. K. Daryanto, and Kuntjoro, J. Agro Ekon. **28**, 153 (2016)