The factors of affecting level of implementation Standard Operational Procedure-Good Agriculture Practice (SOP-GAP) organic rice farming

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Abstract. Organic farming systems can be an alternative to environmentally friendly and sustainable farming. The environmental benefits obtained by implementing organic farming are that it is easier to cultivate the land and does not cause environmental pollution. The limited knowledge of farmers regarding organic rice and the ability of farmers causes them to use production facilities based on their abilities and habits. The aim of this study was to determine the level of SOP-GAP implementation and to analyze the factors that influence the implementation of SOP-GAP in organic rice farming. The research was conducted in Seyegan District, Sleman Regency, Special Region of Yogyakarta which was determined purposively. Farmer sampling was carried out using the Proportional Random Sampling method. Data analysis using Binary Logistic Regression. The results showed that the level of implementation of SOP-GAP organic rice farming was included in the appropriate category with a score of 2.91 or 72.75%. The highest level of implementation of SOP-GAP was at the cultivation stage, namely the treatment of seeds and nurseries Internal factors of farmer's age, farming experience, land area, production costs, and farming income have no effect on the level of implementation of SOP-GAP organic rice farming.

1 Introduction

Organic farming is a combination of traditional agriculture, innovation and science that will benefit the environment and promote quality of life, using the principles of ecological health, justice and protection [1]. Organic farming can be an alternative to agriculture that is environmentally friendly and sustainable [2]. Implementing organic farming has two benefits for the environment: it makes land cultivation easier and doesn't pollute the environment [3]. Paddy or rice is one of the agricultural crops that is grown organically.

Organic rice farming is managed as a whole from the production process to post-harvest in a natural and environmentally friendly way and avoids the use of synthetic chemicals or

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genetic engineering to provide agricultural products that have healthy nutritional levels [4]. Indonesia's organic rice is still in its infancy because of a number of issues, such as farmers' ignorance of the organic philosophy, irregular supply in terms of quantity, quality, and continuity, the need for certification for organic products to be authentic, and an unclear market [5].

Sleman Regency is the main food barn for the Special Region of Yogyakarta, producing 70,202 tonnes of rice in 2021 contributing 22 percent [6]. Both the area used for organic rice farming and the number of rice farmer organisations with organic certification are highest in Sleman Regency. The rising demand for organic rice in Sleman Regency can be linked to customer apprehensions regarding the negative impact of conventional farming on both human health and the environment [7]. Even so, farmers have had difficulties fulfilling market demand as a consequence of land constraints, thus limiting optimization of production. Organic rice farming has certain land requirements, and switching from conventional to organic systems might take one to three years [8].

The Standard Operating Procedure (SOP) for Good Agricultural Practice (GAP) is a standard for the application of organic farming including detailed steps that must be carried out starting from site selection to sorting and packaging (post-harvest) processes aims to improve the quality and safety of manufacturers' products, but also to protect the environment and maintain the health and safety of workers [9]. Several studies show that the level of implementation of SOPs for organic farming systems varies, some are still relatively moderate, namely in West Bandung Regency [10] and some are already quite high, as happened in Bantul. The limited knowledge of farmers related to organic rice causes the use of production facilities and technical implementation of cultivation only based on ability and habit. Many organic farming extension programs have actually been given to farmers, but farmers tend to choose to do it their own way. The purpose of this study is to analyze the level of application and the factors that influence the level of implementation of SOP GAP for organic rice in Sleman Regency.

2 Research method

The study was carried out by survey in Sleman Regency, Special Region of Yogyakarta was purposively based on the consideration that Sleman has developed organic rice as an effort to support food security with the slogan "Go Organic". The research was conducted by means of a survey of 100 respondents selected by Proportional Random Sampling from 191 members of the farmer groups Sapto Dadi, Dadi Makmur, Ngudi Rahayu, and Giri Manunggal. The sample is part of the object that represents the population.

The first objective was to analyze descriptively quantitatively, namely describing the level of application of the SOP GAP of organic rice farming. Based on the appropriate and suitable level of application, then analyzed using binary logit regression [11]. Binary logistic regression analysis, also known as logit analysis, is a statistical approach used to examine the relationship between a response variable (also known as the dependent variable) with two categories and an explanatory variable (also known as the independent variable) that is either categorical or measured on an interval scale. Logistic regression is a statistical analysis approach used to examine the relationship between a dependent variable with two or more categories and one or more independent variables measured on a categorical or continuous scale [12].

$$Ln \frac{p}{(1-p)} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 \quad (1)$$

Information:
P = 1 = the level of implementation of SOP GAP by farmers is appropriate

P = 0 = he level of application of SOP GAP by farmers is not suitable
X_1 = Farmer's age
X2 = Farming experience
X3 = Land area
X4 = Cost of production
X5 = Farming income
$\beta_1..\beta_5$ = Coefficient of regression

2.1 Model Feasibility Test (Goodness of Fit Test)

The Goodness of Fit test is employed to assess the feasibility of a research model as a test tool, allowing an assessment of the feasibility of explaining the effect of all independent factors on the dependent variable.

$$G = -2ln\left(\frac{Likelihood\ (model\ B)}{Likelihood\ (model\ A)}\right) \quad (2)$$

Model B = a model that only consists of one constant
Model A = model consisting of all variables

The Goodness of Fit Test hypothesis in this study is as follows:
H_0 = there is a significant difference between the model and the research data so that it is said that the model is not suitable for use in the research data analysis process
H_1 = there is no significant difference between the model and the research data so that it is said that the model is feasible to use in the process of analyzing research data

If the value of G (-2 likelihood) < X2 (Chi-square), then H0 is rejected and H1 is accepted, it means that the model is suitable for use because it can predict research data. If the value of G (-2 likelihood) > X2 (Chi-square), then H0 is accepted and H1 is rejected, meaning that the model is not suitable for use because it cannot predict research data.

2.2 Wald test (W test)

The Wald test is employed to assess the impact on each of the independent variables on the dependent variable. This test is classified as a partial test, indicating its purpose of assessing the impact of individual independent variables on the dependent variable. To find out how each independent variable influences it, you can look at the Wald test on the SPSS results. The following is the Wald Test formula, namely:

$$Wi=\left[\frac{\beta i}{SE(\beta i)}\right] \quad (3)$$

Information:
βi = Regression Coefficient
SE(βi) = Error Xi

The hypothesis used by the Wald test in this study is as follows:
H_0 : $\beta_i = 0$: Partially variable independent no effect significantly to the implementation level of standard operating procedures (SOP) for organic rice
H_1 : $\beta_i \neq 0$: Partially variable influential independent significantly to the implementation level of standard operating procedures (SOP) for organic rice.

If the W value > Chi-square, or the significance value < sig the level of confidence is obtained, it means that H_0 is rejected and H_1 is accepted, meaning that each of the

independent variables has an effect on level of implementation of the organic rice GAP SOP by farmers. However, if a W < Chi-Square value is obtained, or a significance value > sig the level of confidence means that H_0 is accepted and H_1 is rejected, meaning that each independent variable has no effect on the level of farmer implementation SOP-GAP organic rice.

3 Results and discussion

3.1 Characteristics of organic rice farmers

The respondents in the research consisting of 100 organic rice farmers in Sleman Regency, the characteristics that can be seen in Table1.

Table 1. Characteristics of organic rice farmers in Sleman Regency

Characteristics	Amount (person)	Percentage (%)
Farmers Age (years)		
25 – 36	2	2
37 – 48	19	19
49 – 60	31	31
61 – 72	32	32
>73	16	16
Level of education		
Elementary school	**36**	**36**
Junior high school	18	18
high school	41	41
College	5	5
Farming experience (years)		
1 – 12	7	7
13 – 24	29	29
25 – 36	18	18
37 – 48	41	41
>49	5	5
Land Status		
One's own	51	51
Rent	3	3
Profit sharing	46	46
Land Area (m2)		
0.05 - 0.35	57	57
0.36 - 0.65	28	28
0.66 - 0.95	7	7
0.96 - 1.25	4	4
>1.25	4	4
Cost Production (IDR)		
495,705 - 2,071,941	66	66
2,071,942 - 3,648,178	26	26
3,648,179 - 5,224,415	5	5
5,224,416 - 6,800,652	1	1
> 6,800,653	2	2
Farming income (IDR)		
< 5,635,145	66	66
5,635,146 - 11,300,623	24	24
11,300,624 - 16,966,101	4	4
16,966,101 - 22,631,579	2	2
>22,631,580	4	4

Based on Table 1, it is known that 52% of organic rice farmers in Sleman Regency are of productive age. Farmers of productive age tend to excel at work and ways of thinking in managing their farms and are more courageous in making decisions [13]. The average age of organic rice farmers is 59 years, indicating an older demographic engaged in the cultivation of organic rice. Consequently, the labor-intensive process of organic rice cultivation necessitates difficult tasks such as land preparation, planting, and harvesting, usually carried out by non-family laborers. The age of organic rice farmers in Sleman Regency is comparatively higher than that of organic rice farmers in Nepal [14].

The majority (54%) of organic rice farmers have an educational background that is limited to elementary and junior high school levels. The previous condition is comparable to that of organic rice farmers in West Bandung Regency, where many of them have just elementary and secondary school education [10]. Although the comparatively low level of education among farmers, it does not pose a barrier to their ability to cultivate organic rice. Farmers have the opportunity to improve their knowledge and skills through engagement in farmer group events, where they can learn from their peers or receive guidance from agricultural extension specialists. The regular convening of farmer group meetings in Seyegan District occurs at a frequency of once every 35 days, in which the presence of agricultural extension workers is also observed.

In the context of agriculture, farmer organizations serve three main functions, which include facilitating knowledge acquisition, functioning as units for production, and encouraging collaboration [15]. Farmer groups function as a learning platform that facilitates the cultivation of knowledge, skills, and attitudes among all participating members. Farmer groups, operating as production units, collaborate to enhance profitability through increased quantity, improved quality, and sustained productivity. Farmer groups, when utilized as a means of collaboration, have the potential to enhance the relationships among their members and foster cooperation between diverse groups. This collaboration is capable of solving different agricultural challenges, including technical, managerial, and social aspects [16]. Farmer groups serve as a mechanism for increasing collaboration, enhancing ties among members inside and across groups, with the aim of solving agricultural challenges from managerial, social, and technical aspects.

The quality of farmers is influenced by one of them from the experience they have. This is due to the learning process carried out by farmers regarding cultivation techniques [17]. Farmers have an average of 26 years of farming experience with a minimum of one year and a high of 62 years. Farmers have been quite understanding throughout this extended period of time, which is the proper method for growing organic rice. This finding aligns with the research conducted by regard [16] which suggests that the length of engagement in farming activities has a direct impact on farmers' skill in improving crop yields.

The duration of farming influences farmers' abilities to raise yields. As much as 57% of farmers grow organic rice on less than 0.36 hectares of land, and the average amount of land is 0.39 hectares. The majority of land used for organic rice farming is owned by the farmers themselves. However, there are some farmers who rent other people's land or work on other people's land by sharing the results. Farmers typically adopt a profit-sharing scheme in which the cultivator bears all production costs and each landowner and cultivator receives a 50% share of the yield. The land area utilised for organic rice cultivation in Sleman Regency is comparatively smaller than that of Sragen Regency [18].

The costs incurred by organic rice farmers to buy production inputs and pay labor costs are influenced by the area of land. Farmers with a land area of 0.39 ha need a production cost of IDR 3,000,000. Some of the production inputs, such as manure and natural pesticides, are made by the farmers themselves, thereby reducing production costs. Income can be defined as the difference between total revenue and total explicit costs [19]. The

organic rice farming income in Sleman Regency has been determined to be IDR 5,000,000, with an average land area of 0.39 hectares.

3.2 Level of implementation of SOP-GAP for organic rice

Indicators in the implementation of SOP-GAP cover 10 indicators, namely seed selection, seed treatment and nursery, planting, maintenance and fertilization, weeding, pest control, irrigation, harvesting, post-harvest and milling. There are 2 criteria for the level of implementation of SOP-GAP, namely not suitable (1 - 2.49) and appropriate (2.50 - 4.00).

Table 2. Scoring level of implementation SOP-GAP of organic rice farming

No	Indicator	Score
1	Seed Selection	3.36
2	Treat Seeds and Nurseries	3.88
3	Planting	3.41
4	Maintenance and Fertilization	1.90
5	Weeding	2.26
6	Pest control	2.50
7	Irrigation	1.20
8	Harvesting	3.46
9	Post-harvest	3.76
10	Milling	3.36
Average		2.91

Table 2 shows that the lowest score for the level of farmer application of standard operating procedures for organic rice is at the irrigation stage with a score of 1.20. The existing irrigation system in Seyegan District irrigates directly into the rice fields without any filtering thus allowing contamination from other non-organic rice fields. The highest score was found at the seed and nursery treatment stages which reached 3.88. The majority of farmers use recommended and certified quality seeds. Before sowing the farmers soaked the seeds for 24 hours.

The level of implementation of standard operating procedures for organic rice from all indicators is included in the appropriate criteria to the average score of 2.91. Farmers get quite high scores on SOP indicators for organic rice which are not much different from non-organic rice, such as in seed selection, seed treatment, planting, harvesting, post-harvest treatment and milling. This situation is in line with the application of SOP for organic rice in Bantul Regency [20] and [21] and in West Bandung Regency [22].

3.3 Factors affecting the level of implementation of SOP-GAP organic rice farming

Factors that influence farmers in applying Standard Operating Procedures for organic rice were analyzed using logistic regression analysis. The independent variables analyzed included age, experience, land area, production costs, and farm income, while the dependent variable consisted of two categories, namely the level of organic rice SOP implementation which corresponded to a value of 1 and did not correspond to a value of 0.

The results of the feasibility analysis of the model show that both step 1 and step 0 means that the model test both before and after the inclusion of the independent variable is in accordance with the data, so the model is feasible to use.

Based on the analysis that has been done, the Nagelkerke R Square value is 0.103 and 0.056 for the Cox & Snell R Square value. This shows that the ability of the independent

variable to explain the dependent variable is 10.3% and there are 89.7% of other factors outside the model that explain the dependent variable.

Table 3. Binary logistic regression of factors affecting the level of implementation of SOP-GAP for organic rice

Variable	Regression Coefficient	Wald	Significance	Exp(B)
Age (X1)	0.035	0.822	0.365	1.036
Experience (X2)	-0.015	0.309	0.578	0.985
Land Area (X3)	3.361	1.277	0.258	28.816
Production Cost (X4)	0.000	0.061	0.805	1.000
Farming Income (X5)	0.000	0.007	0.934	1.000
Constant	-0.668	0.132	0.716	0.513

According to the results shown in Table 3, there is no statistically significant relationship seen between the independent variables of age, farming experience, land area, cost of production, and farming income, and the level of implementation of standard operating procedures for organic rice among farmers. The equation representing the result of binary logistic regression analysis is as follows:

$$Y = P = \frac{e^{-0{,}668 + 0{,}035(X1) - 0{,}015(X2) + 3{,}361(X3) + 0{,}000(X4) + 0{,}000(X5)}}{1 + e^{-0{,}668 + 0{,}035(X1) - 0{,}015(X2) + 3{,}361(X3) + 0{,}000(X4) + 0{,}000(X5)}} \quad (4)$$

The natural logarithm of the equation:

$$Y = \ln\left(\frac{\hat{p}}{1-\hat{p}}\right) = -0.513 + 1.036\,X1 - 0.985\,X2 + 28.816\,X3 + 1.000\,X4 + 1.000\,X5 \quad (5)$$

The regression coefficient of age is 0.035 and has no significant effect on the degree of SOP-GAP adoption for organic rice. This means that there is no difference in implementing SOP-GAP for organic rice between older and younger farmers. This situation is in line with the results of the study [22], the age factor does not affect farmers in implementing standard operating procedures for organic farming systems in West Bandung district, as well as what is done by [23] that age has no relationship with the level of farmer adoption of organic rice farming systems. A different situation occurs in Banyuwangi Regency where the age factor has a significant effect on the decision making of organic brown rice farmers in adopting organic SOP-GAP as recommended [24].

The experience variable has a sig value of 0.578 or is not significant at α = 5%. The factor of farming experience is a doubtful factor in influencing farmers' use SOP-GAP for organic rice. Based on the calculation results obtained, farmers with longer rice farming experience have no difference with farmers who have shorter rice farming experience. While the results of the research are contrary to research that discusses the details of the influence of labor, technology and farming experience on farmer productivity, it also mentions the factors of farming experience, together with labor factors, technological factors, training factors and labor interactions affect farmer productivity [25].

The insignificant factor of farming experience is supported by research results which state that farming experience has a very weak factor or with a significance value close to the value of α on adoption rate of organic rice farming system [23]. In addition, this research discusses the factors that influence farmers' implementation of SOP for organic farming systems in Bandung Regency. Then [24] in his research results, supports that the experience factor has no influence on farmers in implementing Good Agriculture Practices (GAP) for organic red rice farming in Banyuwangi Regency.

The farmer's land area factor does not significantly affect the level of SOP-GAP compliance for organic rice, as evidenced by the variable land area's sig value of 0.258, or not significant. So far as applying the SOP-GAP for organic rice is concerned, there is no distinction between farmers with larger and smaller land area. These findings are in line with research examining the implementation of SOP-GAP for organic red rice in Songgon District, Banyuwangi Regency [24].

The research conducted by [23], it is stated that the factor of agricultural land owned by farmers has no relationship with the level of adoption or application of farmers to organic rice farming systems. Based on observations, farmers do not mind the narrow area of land while cultivating organic rice. However, farmers tend to focus more on soil elements on cultivated land, so it can be concluded that land area is not a factor that influences the level of implementation of standard operating procedures for organic rice.

The production cost variable has a significant value of 0.805 or not significant so that it can be seen that the farmer's production cost factor has no significant effect on the degree of SOP-GAP implementation for organic rice. Therefore, it can be seen that farmers who use higher production costs have no difference with farmers who use lower production costs in applying the SOP-GAP of organic rice farming.

The results of this study are supported by research conducted by [24], it was found that capital or production costs did not affect the implementation of standard operating procedures for organic red rice in Banyuwangi. The level of implementation of SOP-GAP by rice farmers in organic farming systems is not affected by the size of production costs. Even though farmers have received assistance from the government in the form of additional inputs so that they can directly reduce production costs, this does not affect the high or low levels of farmer implementation of standard operating procedures for organic rice.

The farming income variable has a sig value of 0.934 or not significant so that it can be seen that the farmer's farming income factor has no significant effect on the degree of SOP-GAP compliance for organic rice. Therefore, it can be seen that farmers who receive higher farming income have no difference with farmers who receive smaller farming income in implementing the SOP-GAP of organic rice farming.

Different results were obtained by [24] stating the decision-making process of organic red rice farmers in adopting organic Standard Operating Procedures-Good Agricultural Practices (SOP-GAP) is significantly affected by income variables. Based on the results of interviews, the income farmers receive does not only come from organic rice farming. However, there are those who have side businesses such as cultivating other commodities or working as laborers. In addition, in carrying out their farming, the respondent farmers tend to be more oriented towards how to protect the surrounding environment by paying attention to soil quality. Willingness and support for natural resource conservation increases for farmers with higher farm incomes [26].

4 Conclusion

The level of implementation the Standard Operational Procedure-Good Agriculture Practices (SOP-GAP) for organic rice is included in appropriate criteria with the average score of 2.91 or with a percentage of 72.75%. The highest farmer application level is at the cultivation stage of seed treatment and nursery, while the lowest farmer application level is at the irrigation stage.

Factors of farmers' age, farming experience, land area, farming income and production cost did not significantly affect the level of application of SOP GAP organic rice by farmers in Sleman Regency.

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