Factors influencing the adoption of integrated crop-livestock to support land conservation of organic agriculture in Mojosongo area, Karanganyar, Indonesia

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Abstract. The current climate change must be anticipated with various efforts in order to preserve nature, especially agricultural land. One effort to preserve sustainability is to apply organic agriculture that brings together crops-livestock. This study aims to determine the influence of four factors (farmer attitude, knowledge and skills, infrastructure, and government support) on the adoption of an integrated crop-livestock system. The basic method in this research is the survey research method. The research sample was determined by convenience sampling consisting of 40 farmers. Data collection techniques were carried out through interviews, observation and questionnaires. The variables used on the adoption of integrated crop-livestock were attitude (X1), knowledge (X2), infrastructure (X3) and government support (X4). Data analysis involved validity analysis, reliability analysis and multiple linear regression analysis. Validity and reliability tests showed the results were valid, with the value of r statistic > 0.5 and the reliability value of α > 0.6. Multiple linear regression analysis showed that all variables had positive values with regression equation Y = 1.102 + 0.374X1 + 0.153X2 + 0.108X3 + 0.145X4 + e and showed the coefficient of determination (R²) of 0.719. F test showed F-statistic > F-table (9.455 > 2.53) at significance level P < 0.05. T-test showed that t-statistic of X1, X2, X3, and X4 were 2.435, 0.138, 0.478 and 1.209, respectively, while the t-table value was 2.030. Simultaneously, adoption factors (X1, X2, X3, and X4) affected significantly the adoption of integrated crop-livestock (Y), while partially only the X1 variable affected significantly the adoption (Y), and X2, X3, and X4 variables did not affect significantly.

1. Introduction
An integrated farming system is an alternative to overcome the impact of climate change on agricultural land by cultivating integrated crops and livestock simultaneously. The integrated farming system is a combined approach aimed at efficient sustainable resource management for increased productivity in the cropping system [1]. The waste generated from one component is recycled and used as a resource for the other. It is a system to protect and conserve land and water resources from depletion hence this farming system plays an important role to achieve sustainable agricultural production. An integrated farming system is an application of resource savings that aims to achieve high and sustainable production while minimizing the negative effects of the land use intensity and preserve the environment. Crop-livestock integration efforts have been commonly carried out by breeders in rural areas. The integration of crop-livestock will bring various benefits, namely improving soil quality and productivity due to the presence of livestock manure and adding value to the previously untapped forage [2].
The crop-livestock integration system is a system that combines the components of crops and livestock in farming activities. The crop-livestock integration system means that the two businesses are expected to complement each other, namely plants as feed input and livestock manure as organic fertilizer [3]. The crop-livestock integration system is important, considering that this system can reduce production costs, especially in providing forage and the use of manure as organic fertilizer to increase soil fertility which in turn has a positive impact on increasing crop yields. In detail, the benefits of crop-livestock integration system include: (1) reducing erosion, (2) increasing crop yields, soil biological activity and nutrient recycling, (3) intensifying land use, (4) increasing profits and helping reduce poverty [1].

The agricultural sector is one of the primary sectors for economic growth in the Mojosongo subdistrict, Boyolali regency. The agricultural sector is divided into several sub-sectors, namely food crops, livestock, fisheries, plantations and forestry. The food crops sub-sector is the sub-sector with the largest production yield consisting of paddy crops, where organic rice is being developed. Another subsector that also supports the economy in the Mojosongo subdistrict is the livestock sub-sector. Mojosongo sub-district has a beef cattle population of 8530 heads [4]. Based on this, Mojosongo District has the potential for agriculture and livestock to be developed in an integrated manner, however, as small farmers have limited knowledge and skills, farmers have not been able to adopt a crop-livestock integration system.

The integration of livestock crops consists of components of crop cultivation, livestock cultivation and waste treatment. The application of technology to each component is a determining factor for the success of the integration system. Therefore, in order for the integrated system to run well and increase agricultural productivity, farmers must master and apply technological innovation. This is in accordance with the opinion of Pasandaran [5], which states that one of the keys to the success of an integrated system is the ability to manage the information needed in the integrated system, including information on the integration technology of livestock crops. In crop-livestock integration, there are several factors that influence the adoption, especially internal factors that come from the farmers themselves in the form of attitudes and knowledge and external factors that come from infrastructure facilities and government support [6]. Therefore, this study aims to determine the influence of the factors of attitude, knowledge, infrastructure and government support on the adoption of crop-livestock integration in organic rice farmers. By knowing the factors that influence the acceptance of crop-livestock integration to farmers, policymakers can create a program to increase the adoption of this crop-livestock integration.

2. Methodology

2.1. Sampling methods

This research was conducted using quantitative methods to investigate the influence of several factors on the adoption of crop-livestock integration innovation. Data were collected using a questionnaire through a survey. The research location was chosen by purposive sampling, namely in Boyolali Regency, especially in the Mojosongo area because this location has abundant natural resource potential for the application of plant and livestock integration. In this area, there are farmer groups that cultivate organic rice and raise beef cattle altogether. Therefore, this area is very suitable for research on integrated farming systems. Respondents of 40 people were selected using purposive sampling, which is a sampling technique using criteria, namely breeders who have carried out the integration of plants and livestock, are members of livestock farmer groups and attend counseling events held by the research team. The variables examined in this study are attitudes, knowledge and skills, infrastructure and government support.

2.2. Validity and reliability analysis

Validity analysis is used to measure the validity of a questionnaire. Decision making is valid or not, an instrument seen from a high validity coefficient of around ≥0.5 will be more acceptable and considered satisfactory and a validity coefficient of less than 0.3 is usually considered unsatisfactory [7]. Reliability
is a tool for measuring a questionnaire which is an indicator of a variable. Mangkunegara [8] states that a variable is said to be reliable, if the Cronbach's Alpha value is greater than or equal to 0.600, whereas if it is less than 0.600 the variable is said to be unreliable.

2.3. Analysis regression linear regression

The multiple linear regression equation is searched by the formula:

\[ Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + e \]  \( (1) \)

Notes: \( Y \) = Adoption of integrated crop-livestock; \( a \) = Constant value; \( b_1 \) = regression coefficient of attitude variable; \( x_1 \) = Attitude; \( b_2 \) = regression coefficient of knowledge variable; \( x_2 \) = Knowledge; \( b_3 \) = regression coefficient of infrastructure; \( x_3 \) = Infrastructure; \( b_4 \) = Government support variable regression coefficient; \( x_4 \) = Government support; \( e \) = error.

The data analysis in this study includes instrument testing, paired t-test, multiple linear regression, and determination coefficient test, hypothesis testing and classical assumption. Instrument test uses validity and reliability tests. The multiple linear regression test aims to explain the relationship between dependent variables and independent variables [9]. The test of coefficient of determination (\( R^2 \)) is used to determine the percentage contribution of independent variables together against dependent variables [10]. Classic assumption test was conducted using residual normality test, multicollinearity test and heteroscedasticity test.

3. Results and discussion

3.1. Respondent characteristics

This research was conducted on members of the Pangudi Bogo Farmers Group, Mojosongo subdistrict, Boyolali Regency who attended a training on crop-livestock integration technology innovation. The number of respondents taken was 40 people who are farmers as well as beef cattle breeders. The characteristics of the respondents analyzed included gender, age, level of education and duration of farming. The characteristics of respondents participating in integrated farming-livestock technology innovation training can be seen in Table 1.

**Table 1.** Characteristics of respondents.

| Characteristics of Respondents | Number | Percentage (%) |
|-------------------------------|--------|----------------|
| **Gender**                    |        |                |
| Male                          | 35     | 87.5           |
| Female                        | 5      | 12.5           |
| **Age**                       |        |                |
| 18-40 years                   | 8      | 20.0           |
| 41-60 years                   | 27     | 67.5           |
| > 61 years                    | 5      | 12.5           |
| **Education**                 |        |                |
| No education                  | 5      | 12.5           |
| SD                            | 15     | 37.5           |
| Junior High                   | 12     | 30.0           |
| High school                   | 8      | 20.0           |
| Diploma / Bachelor degree     | 0      | 0              |
| **Duration of farming-livestock** | | |
| 0-10 years                    | 13     | 32.5           |
| 11-20 years                   | 18     | 45.0           |
| > 20 years                    | 9      | 22.5           |

Source: Processed primary data, 2020.
Based on Table 1, participants who took part in integrated livestock farming technology were male and female. The results showed that most of the respondents were 41-60 years old (67.5%). The education level of the respondents varies, starting from the elementary school level, with 15 people (37.5%). According to Lestariningsih [11] the level of education affects the ability of farmers to adopt the technology. The higher a person's education level, the more dynamic his attitude towards new things will be. Most farming experience >10 years is 27 people. The long experience of farmers in farming livestock can mean that their knowledge and skills are getting better. Following the opinion of Mastuti and Hidayat [12], the higher the experience of livestock farming, it is expected that more knowledge will be gained so that the skills in running livestock farming will increase.

3.2. Validity and reliability test

The research instrument was tested using validity and reliability tests. The validity test results found r-count > r-table (0.334) obtained the value of loading factor between 0.551-0.884. Thus, it can be concluded that all items have a valid question. The reliability test results obtained that the Cronbach's Alpha value of all variables showed the lowest value 0.764 and the highest value 0.923. All variables in the study are reliable according to the opinion of Kline [13] claiming that the reliability coefficient can be accepted if the coefficient value is above 0.6.

3.3. Multiple linear regression analysis

Multiple linear regression analysis is conducted to test the effect of independent variables including attitude (X1), knowledge (X2), infrastructure (X3) and government support (X4) on the adoption of crop-livestock integration (Y) is presented in Table 2.

| Variable             | Regression Coefficient | t-count | Prob. (sig. t) α = 0.05 |
|----------------------|------------------------|---------|-------------------------|
| X1 (Attitude)        | 0.374                  | 2.051   | 0.048                   |
| X2 (Knowledge)       | 0.153                  | 0.988   | 0.330                   |
| X3 (Infrastructure)  | 0.108                  | 0.624   | 0.537                   |
| X4 (Government support) | 0.145           | 0.833   | 0.411                   |
| Constant             | 1.102                  | 2.043   | 0.049                   |
| F count              | 8.987                  |         |                         |
| Adjust R²            | 0.450                  |         |                         |
| R Square (R²)        | 0.507                  |         |                         |

Independent variable = Y (Adoption of integrated crop-livestock)

Source: Processed primary data, 2020.

Based on Table 3, obtained by the equation as follows:

\[ Y = 1.102 + 0.374 X_1 + 0.153 X_2 + 0.108 X_3 + 0.145 X_4 + e \]  \hspace{1cm} (2)

Equation 1 can be explained that the constant value is 1.102 which means that if all independent variables (attitude, knowledge, infrastructure, and government support) have a zero value, the dependent variable (adoption of crops-livestock integration) would be 1.102. The effect of each independent variable can be explained as follows:

- The attitude variable (X1) has a positive effect on the adoption of crops-livestock integration (Y) with a coefficient value of 0.374 meaning that for each increase in one product unit, the variable
adoption of crops-livestock integration will increase by 0.374 assuming that other independent variables from the model regression are fixed.

- The knowledge variable (X2) has a positive effect on the adoption of crops-livestock integration (Y) with a coefficient value of 0.153, meaning that for each increase in one-unit price, the variable adoption of crops-livestock integration will increase by 0.153 assuming that the other independent variables are fixed.

- Infrastructure variable (X3) has a positive effect on the adoption of crops-livestock integration (Y) with a coefficient value of 0.108, meaning that with every increase in one distribution unit, the variable of crop-livestock integration adoption will increase by 0.108, assuming that the other independent variables are fixed.

- The government support variable (X4) has a positive effect on the adoption of crops-livestock integration (Y) with a coefficient value of 0.145 which means that with every increase in one unit of promotion, the variable adoption of crops-livestock integration will increase by 0.145 assuming that the other independent variables are constant.

The coefficient of determination (R^2) is used to measure the level of accuracy, which is the percentage contribution to the fluctuating variation of Y. Based on the regression analysis, the R^2 value is 0.507. This means that the independent variables (attitude, knowledge, infrastructure, and government support) affect the dependent variable (the adoption of crops-livestock integration) by 50.7%, while 49.3% are explained by other variables not examined in the study.

3.4. Classic assumption test

The results of the multicollinearity analysis are presented in table 3. Based on table 3, it is known that the VIF X1 value is 2.463; X2 of 1.873; X3 of 3.400 and X4 of 2.184. That is, the multicollinearity test is fulfilled because there is no multicollinearity in the regression model. Wijaya (2009) states that to detect multicollinearity, it can be seen from the Value Inflation Factor (VIF) value. If the value of VIF > 10, then multicollinearity occurs, conversely if VIF < 10, then multicollinearity does not occur.

Heteroscedasticity Test Results of the scatterplot graph (figure 1) shows the points spread randomly above and below the number 0 on the Y axis, meaning that there is no heteroscedasticity in the regression model [14]. Heteroscedasticity will cause the estimator to be inefficient and the coefficient of determination will be very high [10]. Heteroscedasticity detection is by looking at the presence or absence of a certain pattern on the scatterplot graph.

![Figure 1. Scatterplot graph.](image-url)
Table 3. Multicollinearity test results.

| Variable                  | Collinearity statistic |       |
|---------------------------|------------------------|-------|
|                           | Tolerance   | VIF   |
| X1 (Attitude)             | 0.406       | 2.463 |
| X2 (Knowledge)            | 0.534       | 1.873 |
| X3 (Infrastructure)       | 0.294       | 3.400 |
| X4 (Government support)   | 0.458       | 2.184 |

Source: Processed primary data, 2015.

3.5. Statistical test

The F test is used to determine the effect of the independent variables together on the dependent variable significantly [15]. The results of the F test are presented in table 4. The results of the analysis with a level of \( \alpha = 0.05 \) obtained the value of \( F_{\text{count}} = 8.987 \) with a significance level of 0.000. The results of the analysis show that \( F_{\text{count}} > F_{\text{table}} (8.987 > 2.53) \) means rejecting \( H_0 \) and accepting \( H_a \), namely the independent variables (attitudes, knowledge, infrastructure, and government support) simultaneously affect increasing the adoption of crops-livestock integration. The t-test is used to test the effect of the independent variables individually in explaining the variations in the dependent variable presented in table 4.

Table 4. The Result of the F-test analysis.

| Model         | Sum of Squares | Df | Mean Square | F   | Sig.  |
|---------------|----------------|----|-------------|-----|-------|
| Regression    | 6.986          | 4  | 1.747       | 8.987 | 0.000 a |
| Residual      | 6.802          | 35 | 0.194       |      |       |
| Total         | 13.789         | 39 |             |      |       |

Source: Processed primary data, 2020.

Table 5. The Result of t-Test significant level (\( \alpha \)) 5%.

| Variable                  | Value of t-count | Prob. (sig. t) | T-table value | Information |
|---------------------------|------------------|----------------|---------------|-------------|
| X1 (Attitude)             | 2.051            | 0.020          | 2.030         | Significant |
| X2 (Knowledge)            | 0.988            | 0.089          | 2.030         | Not Significant |
| X3 (Infrastructure)       | 0.624            | 0.635          | 2.030         | Not Significant |
| X4 (Government support)   | 0.833            | 0.235          | 2.030         | Not Significant |

Source: Processed primary data, 2020.

The results of the analysis in table 5 show the significant value of the independent variable, namely the Attitude variable (X1), which means that the attitude of farmers affects increasing the adoption of crops-livestock integration. Meanwhile, the other independent variables, namely knowledge (X2), infrastructure (X3) and government support (X4), have insignificant values. This means that the variables X2, X3 and X4 do not have an individual effect on increasing farmer adoption of crop-livestock integration. The attitude variable shows a significant result (t-count > table), namely 2.051 with a significance value of 0.048, meaning that the attitude variable individually affects the adoption of crop-livestock integration.

Variable of attitude affect in increasing the adoption of crops-livestock integration. It’s mean that the more positive the attitude towards technology will increase the adoption of that technology. According to Gerungan [15] attitude is an evaluation of emotional feelings and propensity for favorable or unfavorable and long-lasting actions from a person towards an object or idea. According to Haryadi [16], if an individual has a positive attitude towards an object, he will be ready to help, pay attention, do...
something that benefits that object. Therefore, the results of this study indicate that farmers who have a positive attitude towards crop-livestock integration technology will find it easier to adopt. This study provides empirical evidence that outreach to farmers to increase positive attitudes towards crop-livestock integration will produce better results [16].

4. Conclusion
Attitude variable, knowledge, infrastructure and government support simultaneously have a significant effect in increasing the adoption of crop-livestock integration, but individually the attitude variable of farmers has the highest influence. The more positive the farmers' attitude towards crop-livestock integration technology, the more readily they will be ready to accept the knowledge and skills provided. Therefore, the results of this study indicate that farmers who have positive traits will find it easier to increase the adoption of crop-livestock integration technology to achieve agricultural land conservation. This study recommends that increasing the adoption of crop-livestock integration requires a positive attitude from the farmers in understanding the importance of this technology. This positive attitude can be increased through counseling and training on crop-livestock integration organized by the government, private sector, universities other institutions.

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