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ANALYSIS OF FACTORS THAT AFFECT THE ADAPTABILITY OF RICE FARMER IN THE FACE OF CLIMATE CHANGE

[1*]Watemin, [1]Pujiati Utami and [2]Wida Purwidianti

[1]Department of Agribusiness, Universitas Muhammadiyah Purwokerto, Indonesia.

[2]Department of Management, Universitas Muhammadiyah Purwokerto, Indonesia.

*Corresponding Author

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ABSTRACT

Climate change is an extreme event characterized by changes in temperature and changes in rainfall that occur. This study aims to analyze the factors that affect the adaptation capacity of rice farmers in Susukan District, Banjarnegara Regency in facing climate change. To achieve this goal, research data was taken from rice farmers in Susukan District as many as 150 farmers. Furthermore, the collected data was analyzed using multiple linear regression analysis. The results of the analysis show that most farmers in Susukan District, Banjarnegara, feel the negative impact of climate change. Factors that affect farmers' adaptability to adapt are the farmer's age, education level, number of family members, and farmer's cultivated land area, all of which have a significant and positive influence. Meanwhile, farmers' experience in farming and land ownership status have a negative effect on farmers' ability to adapt to climate change. Based on the existing conditions to reduce the greater negative impacts of climate change, it is recommended to provide training to farmers on climate change and strategies to deal with it. In addition, incentives are provided to farmers with narrow plots of land and tenant farmers in the form of capital assistance.

Keywords: Climate Change, Adaptation Strategies, Adaptation Capacity, Sustainable Livelihood Approach.

1. INTRODUCTION

The issue of the impact of climate change has become a major global concern and has become one of the main goals in the Sustainable Development Goals (SDGs), namely handling climate change. Climate change is characterized by the emergence of floods, long droughts, and extreme temperature changes. Climate change has a direct and indirect impact on various sectors. The

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agricultural sector is the most vulnerable sector affected by climate change. Directly climate change can reduce agricultural production in Indonesia (Akmalia, 2022; Ansari et al., 2023), so is rice production in China (Wang et al., 2024; Saud et al., 2022). To overcome the impact caused by climate change, farmers are adapting. Farmers' ability to adapt is influenced by various factors. Research conducted by Sirisunyaluck et al., (2020) mentioned that the cost and income of rice farming and the membership of farmers in farmer groups affect farmers' adaptation in the face of climate change. Likewise, research conducted by Bello et al., (2023) mentioned that farming costs are a factor that affects farmers' adaptation in facing climate change, and even an obstacle in implementing their adaptation strategies. While the research conducted by Esfandiari et al., (2020) it was stated that factors of agricultural land area, irrigation system, and skills training were key factors that influenced adaptation strategies, while labor and land tenure systems had less influence on adaptation strategies. Likewise with research conducted by Watemin et al., (2025) mentioned that farmers have good adaptability by applying the principles of sustainable livelihood.

Farmers' ability to adapt to climate change depends on farmers' perceptions (Watemin et al., 2024; Bouda et al., 2025). In recent years, adaptation to climate change has become a major concern for farmers, researchers, and policymakers. Himel et al., (2025) report that vulnerability and adaptation strategies are related to poverty alleviation efforts and community empowerment programs. Likewise Sawadogo (2025) states that adaptation in agriculture is how the perception of climate change is translated into the agricultural decision-making process. A review of studies on the adoption of new technologies identified the size of agriculture, land tenure status, education, access to extension services, access to markets, and availability of credit as the main determinants of the speed of adoption of agricultural technologies [13]. To improve policy formulation in addressing climate change challenges for farmers, it is important to know farmers' perceptions of climate change, the adaptation measures that farmers are taking, and the factors that affect their adaptation to climate change. Based on this description, this study aims to analyze the factors that affect the adaptability of farmers in facing climate change.

2. LITERATURE REVIEW

Climate change has had various negative impacts on the agricultural sector. One of the ways to handle the impact of climate change is through strengthening the ability of farmers to adapt to climate change [14]. According to Waseem & Rana (2026) and Abid et al., (2016) there are several factors that affect farmers' ability to adapt.

2.1. Farmer age

Age affects the physical condition of farmers in dealing with climate change. At productive age, farmers will be strong to face the pressures of climate change [17]. With strong physical conditions, farmers can carry out various strategic activities to deal with climate change.

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H_1: It is suspected that the age of farmers has a positive effect on farmers' adaptability.

2.2. Farmer education

The education in this study is the formal education of farmers as the head of the family. The higher the education of farmers, the wider the way of thinking in dealing with climate change pressures. Thus, the higher the education of farmers, there are many strategies that farmers can carry out to minimize the risks that will occur due to climate change (Purwanti et al., 2023; Abate, 2024).

H_2: It is suspected that farmer education has a positive effect on farmers' adaptability.

2.3. Number of family members

Agricultural systems in developing countries generally still depend on the number of family human resources. The number of family members is the main workforce that operates the existing farming system. The more family members, the greater the number of resources available. The availability of family labor can be used to adapt to climate change that occurs [20].

H_3: It is suspected that the number of farmer family members has a positive effect on farmers' adaptability.

2.4. Cultivated land area

The area of land cultivated by farmers shows control over the resources owned. The larger the cultivated land, the more resources available to carry out adaptation activities. Farmers with narrow land areas do not have much ability to invest in farming as a form of adaptation, such as using superior seeds at a higher cost, or conserving land to maintain the sustainability of farming due to climate change (Nuringsih et al., 2016; Nurwenda et al., 2024).

H_4: It is suspected that farmland has a positive effect on farmers' adaptability.

2.5. Farmers' experience in farming

Farming experience is a good capital for farmers in dealing with climate change. The more practiced farmers are, the more they have the ability to deal with climate change by combining local farming practices and modern agricultural innovations (Adeagbo et al., 2021; Azizi et al., 2025). In addition, with a lot of experience owned by farmers, it will increase confidence for farmers in facing climate change.

H_5: It is suspected that farmers' experiences have a positive effect on farmers' adaptability.

2.6. Status of cultivated land ownership

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Land is the main resource for farmers in carrying out their farming activities. The larger the arable land, the more efficient it will be for farmers to carry out their farming activities. The area of cultivated land is determined by the financial resources owned by farmers. Farmers with more financial resources are more likely to own large land and are their own land. Meanwhile, farmers with limited financial resources will generally rent for farming activities (Murken & Gornott, 2022; Maulidani, 2025). Thus, farmers who have their own cultivated land tend to have more adaptability compared to farmers with rented land.

H_6: It is suspected that the status of farmer ownership has a positive effect on farmers' adaptability.

3. MATERIALS AND METHODS

This research was carried out in Susukan District, Banjarnegara Regency, Central Java Province. Susukan District was chosen as the research location with the consideration that this sub-district has an Independent Agricultural and Rural Training Center (P4S). The research was carried out using the survey method. The research data was taken from 150 respondent farmers using questionnaires through interviews.

To analyze the factors that affect the adaptive capacity of rice farmers in Susukan District, Banjarnegara Regency in facing climate change, the analysis will use multiple linear regression, by modifying the adaptability of farmers as used by Datta & Behera (2022) as follows:

$$Y_i = \alpha + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i3} + \beta_4 X_{i4} + \beta_5 X_{i5} + \beta_6 X_{i6} + \mu_i$$

Remarks:

Variable	Indicator	Description
Y_i	Adaptability capacity	Farmers' adaptation capacity based on *sustainable livelihood approach score (SLA)*
X_{i1}	Farmer age	The age of the farmer as the head of the family expressed in units of years
X_{i2}	Farmer education	The formal education that has been taken by the head of a farmer household is expressed in units of years
X_{i3}	Family members	The number of people who are dependent on a farmer's household is expressed in the unit of people
X_{i4}	Land area	The area of land cultivated by farmer households in hectares
X_{i5}	Farmer experience	The experience of the head of a farmer's family in farming is expressed in units of years

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X_{i6}	Land ownership status	Dummy variable, valued at 1 if the land is owned by oneself and 0 for others

Not all variables in the Sustainable Livelihood Framework (SLF) are used in the analysis of this study. This is a limitation in this study. The restriction on the use of variables is due to the limited availability of data and the consideration of variables that are more dominant in the research area.

To test the hypothesis about the influence of independent variables on dependent variables, a t test (partial test) will be carried out. Next, to see how much independent variables can explain their influence on dependent variables, look at the determination coefficients (*Adjusted* R^2). Value *Adjusted* R^2 ranges from 0-1 ($0 < Adjusted\ R^2 < 1$). The *value of Adjusted* R^2 is said to be good if > 0.5 which means that the influence of independent variables on its dependent variables can be explained more and more (Hair et al., 2019).

4. RESULTS AND DISCUSSION

4.1. Results

To analyze the factors that affect farmers' adaptability in the face of climate change, multiple linear regression analysis was used. To get good analysis results, the data used must have a normal distribution. To find out whether the data used is normally distributed or not, the Kolmogorov-Smirnov test is performed. The results of the data normality analysis obtained the value of Asymp.Sig. > 0.05 which means that the data used has a normal distribution. In addition to having a normal distribution, the data used must also have a homogeneous residue variant. For this reason, the data used was tested using *the Glejser test* to determine the heteroscedasticity problem. The results of *the Glejser test* showed that all variables had a Sig. value of > 0.05 so that there was no heteroscedasticity problem. In addition to the problem of data normality and homogeneity of residual variants, the results of regression analysis will be good if all variables used are free from *multicollinearity problems*. To test the high correlation between variables, a multicollinearity test was performed. The results of the multicollinearity test showed a tolerance value of > 0.10 and a VIF value of < 10.00 so that all variables used in the analysis were free from multicollinearity problems.

Furthermore, the data obtained was analyzed using multiple linear regression analysis using *the Ordinary Least Squares* (OLS) method. To see the accuracy of the model used, it is done by looking at the *Adjusted R Square value*. The results of the model precision test analysis can be seen in the following **Table 1**.

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Table 1: Model Accuracy Test Analysis Results

Model Summary[b]					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.961[a]	.924	.913	.67996	1.608

a. Predictors: (Constant), X6, X1, X3, X4, X2, X5

b. Dependent Variable: Y

Based on the results of the model fastness analysis, it is known that *the Adjusted R Square* value is 0.913, which means that 91.30 percent of the factors that affect farmers' adaptability to climate change can be explained through the variables used in the analysis. While the remaining 8.70 percent was explained by other factors that were not included in the analysis. Thus, it can be concluded that the analysis model used is very good because the *Adjusted R Square* value > 0.5 (Montgomery et al., 2012). To be more confident that the model used is good, model sensitivity analysis was carried out using Bayesian models. The results of the analysis showed that the values of the model parameters and the estimates were within the confidence interval. This shows that the model used is not sensitive and reliable. Furthermore, the data was analyzed using a t-test (partial test) to see the influence of each individual variable on the adaptability of farmers. The following **Table 2** shows the results of multiple linear regression analysis of the factors that affect farmers' adaptation to climate change.

Table 2: Multiple Linear Regression Analysis Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	27.029	.842		32.112	.000
	X1	.041	.015	.156	2.792	.008
	X2	.328	.026	.660	12.704	.000
	X3	.540	.075	.321	7.157	.000
	X4	1.127	.149	.352	7.558	.000
	X5	-.024	.010	-.144	-2.335	.024

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	X6	-1.083	.211	-.235	-5.133	.000

a. Dependent Variable: Y (Adaptability); X_1 (Age); X_2 (Education); X_3 (Number of family members); X_4 (Land area); X_5 (Experience); X_6 (Land Ownership Status)

4.2. Factors Affecting Adaptability

4.2.1. Farmer age (X_1)

The results of the analysis showed that the variable coefficient of farmer age was 0.041 which means that if the farmer's age increases by 1 year, the farmer's adaptability will also increase by 1 unit. The results of the analysis also showed that the Sig. value < 0.05 which means that the age of farmers has a real effect on farmers' ability to adapt to climate change. The higher the age of farmers, the more farmers will increase the adaptability of farmers because with increasing age, there will be more considerations made by farmers in taking adaptation actions to climate change. The more consideration the farmer makes, the better his adaptability. The results of this study are in line with the results of research conducted by Obayelu et al., (2014) which mentions that farmers in Africa are generally old so they have a lot of experience. Consciously, farmers will adapt to existing climate change, because if they do not take adaptation actions, they will experience crop failure in farming.

4.2.2. Farmer education (X_2)

A person's education plays an important role in every decision taken. The decision to be taken is always based on the knowledge that is possessed. The more extensive knowledge you have, the more materials that are considered in decision-making so that you can minimize the risks that will occur. Based on the results of the analysis carried out, the results of the Sig. < value of 0.05 were obtained so that the level of education of farmers in Susukan District, Banjarnegara, has a significant influence on the ability to adapt to climate change. Furthermore, the value of the regression coefficient is 0.328 which means that every increase in farmer education by 1 year will increase their adaptability by 0.328 units. Improving education will increase adaptability because higher education will encourage farmers' literacy skills to be better. With better literacy skills, farmers will look for a lot of information about the impact of climate change and will look for solutions. The results of this study support the research conducted by Ahmed & Givens (2025) which states that climate change makes existing weather difficult to predict. This condition causes farmers to seek more information about the opportunities for climate change. With a higher level of education, farmers' ability to trace existing climate change will be better. In addition, with a higher level of education, farmers will usually be more creative in implementing various adaptation strategies in dealing with climate change.

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4.2.3. Number of family members (X_3)

The number of family members can affect farmers' ability to adapt to climate change. The influence can be either positive or negative, depending on the strategy chosen by the farmer's family (Joshi et al., 2017). The positive impact of the availability of the family workforce is:

- *Labor availability*. Families that have more members at productive age can utilize family labor to manage farms. This reduces reliance on outside labor and allows them to perform intensive work such as manual irrigation, weeding, or harvesting when needed.
- *Livelihood strategies are* diverse. Many family members can find work outside the agricultural sector to supplement family income. Income from these non-farm jobs can be used to fund climate adaptation practices, such as purchasing drought-resistant seeds, installing irrigation systems, or diversifying crops.
- *Risk sharing*. Families with many members are more likely to spread the risk of crop failure. If one source of farm income fails, they can depend on income from other livelihoods run by different family members.
- *Knowledge and experience*. Larger families can accumulate a wide range of knowledge and experience. Experience from older family members or new knowledge from younger educated members can improve the family's ability to assess risk and make more effective adaptation decisions.

Meanwhile, the negative impact of the large number of family members includes:

- *Economic burden*. A large number of family members, especially if the proportion of children or the elderly is high, can increase the economic burden. This increase in food needs and daily expenses can limit investment in climate change adaptation practices.
- *Limited resources*. In some cases, large family members can put a strain on limited resources, such as arable land. This can reduce farmers' response to climate change, especially for smallholder farmers.
- *Migration of young workers*. Young farmers often prefer to work in cities or other sectors that are considered more financially promising. This can reduce the amount of labor available to manage family farms and adopt intensive adaptation practices.

Overall, family size is an important factor that determines a farmer's adaptation capacity. Government policies and non-governmental organizations should consider the demographic structure of farmer households when designing support programs to suit the social and economic conditions of farmer families. Based on the results of the data analysis carried out, the results were obtained that the Sig.< value of 0.05 which means that the number of household members means significant to the adaptability of farmers. The value of the regression coefficient is 0.540 which

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means that if the number of farmer family members increases by 1 person, it will increase the adaptability of the farmer family by 0.540 units. The increase in farmers' adaptability to climate change along with the increase in the number of family members is due to the increase in family members means increasing the existing resources of farmer families. This is in line with research conducted by Mekonnen et al., (2021) which states that the number of family members significantly affects household food security so that the increase in the number of family members increases family awareness to improve the ability and strategies to adapt to climate change. Likewise, research conducted by Koshti & Mankar (2016) stated that the number of farmer family sizes has a positive effect on the adaptability of farmers through the addition of *human assets* (human capital) to farmer families.

4.2.4. Land area (X_4)

Farmers' land area can affect their ability to adapt to climate change. Larger land can provide greater resources to invest in adaptation strategies such as crop diversification or better irrigation, while farmers with narrow plots of land may struggle with capital to deal with climate change. The results of the regression analysis showed that the value of Sig. < 0.05 which means that the area of land cultivated by farmers in Susukan District, Banjarnegara, has a significant effect on the ability to adapt to climate change. The results of the analysis showed a coefficient value of 1.127 which means that if the area of farmer cultivated land increases by 1 hectare, the adaptability of farmers will increase by 1.127 units. The increase in climate change adaptability caused by the increase in land area because with more cultivated land shows a higher investment ability so that it is able to implement adaptation strategies that require greater capital such as buying new seeds that are more resistant to climate change or building their own irrigation system through pump wells. In addition, with a larger land area, farmers can carry out plant diversification activities more freely to avoid crop failure on one type of existing crop. While the research conducted by Sugihardjo et al., (2021) showed different results, and stated that the area of land cultivated by farmers did not have a significant effect on the ability to adapt to climate change. This condition is caused by the narrow average area of cultivated land so that every harvest failure can have a big impact on the sustainability of family income so that it is very unlikely for the farmer to carry out an adaptation strategy that requires greater capital.

4.2.5. Farmer experience (X_5)

In general, farmers' experiences affect their ability to adapt to climate change, as experiences shape local knowledge and practical strategies used to adapt. Longer experience gives farmers a better understanding of weather patterns and risks, allowing them to implement strategies such as crop diversification, planting schedule adjustments, and more effective use of drought-tolerant varieties. However, the results of the analysis show that the higher the experience of farmers in

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Susukan District, the higher it will reduce their adaptability. This is because the higher the experience in farming, the more things are taken into consideration so that the decisions taken take longer and cause the risk to fail to be higher. Erratic climate change requires farmers to adapt quickly to make decisions to avoid more negative impacts. This condition is owned by farmers who are still young (not much experience) but have higher education. The results of this study are in line with what was stated by Ali & Erenstein (2017) that farmers with a younger age but with higher education will apply more adaptation strategies than older farmers in dealing with existing climate change. Generally, younger farmers have less experience but with higher education are willing to take risks with a variety of new adaptation strategies. The results of the study are also in line with the research conducted by Funan et al., (2025) which states that the experience of horticultural farmers has a negative relationship with adaptability. This is because climate change is an uncertain condition and changes very quickly, while farmers with enough experience take a long time to adapt.

4.2.6. Land ownership status (X_6)

Land ownership status can affect farmers' ability to adapt to climate change. Farmers with self-owned land ownership status tend to be more able to take long-term adaptation steps, while farmers with leasehold or borrower status are often limited to short-term strategies. Based on the results of data analysis, it is known that farmers with rented or borrowed land (profit sharing) in Susukan District, Banjarnegara, have higher adaptability compared to farmers who have their own land status. This is because farmers with leased or profit-sharing status will consider the losses that occur due to climate change so that farmers with leased or profit-sharing land in the short term will be quicker to take adaptation actions. This is in accordance with the opinion Holland et al., (2022) which states that farmers with the status of their own land will tend to invest in the sustainability of their farming in the long term, while farmers with the status of leased or borrowed land will invest in farming for short-term interests so that it is faster to take adaptation actions in terms of facing climate change. Learn more Holland et al., (2022) explained that farmers with their own land status in the face of climate change will act:

- *Make long-term* investments. They are motivated to invest in climate-resilient and sustainable farming practices, such as agroforestry systems, water-efficient irrigation, or drought-resistant crop varieties, because they are confident of reaping the rewards in the long run.
- *Access to credit*. Secured land rights can often be used as collateral to obtain agricultural loans or credits. It provides access to the capital needed to purchase more sophisticated agricultural technologies or inputs in implementing adaptation strategies to climate change.
- *Decision-making*. Farmers with their own land status have full control over their land, which allows farmers to make adaptation decisions without having to seek permission from

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other landowners.

Meanwhile, farmers with the status of rented or borrowed land in the face of climate change will take action:

- *In making investments, focus on the short term*. Due to uncertainty regarding the sustainability of land use rights, they are reluctant to make long-term investments. They prefer adaptation practices that require little capital and can provide quick results, such as mulching or manure applications.
- *Lack of incentives*. The lack of guarantees that they will control the land for a long time does not motivate them to carry out sustainable land improvements, which are actually important for long-term resilience.
- *Limitations and prohibitions*. Tenant farmers may face restrictions or prohibitions from landowners to implement certain adaptation practices, especially if those practices permanently change the condition of the land.
- *Vulnerability to climate shocks*. When extreme climate events occur, farmers with unsafe land status will be more vulnerable because they do not have the financial reserves or long-term investments to deal with losses.

While the research conducted by Hikmah et al., (2024) mentioned that small farmers with narrow land are more likely to implement *survival* and *consolidation* strategies in dealing with climate change. The *survival* strategy carried out is to find a job outside the agricultural sector and sell the assets they have to maintain the sustainability of family life. Meanwhile, the *consolidation* strategy is carried out in the form of looking for loans when other children or families no longer provide assistance for the sustainability of family life.

5. CONCLUSION

Most farmers in Susukan District, Banjarnegara, feel the negative impact of climate change. To avoid greater negative impacts, farmers take adaptation measures to climate change. Climate change adaptation strategies depend on the capacity of farmers to take adaptation actions. Factors that affect farmers' adaptability to adapt are the farmer's age, education level, number of family members, and farmer's land area, all of which have a significant and positive influence. Meanwhile, farmers' experience in farming and land ownership status have a negative effect on farmers' ability to adapt to climate change. Based on existing conditions to reduce the greater negative impacts of climate change, it is recommended to the government through the Agriculture Office Regency to provide training to farmers on climate change and strategies to deal with it. This is necessary because farmers' experience in dealing with climate change is still lacking, even though they have a lot of farming experience. Providing incentives to farmers with narrow plots

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and tenant/borrower farmers in the form of capital assistance (capital loans) through farmer groups or farmer groups. This is necessary so that the farmer thinks long-term for the sustainability of farming by maintaining the health of the soil so that the greater impact due to climate change can be reduced.

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