

## **Did The *Program Kampung Iklim* Lead Farmers to Implement More Adaptation Strategies? Case Study of Rice Farmers in Sleman Regency**

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### **ABSTRACT**

The negative impacts of climate change caused many losses for farmers. One solution to minimize losses is to implement a climate change adaptation strategy. The Indonesian government established a program called the *Program Kampung Iklim/Proklim* in 2012 which aims to increase awareness of climate change and the capacity to implement community adaptation strategies. This study aimed to determine the effect of the Proklim on the implementation of climate change adaptation strategy by farmers. The study was conducted in Proklim and non-Proklim locations. By implementing the simple random sampling method, it was obtained 112 samples divided into 56 farmers from each Proklim and non-Proklim location. The results showed that farming experience, land area, membership in farmers group, access to weather information, awareness towards climate change and perceptions towards climate change risks are associated with more practice of adaptation strategy. The results also showed that the implementation of adaptation strategy was influenced by the Proklim location, so that the farmers involved in the program locations applied more climate change adaptation strategy than the farmers in non-program locations. The authors recommend that Proklim needs to be applied in many locations, especially areas that are vulnerable to climate change, so farmers can improve the implementation of climate change adaptation strategies.

**Keywords:** adaptation strategy, climate change, proklim

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### **INTRODUCTION**

Unnatural changes in climate indicators such as unpredictable rainfall, shifting seasons, and increasing environmental temperatures, cause

concern for the phenomenon of climate change (WMO, 2017). Global land and sea surface temperature trends in 1880-2010 have reported an increase in average temperature of 0.85<sup>0</sup>C, with a

range between 0.65°C to 1.06°C (IPCC, 2014). Indonesia is one of the countries with the highest levels of greenhouse gas emission that is very vulnerable to the impacts caused by climate change (Measey, 2010), and one of the most vulnerable sectors to this is the agricultural sector, especially grains and vegetables (Bacha et al., 2018). Climate change indirectly causes agricultural land to dry up, land management increasingly difficult, and a decrease in the volume of water sources (Irham et al., 2018), which then has an impact on decreasing production and can cause crop failure.

The negative impacts of climate change on crop yields can be minimized by implementing adaptation strategies that are technically appropriate, socio-cultural, and economically feasible, so that farmers can still maintain their main livelihood (Waibel et al., 2017; Widada et al., 2014). Some of the adaptation strategies adopted by farmers are crop rotation, soil fragmentation, making bore well, using short duration rice varieties, reduce soil acidity by adding calcium fertilizers (ameliorant), and others (Aldrian et al., 2011; Fadina & Barjolle, 2018; Muslim, 2013). Implementing climate change adaptation strategies can provide benefits in the form of increased productivity and incomes of farmers (Abid et al., 2016; Ali & Erenstein, 2017).

The government also participated to improve the implementation of community adaptation strategies to climate change by establishing a program called the *Program Kampung Iklim* in 2012. Based on the Ministry of Environment and Forestry

(Kementerian Lingkungan Hidup dan Kehutanan) No. P. 84/ MENLHK-SETJEN/ KUM.1/ 11/ 2016, *Program Kampung Iklim* or Proklim is a national scope program managed by the Ministry of Environment and Forestry to increase the involvement of the community and stakeholders in strengthening the capacity of adaptation to the effects of climate change and reducing greenhouse gas emissions. Proklim gives recognition to all adaptation and mitigation efforts made by the community following regional conditions to improve local welfare. Through the implementation of adaptation strategies, communities from Proklim locations have the resistance to face drought, floods, crop failure, and are able to increase food security (Gunawati & Rejekiingsih, 2020; Muttaqin et al., 2019). In addition, there are other programs that aim to improve the implementation of adaptation strategies, namely the Climate Smart Village (CSV) program, one of which is carried out in Nepal (Aggarwal et al., 2018; Khanal et al., 2019).

In formulating policies related to the adoption of adaptation strategies, policy makers must pay attention to the factors that enhance the adoption of adaptation strategies (Niles et al., 2015). A lot of researches have obtained results that farmer education, farming experience, land area, land status, experience of crop failure, number of family members, membership in farmers group, and weather information influence the implementation of climate change adaptation strategies (Abid et al., 2016; Ali & Erenstein, 2017; Fadina & Barjolle, 2018; Fagariba et al., 2018; Gc

& Yeo, 2019; Trinh et al., 2018). The adoption of adaptation strategies is also influenced by farmers' awareness of the phenomenon of climate change (Hasan & Kumar, 2019) and perceptions of risks posed by climate change to farmers' cultivation (Azadi et al., 2019).

Related to the existence of the program, previous research only focused on the adaptation strategy activities, the distribution of the community implementing the adaptation strategy and the benefits of the strategy application for the people who were in the program location (Khanal et al., 2019; Muttaqin et al., 2019). Previous research was conducted without involving non-program locations. The novelty of this research is that it investigates the effect of the *Program Kampung Iklim* (Proklam) on the implementation of climate change adaptation strategies by farmers. The research is important to know whether the existence of a Proklam can improve the implementation of adaptation strategies by farmers, so the results are expected to be used as an evaluation for future policies.

## METHODS

Sleman Regency was chosen purposively as a research location. The first reason, Sleman Regency shows a decreasing trend of rice productivity and an increase in climate indicators, namely maximum rainfall, wind speed, minimum temperature and maximum temperature based on 2008-2017 data (BPS Sleman, 2019). The second reason, there are 9 hamlets registered as Proklam participants spread across 6 sub-regency based on information from The Department of Environment and Forestry of Sleman Regency. This research was conducted in 3 villages that have Proklam hamlets which had won Proklam competitions at the national level, namely Wonorejo Hamlet, Ngaglik Sub-Regency (2018), Karangtanjung Hamlet, Sleman Sub-Regency (2018), and Pendulan Hamlet, Moyudan Sub-Regency (2016). Then the non-Proklam hamlet was selected from the same sub-regency and village as a comparison of the Proklam location (Table 1). The simple random sampling was used suggesting a total sample of 112 farmers from Proklam and non-Proklam locations with the distribution shown in Table 1. The total population of farmers in the study location was 2,996 farmers.

**Table 1.** Location of the study

Sub-regency	Village/ Hamlet	Population	Sample	
			Proklam	Non-proklam
Ngaglik	Sariharjo	621		
	- Wonorejo		16	-
	- Karangmloko		-	16
Sleman	Pandowoharjo	851		
	- Karangtanjung		20	-
	- Karangasem		-	20
Moyudan	Sumberagung	1,524		
	- Pendulan		20	-
	- Kaliduren II		-	20
<b>Total</b>		<b>2,996</b>	<b>56</b>	<b>56</b>

Based on the results, there were 14 farmers (12.5%) who did not implement the adaptation strategy and there were 98 farmers (87.5%) who implemented at least 1 adaptation strategy, so the bound of error of the number of samples was shown by the following calculation (Nazir, 2017),

$$V(\bar{p}) = \frac{\bar{p}(1-\bar{p})}{n-1} \left( \frac{N-n}{N} \right)$$

$$V(\bar{p}) = \frac{0.875(0.125)}{112-1} \left( \frac{2,996-112}{2,996} \right)$$

$$V(\bar{p}) = 0.000949$$

Notes:

$V(\bar{p})$  : Estimates of variance

$\bar{p}$  : Percentage of farmers implementing at least 1 adaptation strategy

$(1 - \bar{p})$  : Percentage of farmers who don't implement adaptation strategies

$n$  : Number of Samples

$N$  : Total population

Obtained bound of error values:

$$B = \sqrt{V(\bar{p})} = 0.0308$$

The value of 0.0308 or 3.08% is the error limit or the maximum error limit in determining 112 farmers samples from a population of 2,996.

### Tobit regression model

Tobit regression analysis is used to determine the effect of Proklim on the number of climate change adaptation strategies implemented by farmers. Tobit regression analysis was developed by Tobin to analyze the factors influence the dependent variable that is censored at the lower or upper threshold, or both. The dependent variable in this study is censored at a low threshold because it has a value of 0 (Farmers who don't implement adaptation strategies) at the upper threshold because the maximum adaptation strategy studied was 4 strategies. Research with censored dependent variables will show inconsistent estimation results when

analyzed using OLS regression with the least squares estimation approach (Greene, 2012). The tobit regression model is shown by the following model,

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \varepsilon$$

Where the dependent variable Y is the number of adaptation strategies;  $X_1$ - $X_{11}$  are the independent variables namely  $X_1$  is Proklim,  $X_2$  is farmer education,  $X_3$  is farming experience,  $X_4$  is land area,  $X_5$  is own land,  $X_6$  is rental land,  $X_7$  is harvest failure,  $X_8$  is membership in farmers group,  $X_9$  is weather information,  $X_{10}$  is awareness of climate change, and  $X_{11}$  is perception of the risks of climate change;  $\alpha$  is the intercept or the model constant;  $\beta_1$ - $\beta_{11}$  is regression coefficient;  $\varepsilon$  is error term.

Table 2 shows the variables using tobit regression model and the

**Table 2.** Definition of variables used in the tobit model

Variable	Variable definition
Dependent variable	
Climate change adaptation strategies	Number of adaptation strategies implemented by farmers, i.e., 1 to 4 strategies. The adaptation strategies studied were crop rotation, use of bore well, use of short duration rice varieties, and use calcium fertilizers/ ameliorant.
Independent variable	
Proklim	1 if the farmer comes from a proklim location, 0 if otherwise
Farmer education	Farmer's formal education in years
Farming experience	The number of years of farming
Land area	Land area of farmers for rice cultivation per 1,000 m <sup>2</sup>
Own land	1 if farmers cultivate rice on their own land, 0 if otherwise
Rental land	1 if farmers cultivate rice on the leased land, 0 if otherwise
Sharecropped land	1 if farmers cultivate rice on the sharecropped land, 0 if otherwise
Harvest failure	1 if farmers have experienced 100% crop failure, 0 if otherwise
Membership in farmers group	1 if farmers are members of farmers group, 0 if otherwise
Weather information	1 if the farmer obtains weather information, 0 if otherwise
Awareness of climate change	Farmers' awareness of the phenomenon of climate change in %.
Perception of the risks of climate change	Farmers' perceptions of climate change risk in %.

definition of each variable is also shown as information. The selection of variables is based on empirical studies conducted previously. The value of awareness of climate change and perception of the risks of climate change were obtained from 7 question indicators. The indicators consist of temperature, rainfall, wind speed, and unpredictable seasonal changes, as well as their impact if an increase occurs. The Likert scale is used to obtain farmers' answers to indicators. The Likert scale cannot be summed up because it's an ordinal scale. The scores on the question indicator can be summed up if converted into a ratio scale. Therefore, the Z distribution approach is carried out to fulfill it (Sappaile, 2007). The question indicators are converted into a Z score so that it can be summed up to obtain the value of awareness of climate

change and perception of climate change risk. The value of awareness and perception in percentage (%) is obtained from the total value of awareness and perception multiplied by 100% and then divided by the highest total Z score of the 7 question indicators.

## RESULTS AND DISCUSSION

### Farmers' climate change adaptation strategies

The number of adaptation strategies implemented by farmers is shown in Table 3. There were 98 farmers (87.5%) implementing more than one adaptation strategy. From 56 farmers from Proklim and 56 non-Proklim farmers, there were 12.5% farmers who did not implement the adaptation strategy, consisting of 5.4% Proklim farmers and 7.1% non-Proklim farmers. This shows that the number of

**Table 3.** Distribution of Proklam and non-Proklam farmers based on the number and average implementation of adaptation strategies

Location	Percentage of farmers based on number of adaptation strategies implemented (%)					Average number of adaptation strategies (Adaptation strategy)
	0	1	2	3	4	
Proklam (56)	5.4	4.5	28.6	10.7	0.9	1.9
Non-proklam (56)	7.1	10.7	23.2	6.3	2.7	1.7
Difference	-1.7	-6.2	5.4	4.4	-1.8	0.2

Source: Analysis of primary data, 2020

farmers who did not implement adaptation strategies from Proklam locations was less than from non-Proklam locations. Farmers from Proklam locations mostly applied 2 and 3 adaptation strategies, while farmers from non-Proklam locations mostly applied 1 and 4 adaptation strategies.

Farmers' capital and knowledge about climate change were several factors affecting the number of

adaptation strategies. Farmers with the implementation of 4 adaptation strategies had the highest average land area, awareness, and perception of 0.85 Ha, 68.24%, and 85.76%, respectively. Farmers without implementation had the lowest average land area and perception of 0.1 ha and 67.24%, respectively. Farmers with the lowest average awareness (53.2%) mostly implemented 1 adaptation strategy.

**Table 4.** Results of tobit regression analysis on the factors that influence the number of climate change adaptation strategies

Variable	Expected sign	Coefficient	Std. error	p-value
Constant		2.200 ***	0.545	0.000
Proklam	+	0.401 **	0.154	0.010
Farmer education	+	0.030	0.023	0.193
Farming experience	+	0.008 *	0.004	0.069
Land area	+	0.293 ***	0.034	0.000
Own land	-	0.097	0.154	0.530
Rental land	+/-	0.180	0.295	0.543
Harvest failure	+	0.095	0.158	0.551
Membership in farmers group	+	0.365 **	0.164	0.028
Weather information	+	0.405 **	0.161	0.013
Awareness about climate change	+	0.014 **	0.007	0.038
Perception of the risks of climate change	+	0.016 **	0.006	0.012
Number of observations	112			
Prob>chi2	0.0000			
McFadden's Pseudo R2	0.2789			

\*\*\* : Significant at 1% (p-value < 0.01); \*\* : Significant at 5% (p-value < 0.05); \* : Significant at 10% (p-value < 0.1)

Source: Analysis of primary data, 2020

Farmers were more likely to implement adaptation strategies using short duration varieties (75% farmers), then crop rotation strategies (64.29% farmers), ameliorant (33.04% farmers), and bore well (11.61% farmers).

The average adaptation strategy implemented by farmers from the Proklam location shows a greater number of strategies compared to non-Proklam farmers with a difference of 0.2 adaptation strategies, it means that the number of adaptation strategies implemented by farmers in the Proklam location was higher compared to that of farmers from non-Proklam locations.

#### **Factors that influence the implementation of climate change adaptation strategies**

This study examines the factors that influence the number of implementation of climate change adaptation strategies. The dependent variable is the number of adaptation strategies with a lower threshold value of 0 strategies (not implementing the adaptation strategies) and an upper threshold value of 4 adaptation strategies. Table 4 shows the results of tobit analysis using STATA 14. The results show that the Pseudo R-square value of 0.2789, which means that the independent variables tested were able to explain the factors that could influence the number of adaptation strategies applied by 27.89%, while 72.11% were explained by variables outside the model.

Analysis of the Proklam variable shows a significant positive sign which means that farmers from the Proklam location implemented more adaptation

strategies than farmers from non-Proklam locations. These results are consistent with the Proklam's goal, which is to increase the community's adaptation capacity for climate change. According to Muttaqin et al. (2019), the Proklam was established because climate change had a negative impact on the economic sector in Indonesia.

Proklam is expected to provide benefits to the community, especially in increasing understanding and application of climate change adaptation and mitigation strategies. Hasan & Kumar (2019) compared the application of adaptation strategies based on participation in the field school program, the results show that farmers involving in the field school program implemented more adaptation strategies than farmers who did not participate. Another program, Climate Smart Village (CSV), is carried out to increase adaptation capacity, especially in the agricultural sector (Aggarwal et al., 2018). Communities in the Proklam location jointly fight climate change through adaptation and mitigation actions. The community planted trees as a form of mitigation action and forming biopores (water infiltration) as an adaptation action also had an impact on the adoption of adaptation strategies in the agricultural sector. Beginning with an awareness of climate change adaptation and mitigation actions, farmers from Proklam locations will also implement climate change adaptation strategies in the agricultural sector.

The variable farming experience had a significant positive effect, indicating that increasing farming experience will increase the number of

climate change adaptation strategies. Farmers with long experience know climate indicator changes, their impacts, and actions to minimize the impacts of climate change. In fact, farmers who did not apply the adaptation strategy showed the lowest average experience of 31 years, while farmers who implemented 1 and 2 adaptation strategies showed an average experience of 30 and 31 years. Farmers with the implementation of strategies 3 and 4 adaptation strategies had the highest average rice farming experience of 35 years. These results are consistent with previous research that farming experience has a significant positive effect on the adoption of adaptation strategies. According to Afroz & Akhtar (2017), farmers with higher experience show a longer cultivation period, so that they have higher knowledge about climate change and how to minimize the impacts. Fadina & Barjolle (2018) reported that, the higher the experience of farmers, the ability to predict the weather was also higher, then it would increase the possibility of implementing adaptation strategies.

Land area shows a significant positive effect on the number of climate change adaptation strategies. It shows that increasing the area of farmers' cultivation land will increase the number of adaptation strategies. In this study, the average farmer rice land that did not implement the adaptation strategy was 0.11 Ha, while the average rice farmer land with the implementation of 4 adaptation strategies was 0.85 Ha. Farmers with larger land areas tend to adopt more adaptation strategies such as using bore

well that require a larger area because the area of land is also related to investment from farmers. The more land planted with rice, farmers must invest more by implementing more adaptation strategies. According to Ali & Erenstein (2017), the reason for this positive effect is because farmers with larger land areas had higher investment opportunities to implement adaptation strategies to minimize the risks of climate change. Afroz & Akhtar (2017) argue that farmers with large land area will spend more money to implement the adaptation strategy, while farmers with small land area cannot afford to spend the money, so they tend not to implement the adaptation strategy.

The significant positive effect of membership in the farmers group means that farmers who are members of the farmers group implement more adaptation strategies than farmers who are not members of the farmers group. Based on farmers' information, through farmers group meetings they could obtain information about suitable rice varieties to be planted, planting schedules to adjust the arrival of the rainy season, and discussions on how to deal with pests and plant diseases. Participation in farmers group will become social capital to interact with other farmers by discussing phenomena and problems related to agriculture. This will increase knowledge, innovation, and technology to solve problems in agriculture, especially the risks of climate change by implementing adaptation strategies (Gc & Yeo, 2019; Uddin et al., 2014; Žurovec & Vedeld, 2019). Farmers who are members of farmers group will get new knowledge



from the Agricultural Extension Officer. Agricultural extension agents play an important role in conveying new technological information including how to adapt to climate change, so that access has the opportunity to increase the opportunities for implementation of adaptation strategies (Afroz & Akhtar, 2017; Fagariba et al., 2018).

Weather information had a significant positive effect on the number of adaptation strategies. The results show that farmers who did not receive weather information applied a lower average adaptation strategy (1.41 strategies) than farmers who received weather information (2.02 strategies). Most farmers interviewed received weather forecast information from television. Weather information is useful for farmers to plan adaptation actions that must be taken in the coming planting season. The results are consistent with the research conducted by Fagariba et al. (2018), farmers who regularly obtain weather information show a greater likelihood of implementing adaptation strategies than farmers who don't obtain weather information. Access to weather information is useful for farmers, because it can provide weather forecasts for the upcoming planting season. Accordingly, farmers can plan future planting strategies and implement adaptation strategies to minimize the impact of temperature anomalies, drought, and resurgence of pests and plant diseases.

Awareness of climate change had a significant positive effect on the number of adaptation strategies implemented. Farmers with the implementation of 4

adaptation strategies show the highest level of awareness, which was 68.24%, then followed by farmers who implemented 3 adaptation strategies with an awareness value of 65.33%. The average awareness of farmers who did not implement the adaptation strategy was 57.7%. This shows that farmers with high awareness tend to implement more adaptation strategies. Hasan & Kumar (2019) obtained the result that awareness of the phenomenon and vulnerability of climate change is positively correlated with the adoption of adaptation strategies. Farmers with higher awareness and understanding of climate change also had higher levels of implementation of adaptation strategies. Farmers are aware that there has been an increase in current temperatures compared to that of 20 years ago. According to Fagariba et al. (2018), increasing temperatures will cause evaporation of ground water which will reduce the water content and moisture in the soil. Farmers will implement an adaptation strategy if rising temperatures is believed to cause crop failure.

Farmers' perceptions of the risks of climate change encourage farmers to implement adaptation strategies. Field studies show that farmers who don't implement adaptation strategies show the lowest average risk perception of 67.24%, while farmers with the adoption of 4 adaptation strategies show the highest average risk perception of 85.76%. Farmers believe that extreme climate events such as floods, droughts, storms cause damage to humans. Therefore, losses can be minimized by implementing adaptation

strategies. These results are consistent with the research of Azadi et al. (2019) which states that farmers will do the prevention and adaptation to climate change when farmers are given an explanation of the risks or negative impacts caused by climate change on agriculture, property, health and others. Mase et al. (2017) argue that one of the factors influencing the adoption of adaptation strategies is farmers' awareness of extreme climate risks such as drought, extreme weather, and pest and disease outbreaks. Policy makers must take part in increasing the implementation of adaptation strategies, in addition to design programs in increasing the adoption of adaptation strategies, it is also important to know farmers' perceptions of the negative impacts of climate change (Menapace et al., 2015).

#### **CONCLUSION AND SUGGESTION**

Based on the results of the analysis and discussion, it can be concluded that according to the 4 adaptation strategies studied (crop rotation, bore well, short duration rice varieties, and use of calcium fertilizers), there were 87.5% of farmers who implemented at least 1 adaptation strategy, and 12.5% farmers did not implement the adaptation strategy. Farmers from Proklim have an average number of adaptation strategies higher than farmers from non-Proklim. Farming experience, land area, membership in farmers group, weather information, awareness of climate change, and perceptions of climate change risks were found to be determinants of increasing the number of adaptation strategies by farmers. In addition, the status of the Proklim

location also plays an important role in increasing the number of adaptation strategies because it is known that farmers from Proklim apply a higher adaptation strategy compared to non-Proklim farmers.

Suggestions for policy makers and further researchers are as follows. The government needs to pay attention to factors that have a positive effect on increasing the number of adaptation strategies. Access to weather information including weather forecasts for the next growing season must be provided and easily accessible to all farmers. The government must encourage farmers to enter the farmers group to get the latest information on agricultural issues. Farmers' awareness of the phenomenon of climate change and perceptions of the risks posed must be increased through the provision of knowledge about climate change by agricultural extension workers. The positive influence of the Proklim location shows that the existence of the program is able to improve the implementation of climate change adaptation strategies. Proklim needs to be applied in areas that are vulnerable to the negative impacts of climate change so farmers can increase the implementation of adaptation strategies. Suggestions for further researchers to examine the impact of the implementation of adaptation strategies on the productivity and income of farmers in Proklim and non-Proklim locations. It is also necessary to expand the research location to obtain more detailed results.

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