

FARMER'S INTENTION ON CLIMATE CHANGE ADAPTATION

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Abstract: The purposes of this research is to describe local knowledge of farmer's perception toward climate change and to analyze farmer's intention toward climate change adaptation based on the theory of planned behavior. The sampling method used is simple random sampling with the population is the farmers in the research location. Data was analyzed using descriptive statistics analysis and also structural equation modeling – partial least square (SEM-PLS) for generating information regarding farmers behavior toward climate change. The results showed that 57.5 percent of respondents said that the intensity of rainy season and the temperature were changing significantly and 40 percent respondents also agree that the temperature was getting higher. There was 65% of respondents said that the climate change was driven by deforestation or logging. However, there was 17.5% of respondents said that factories have caused the climate change. Impact of climate change cause increasing pests and diseases attacking paddy crops and decreasing significantly of land productivity. For the structural equation modeling, subjective norm and perceived behavior control influence positively the intention of farmers' adaptation toward climate change.

Keywords: *Intention, Adaptation, Climate Change, Theory of Planned Behavior, Structural equation Model-Partial Least Square (SEM-PLS)*

PENDAHULUAN

Climate change is an inevitable and urgent global challenge. According to assessment of Intergovernmental Panel on Climate Change (IPCC), average global temperature has increased 1.1⁰C about 6.4⁰C between 1980-1999 (Andrade *et al.*, 2010).

Many factors lead for climate change, one of them is agriculture sector. The contribution of agriculture reached 20-25% in Greenhouse Gas Emissions globally (Lenka *et al.*, 2015). Rice cultivation is one of direct emission sources. Methane (CH₄) emission from rice production caused by anaerobic decomposition on flooded fields that need 40% water irrigation

Climate change has negative impact in rice cultivation. On climate change scenario, temperature above 25⁰C may cause decline in grain mass between 4,6%-6,1% per 1⁰C temperature under CO₂ level. Variability of rainfall also increase the level of environmental stress that decline productivity of paddy. If rainfall increade 1%, productivity will decline 0,12% in current paddy yields and 0,21% in next seosan. (Alam *et al.*, 2010).

The impact and loss due to climate change could be minimized by farmers. Adaptation is strategy to cope vulnerability by climate change damage (OCED, 2012). Because adaptation is important for farmer, many researches observed the

factors determining the farmer's decision to adapt climate change (Ibrahim & Ayinde, 2015; Speelman, 2017; Yila & Resurreccion, 2013). Farmers' capability to adapt climate change can be influed by innovation irrigation management system, crop development, early warning about weather and climate information, proper guidelines or suggestion, raw materilals subsidy, insurance support, and diversify crop variety (Alamet *al.*, 2011). Furthermore, number of families, income, participation in farmer's group, access of loans, location, and education also supported farmer's adaptation (Speelman, 2017). But, the exploration of social and psychological factors has been limited.

Understanding farmers for adaptation is critical issues to analyze. Because farmer's decision for adaptation not only influed by social-demografis factor, but also psychological factor such as intention and behavior (OCED, 2012). For example, knowing for intention in decision making process in their behavior can describe farmers' awarenees toward their contribution in environmental management. Masud *et al* (2016) also describe that attitude toward environmental awarenees was related to the intention behavior for environmental improvement.

Research about farmer's intention and behavior can use theory of planned behavior (TPB) approachment. (Dang *et al.*, 2014; Masud *et al.*, 2016; dan Redfern *et al.*, 2012). This theory

describe three variables such as attitude toward adaptation, subjective norm and perceived behavioral control can influead intention farmers to do something (Ajzen, 1991).

Research about the climate change connected with planned behavior is limited in Indonesia. Therefore, ths research is attempting to fill the empirical gap and bringing information in the way how the farmers adapt with the environmental changing.

Based on problem formulation above, the purposes of this research are: 1) to describe local knowledge of farmer's perception toward climate change; 2) to analyze farmer's intention on climate change adaptation.

RESEARCH METHODS

Research location was selected purposively in Menang Village, Pagu Distric, Kediri Regency. Sampling method uses formula introduced by Parel et al (1978). So, the total sample selected is 40 respondens. This research use primary data which obtained by interview and questionnaire in three farmers' group, and secondary data from government of Indonesia.

In this research, model is formed by latent variables who needs indicators to explain the measurement. Figure 1 shows the model of this research. Endogenous variable as laten variable is namely intention of farmer adaptation (Y1). This variable is measured by four indicators which are adjusting planting calender (Y1.1), adjusting technique planting (Y1.2) and crop diversification (Y1.3). Exogenous laten variables are devided in three variables. Those three variables are attitude toward adaptation (X1), subjective norm (X2), and perceived behavioral control (X3).

Attitude toward adaptation are reflected by four indicators which are doing additional steps to adapt climate change (X1.1), farmer adaptation (X1.2), uncertain climate change with no adaptation (X1.3) and harmful climate change on their production (X1.4). Indicators of subjective norm are family (X2.1), farmer's friend (X2.2), farmer's group (X2.3) and agriculture extention (X2.4). Perceived behavioral control is measured by two indicators which are capability knowledge of farmer and self-confidence of farmer to commit farming.

The data was analyzed using two analyses, descriptive statistic and *structural equational model-partial least square* (SEM-PLS). Descriptive statistic will explain about characteristics of respondent and farmer's perception about climate

change. Then, SEM-PLS is used to analyse intention of farmer's adaptation toward climate change.

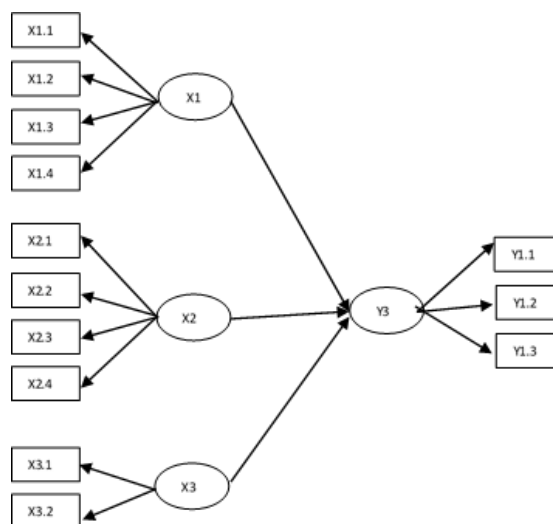


Figure1. Research Model

Then, validity test use *discriminant validity* (DV) and *average variance extracted* (AVE). Indicator will be valid if AVE greater than 0.5 and loading factor in their own indicator greater than each other. Fit structural model is performed by path coeffisien, p-value, R-squared and Q-squared.

RESULT AND DISCUSSION

Farmer's Perception toward Climate Change

Knowing perception of farmers toward climate change is an important part before we discuss about adaptation intention. Climate change is serious challenge but farmer's awareness is low. In this chapter, perception of climate change devided in three topics which are characteristic of climate change, the causes of climate change, and the effect caused by this phenomenon.

In order to explore farmers' perception on climate change, respondents were asked several carefully weigthed questions, as shown in Table 1. The result shows that 57.5% respondents know that characteristic of climate change is indicated by unpredictable rainfall patterns. Moreover, the respondents' statement that there were increasing temperature were about 40%. The village location of this research is located in more than 500 meters upper sea levels. Then, according to the reponse of respondents, there was 90% of respondents agree

that there is no extreme disasters and flood happened.

Table 1. Farmer's Perception on Climate Change

Climate Change	Respondent's Answer		
	Agree	Neutral	Disagree
Characteristics of climate change			
Temperature heater than 10 years ago	40%	40%	20%
Rainfall More Intensively	77.5%	20%	2.5%
Rainfall in abnormal cycle	57.5%	35%	7.5%
Summer coming fast	5%	7.5%	87.5%
Flood and extreme disaster	0%	10%	90%
Cause of Climate Change			
Logging	27.5%	65%	7.5%
Factory industrialization	17.5%	55%	27.5%
People migration	0%	35%	65%
Bad management on natural resources	0%	35%	65%
Consequences of Climate Change			
Increased pest and diseases	92.5%	7.5%	0%
Unfertile soil	75%	25%	0%
Declining productivity	92.5%	5%	2.5%
Rains makes acid soil	50%	45%	5%

The cause of climate change should be known for measuring adaptation level of farmers. (Nakashima, D.J., Galloway McLean, K., Thulstrup, H.D., Ramos Castillo, A. and Rubis, 2012). Local knowledge of respondent is highly influenced by where they live. There is 65% respondents answering neutral that logging activities cause climate change. The statement that industrialization causing climate change is agreed by 17.5% respondent. It is because the respondents live close enough to the cigarette factory. Respondent disagree that climate change was caused by irresponsible natural resources management (75%) and people migration (65%).

Tabel 2. Realibility Test

Indicators	Description
X1.1 Doing additional steps	Realible
X1.2 Farmer Adapt	Realible
X1.3 Uncertain_No Adapt	Not Realible
X1.4 Climate Change Harmful	Realible
X2.1 Family	Not Realible
X2.2 Farmer's Friends	Not Realible
X2.3 Farmer's Group	Realible
X2.4 Agriculture Extention	Realible
X3.1 Capability & knowledge	Realible
X3.2 Farmer's Confidence	Realible
Y1.1 Adjusting planting calender	Realible
Y1.2 Adjusting planting techniques	Realible
Y1.3 Crop diversification	Realible

Climate change has negative impact on agricultural sector. It is due to increasing intensity

of pests and diseases attack to the farmer' crops. Respondents said that rice productivity was decreasing significantly was about 92.5%.

The average rice productivity is about 4 tons/hectare. The optimal production of the land can achieve about 5 fields has decreased quality and too much use of chemical substances. A half of total respondents also acknowledge that their land is not fertile anymore. tons/hectare. In addition, there is 75% of respondents believe that the current land of rice

Analysis of Farmer's Intention on Climate Change Adaptation

The strategy of adaptation is needed by farmers to minimize the impact of climate change. Intention is the first important thing before behavioral aspek of farmers.

In this reasearch, intention can be formed by attitude toward adaptation, subjective norms and perceived behavioral control. Realibility test shows in Table 2, there are three variables are not realible with their variable such as uncertain climate change_no adapt, family and farmer's friends. So, this indicator must be deleted. But, farmer's friend can be save because it's composite realibility (CR) more than 0.6. Then validity test can be see on their discriminat validity and AVE. All variables are valid because AVE more than 0.5.

Tabel 3. Validity Test

	ATT	NS	PBC	Y_INT	Result
X1.1	(0.816)	-0.093	0.434	-0.045	Valid
X1.2	(0.876)	0.073	-0.254	0.209	Valid
X1.3	(0.719)	0.017	-0.184	-0.204	Valid
X2.2	-0.301	(0.303)	-0.177	0.756	Valid
X2.3	0.065	(0.954)	0.007	-0.145	Valid
X2.4	0.031	(0.948)	0.050	-0.096	Valid
X3.1	0.419	0.220	(0.845)	-0.308	Valid
X3.2	-0.419	-0.220	(0.845)	0.308	Valid
Y1.1	-0.042	0.078	-0.046	(0.749)	Valid
Y1.2	0.104	-0.006	0.007	(0.798)	Valid
Y1.3	-0.077	-0.080	0.044	(0.665)	Valid
AVE	0,547	0,650	0,634	0,714	

Table 4. The Analysis of PLS SEM Farmer's Intention on Climate Change Adaptation

Hypothesis	Path coeff	p-values	Result
ATT>Y_INT	0.48	0.001*	Ho rejected
SN>Y_INT	0.36	0.006*	Ho rejected
PBC>Y_INT	0.27	0.030*	Ho rejected
R-square	0.52		
Adj. R-square	0.48		
Q-square	0.539		

* level significance 95%

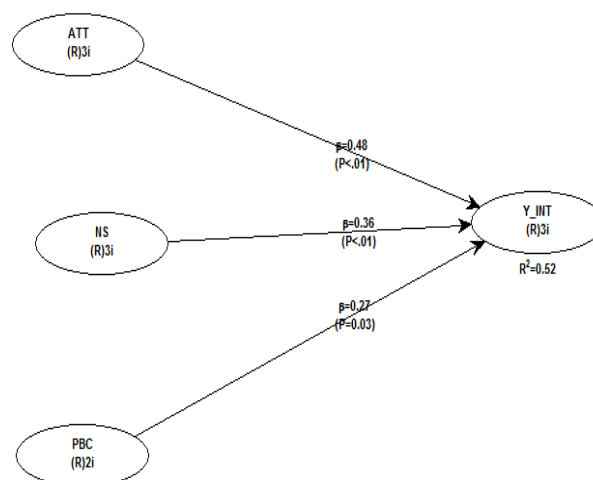


Figure 2. Model of Intention on Climate Change Adaptation

Based on Table 4, all variables are significantly effect toward intentions of farmers in climate change adaptation, so all hypotheses are accepted. Attitude toward intention has positive coefficient of 0.48, whereas subjective norm has a path coefficient about 0.36 and the perceived behavioral control has 0.27 path coefficient influencing the intention in adapting the climate change. The R-square value is 0.52, it means that intention model adaptation can be describeb 52% by attitude variable, subjective norms and

perceived behavioral control, while the rest was explained by other variables outside the model. Views on the value of the Q-square that this model can predict model of 53.9%. The overall intention model adaptation to climate change can be described in the model in Figure 2.

Farmer's Attitude toward Adaptation Intention

Climate change is lead to loss for farmer's productivity (Peng et al., 2004). Therefore, farmers must take additional activities to minimize the

impact of climate change. On rice cultivation, high rainfall can cause increasing of fungal diseases called blast disease. Farmers do some efforts to cope these diseases by spraying a chemical fungicide every two times a week.

This attitude is different from the rice cultivation process in the time before. In addition, farmers soak of seeds before planting by chemical anti-fungal drugs. Additional activities for grooming process is also done by changing the use of fertilizer to prevent planthopper. To reduce intensity of the birds eating the rice, farmer put up the paranet and scarecrow. The attitude toward adaptation is employed to address the consequences of climate change (Masutomi, Takahashi, Harasawa, & Matsuoka, 2009).

Attitude toward adaptation is also described by additional step to anticipate climate change conducted by farmers. Howden *et al.*, (2007) stated that will be hard to make a collaborative strategy for the adaptation when farmers are individuals. The farmers claimed that when the attitude of adaptation is carried out together, it will minimize crop failures. For example, using same variety seed in the landscape can reduces planthopper's attack.

Subjective Norm toward Adaptation Intention

Intentions is not only built from the attitude of individual person, but also environmental process and social pressures (Cialdini and Goldstein, Griskevicius, 2008). That is called the subjective norm. Friend's farmer is the most important element in the subjective norms that affects farmers' intentions toward climate change adaptation (Roesch-mcnally, 2016). This is reflected by the existence of respondent who discussed among farmer's friends when they get problems. Discussions were often performed informally at the home or fields. This discussion process will influence farmers to collect adaptation intention in climate change strongly (Pannell et al., 2006; Reimer, Prokopy and Weinkauff, 2012).

In this research, farmers' group was also influenced by subjective norms. Farmer's group often discuss about agricultural issues or innovation that will be applied in cultivation. But, the topics of climate change are limited in their discussions. One of the statements of the head of farmer's group stated that climate change could not directly be anticipated when farmers are difficult to be directed. For example, land is one of factors determining rice productivity, but farmers ignore declining of land fertility due to excessive use of chemical fertilizers. This issue has been raised. Using biological agents is one of the alternative solution. However, biological agents are not common used by farmers in the Menang Village.

Agricultural extension also affects farmers in adapting to climate change. Agricultural extension in Menang Village offers socialization that just focus on eradication of pests and diseases. However, the farmers were not interested enough in the extension topic since the farmers have their own solution. It is important to include other topics in extension program such as soil management, water filtration process and post-harvest processes. Then, innovation can be adopted and practiced by farmers (Pannell et al., 2006). Moreover, the critical point of a traditional extension officers is in the communication processes, noticing that farmers are generally passive recipients.

In this study, families have no effect in subjective norms. Farmer's friends are more influence than family. The farmers tend to have minimum time discussing the production decision with their family. The case in the research area reveals that if the husband works as a farmer, farmer's wife tends to have less knowledge about agriculture.

Perceived Behavioral Control toward Adaptation

Farmer's confident to adapt climate change is important point to build intention. Farmers who have high confidence on their agriculture practice has had a high perception also to cope the risks from climate change (Roesch-mcnally, 2016). Increasing pests and diseases can cause crop failure, but it does not make farmer stop from farming. For farmers, planting rice is part of their life. Farmer admitted that having food all the time is the highest concern for farmers and eventhough suffered heavy losses in farming, the farmers will continue growing it again. The confidence of farmers in adapting the climate change is proved by farmers with cultivate gago paddy.

The capability and knowledge of farmers also important to increase adaptation intention. This is related to Mantalvo (2003); Howgrave-Graham dan van Berkel, (2007); Shie *et.al* (2008); Zhang, Yang and Bi, (2013) stated that individual or organization's capability can create new innovation. In this reasarch, capability and knowledge are applied in adjusting planting calender, adjusting planting techniques, and crop diversification. Based on farmers' experience show that there are three planting seasons. Rice cultivation starts from November up to February.

Farmers adjust planting techniques through irrigation management, changing of fertilizers and changing labour use. The best time to irrigate paddy is when vegetative up to 40 days left. Overload irrigation in generative time make paddy

less sturdy. Fertilizer management also be planting strategy. When the intensity of rain is increased, farmer will reduce N fertilizer use because it makes roots and stems become weak.

Using chemical such as pesticides or fungicides also need strategy. Although farmer has limited knowledge about active ingredients in pesticides, it does not limit farmer's intention to use it. Farmers generally use pesticides using their estimation. This strategy is the adaptation process to cope the impact of climate change. Beside, crop diversification also includes the adaptation strategy. All respondents have common cropping pattern, such as chili-corn-rice cultivation. Moreover, to prevent vulnerability, farmers should consider to choose better variety. Commonly, farmers use Ciherang, Membramo, IR-64 and legowo variety. But, many farmers plant Ciherang because it is more resistant in rainy season.

CONCLUSION AND SUGGESTION

Conclusion

1. Climate change is a serious problem for farmers. The characteristics of climate change based on farmer's perception are increasing rainfall and rising temperature. The causes of climate change are logging and factory industrialization. The impact of climate change is increasing pests and diseases attack and declining productivity. Therefore, farmers should adapt this and minimize the damage of production due to the climate change.
2. The results show that attitudes, subjective norms and perceived behavioral control have positive influences for farmers' intention towards adaptation. The attitude contributes to affect intention about 0.48. Subjective norm and perceived behavioral control have path coefficient about 0.36 and 0.27, respectively. Subjective norms or environmental factors of farmers are farmer's friend, farmer groups and agricultural extension officers. In perceived behavioral control, farmers have capability and knowledge to adapt climate change, also have good confidence to commit agriculture practices. Intention of farmers are represented by adjusting planting calendar, adjusting planting techniques and crop diversification.

Suggestion

Increasing awareness of farmers about climate change should be achieved through more socialization and discussion. Attitude toward

adaptation can be increase by climate field school. Farmer's group must make an innovation discussion and strategy to make farmers interest with this issue.

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