Farmers' Knowledge and Attitude to Climate Change

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Abstract. The objective of research is to describe: 1) the dry field farmers' knowledge on climate change, and 2) the farmers' attitude to climate change. This research was conducted in Cemoro Sewu Rivershed, Karanganyar Regency using a descriptive qualitative method**.** Data collection was conducted through observation, in-depth interview, documentation, and Focus Group Discussion. Technique of analyzing data used was Miles and Huberman's interactive model of analysis. Data validation was done using source and method triangulations. The result shows that farmers' knowledge on climate change still belongs to low category, the use of *titen* or *pranata mangsa* signifying science is still applied by a few of people in their farming. Farmers deal with the climate change responsively, but they always feel anxious with the effect of climate change.

Keywords: knowledge level; attitude; farmers; climate change;

1 Introduction

Global climate change is one of important environmental issues in the world. Climate change is particularly due to the effect of global warming resulting from human activities. It plays a very important role in agricultural sector as it leads to excessive rainfall increase, thereby leading to flood or prolonged dry season constituting one of factors causing production decrease and harvest failure in some farming commodities[1]. Recent studies on the climate change recorded that climate change threatens the food production sustainability. Climate change is one of factors causing the decrease in farming production, thereby affecting food resilience directly [2]. Although the climate change can allow for a small increase in the harvested area, the decrease of paddy harvest yield will likely be higher than its increase. The farmers in Nusa Tenggara Barat (West Nusa Tenggara) still can meet the rice demand at local level amid the climate change occurring, but they cannot provide sufficient rice for other provinces [3].

Climate change also affects the world food production like China. Each 1ºC increase in weather temperature will result in a decrease in corn harvest yield by 1.7% [4]. Climate change also results has an impact on harvest yield uncertainty in Indian agro ecological zone [5]. Rainfall is the most important factor to paddy harvest yield in Thailand, because temperature increase will lead to the decrease in it [6]. Climate change also affected paddy production paddy production in China in 1961-2010. The increase in average air temperature has increased single-paddy production at national level up to 11% relative to that during research period, but it results in the loss in the total double-paddy plant production up to 1.9% [7]. Climate change like extreme weather, unpredictable temperature and fluctuating rainfall result in some significant risks to agricultural economy [8].

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Regarding the phenomenon, the farmers necessarily take a measure to adapt to climate change to minimize its effect. The adaptation is manifested actually into cultivation activity through their knowledge, attitude, and skill. Considering the statement above, this research aims to describe: 1) dry-field farmers' knowledge on climate change, and 2) farmers' attitude to climate change. Farmers' knowledge and attitude to climate change is very important to know to map the farmers' condition on climate change and the attempt to anticipate it. The responsive farmers tend to find out and to anticipate and to minimize the effect of climate change.

2 Method

Global climate change is one of important environmental issues in the world. Climate change is particularly

3 Result and Discussion

3.1 *Pranoto Mongso*, as Farmers' Local Knowledge in Dealing with Climate Change

Knowledge is a product of sustainable interaction, dialogue, negotiation, and accommodation between one individual and another in different groups. Considering Bloom's taxonomy, cognitive domain is an ability aspect related to knowledge, reasoning or mind. Bloom divides cognitive domain into six levels or categories: knowledge, comprehension, application, analysis, synthesis, and evaluation. The first (bottom) three levels are lower order thinking skills.

Farmers' knowledge in defining the term climate change on the lowest levels or lower order thinking skills. Old farmers who have done their farming for more than 50 years do not know the term climate change on average. Most of them merely can mention the signs of climate change occurring, such as hotter air temperature, uncertain season change, and extreme rainfall. The farmers merely know and explain climate change as season shift, either rainy or dry season. The farmers' knowledge in comprehending climate change is a fundamental aspect in the attempt of mitigating and adapting to climate change. The farmers with good knowledge on climate change will attempt to adapt to climate change in order to minimize its effect on their farming [1].

In predicting the time of rainy and dry season coming and ending, the farmers use local wisdom existing. Local wisdom is a social system including knowledge believed to be true not only to an individual or a group of individuals, but to a community in a certain area. Local wisdom in the implementation of farming activities is, among others, the use of *pranata mangsa* calendar system. *Pranata mangsa* derive from the word *pranata*, meaning rule or stipulation, and *mangsa* means season. The farmers who have done their farming for ten years usually decide to embark on their farming using *pranata mangsa*. *Pranata mangsa* is a season calendar to Javanese farmers based on natural signs, either flora or fauna, believed to be the sign of the beginning of rainy or dry season. Figure 1 shows a model identifying natural signs appearing, believed by the farmers to determine the beginning or the end of rainy season.

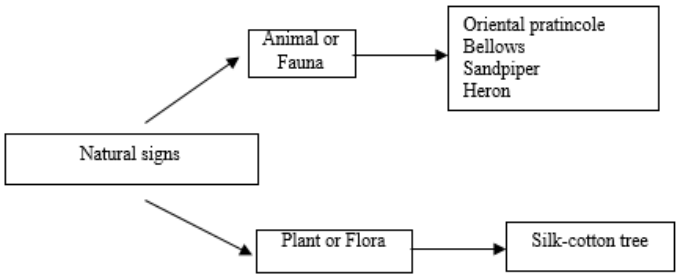

Fig 1. Model of Identifying Natural Signs of the beginning and the end of Season in DAS Cemoro Sewu, Karanganyar Regency

From figure 1, it can be concluded that farmers, in addition to using *pranata mangsa* in predicting the coming of rainy and dry season, also see the natural sign appearing. The farmers define *Pranata mangsa* as the season calendar to determine when the appropriate time to plant is and when the time not to plant is. *Pranata mangsa* contains ecological wisdom indicating ecological service [9]. *Pranata mangsa* or called *ilmu titen* by the farmers is the product of an activity of knowing, identifying, and recording surrounding environment in their lifetime. The farmers acquired information on *pranata mangsa* from their parents hereditarily. A study on small farmers' knowledge and perception on climate change in Ghana found that a strategy to adapt to location is recognized as an effective way of dealing with vulnerability to climate change felt by the small farmers [10].

Table 1. *Pranata Mangsa* System in determining the beginning of their farming in Gondangrejo Sub district, Karanganyar Regency.

Mangsa (phase)	Characteristics
Mangsa 1	Dry season, no drizzle falls, many pests and diseases spread
Mangsa 2	Dry season, pests and diseases begin to decrease
Mangsa 3	Dry season usually occurring in August, farmers are prepared for cultivating land by sowing dry manure on the rice farmland while waiting for the rain falling.
Mangsa 4	Rain begins to fall, despite small quantity
Mangsa 5	*Kalimati*, *kali*= river, *mati* = stop flowing, becoming hot, meaning that water in the river becomes hot, thereby is not appropriate to use to irrigate farmland, farmers have not begin to plant yet.
Mangsa 6	Oriental pratincole begins to appear, farmers begin to sow seed
Mangsa 7	Beginning to plant
Mangsa 8	High rainfall intensity, farmers begin to plant (usually occurring in February)
Mangsa 9	*Mareng*, is characterized by many thunderbolts, usually occurring in late February to the middle of March, hot soil temperature, so that farmer are not dare to plant
Mangsa 10	Planting season (MT) II begins
Mangsa 11	Planting season II
Mangsa 12	Planting season II

Table 1 shows *pranata mangsa* system used by the farmers in determining the time to embark on farming activity. From the table, it can be concluded that each of *mangsa* existing has different characteristics. The farmers' knowledge on climate change is also supported by the activities of *Sekolah Lapang Iklim* (SLI or Climate Field School) having ever been held by Farming Office and Agricultural Extension Officer. The farmers were equipped with knowledge

and practice of farming to anticipate the climate change occurring. These climate field school activities can improve farmers' knowledge on the climate change and improve the practice of identifying climate change with local knowledge on *pranata mangsa*.

3.2 Farmers of Cemoro Rivershed deal with Climate Change

Attitude, as the farmers' response to the climate change phenomena occurring in DAS Ceemoro Sewu, is affected by internal and external factors. The farmers' internal factor in dealing with climate change is affected by knowledge and technology mastery, and capitalization. Farmers' knowledge, particularly related to climate change, comes from their personal experience or information from others. Based on a study in Ghana, the farmers have good knowledge on climate variable affected by their education level and farming experience [10].

Farmers' knowledge and technology mastery also determines the quantity of farming information they acquire. The farmers acquired knowledge and technology mastery through formal education activities they attended, trainings related to climate. The farmers who have technology mastery tend to have convenience in accessing information on climate. They usually acquire information on climate change from printed media like newspaper, electronic media like radio, television, cellular phone, information exchange with other farmers, or information from the agricultural extension officer. Capitalization consists of cattle ownership, irrigation technology ownership, and farmers' family income level. The farmers in Cemoro Sewu Rivershed have rain-fed land that can harvest paddy 1-2 times in a years; it, of course, will lead to the low farming main income compared with irrigated-land farmers that can harvest 3 times a year. Decision making to adapt to climate change to farmers (a case in Nepal) is affected by farmers' education, access to capitalization and extension service, experience with the effect of climate change like drought, flood, and information on climate change issue, belief in the change of others considered important or opinion leader. The attitude of the farmers with rain-fed land is "anxious" with the climate change and speculative on their harvest yield because if there is no rain falling in the end of second planting season (MT II), climate and need for adaptation [11]. The small paddy farmers' gross income is sensitive to marginal change in temperature and rainfall. The farmers' perceived intensity of climate change is affected by farmers' size, experience, marital status, and education level [8].

Fig 2. Irrigation source "*sibel*"

Fig 2. Irrigation source PWS

External factors affecting the farmers' attitude to climate change are: the availability of irrigation infrastructures including water source, type of land, institution, role of agricultural extension officer, and culture. However, to the farmers with irrigated land, the climate change particularly the change of rainfall intensity does not affect significantly the harvest yield because adequate water supply enabling the farmers to keep harvesting paddy up to three times a year.

The climate change occurring does not affect the farming pattern in irrigated land. The farmers with irrigated type of land keep doing their farming activities despite the shift of season. They can utilize irrigation channel or water source coming from the river for their farming activities. Recent studies on the farmers' adaptation to climate change explained that although the farmers realize the long-term change in climate factor like temperature and rainfall intensity, they cannot identify this change as climate change. Although they are also aware of the risk resulting from climate variability and extreme climate event, they cannot take concrete measure to deal with the climate change felt, they just change their farming practice like changing seedling and harvesting times, cultivate plant with shorter age, implement companion planting, change planting pattern, and invest in irrigation and agroforestry [12].

The farmers' daily habit and routine activity is to visit their farm land, to find out pest and disease attacking their plant, and overcome the pest and disease invasion directly. It is this culture that make the farmers keeping responsive to the climate change indirectly also having an impact on the increased pest and disease attack appearing. This culture has been the farmers' habit practice, mindset, and belief in farming.

The external factor affecting the farmers' attitude to climate change is the effect of others considered important or opinion leader. For example, the head of local hamlet; when the rain falls at night, the pest appearing is "*kaper* or stem borer" pest; thus the head of hamlet serving as the head of Makmur I Farmer Group all at once informs the farmers immediately to anticipate the appearance of *kaper* pest that will generate "*sundep* (dead heart)" disease in paddy plant.

The members' activeness in farmer group institution also affects the farmers' attitude in adapting to the climate change. The farmers participating actively in the farmer group's meeting will love to attend the meeting because the presence of agricultural extension officer always gives update information on the condition of climate change occurring, and they can exchange opinion, share experience with each other to increase their knowledge in farming activities.

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References

[1] Mutolib, A, Ali R dan Tita S: Pengetahuan dan Adaptasi Petani Kopi terhadap Perubahan Iklim di Kecamatan Air Hitam Kabupaten Lampung Barat. Jurnal Serambi Engineering. pp. 2330-2336 (2021)

[2] Harini, R dan Bowo Susilo: Kajian spasial dampak perubahan iklim terhadap produksi pangan. Juenal Agripta. pp. 14-20 (2017)

[3] Muhamad Khairulbahri: Analyzing the impacts of climate change on rice supply in West Nusa Tenggara, Indonesia. Heliyon. pp. e08515 (2021)

[4] Jian-zhai Wu, Jing Zhang, Zhang-ming Ge, Li-wei Xing, Shu-qing Han, Chen Shen, Fan-tao Kong: Impact of climate change on maize yield in China from 1979 to 2016,Journal of Integrative Agriculture. pp. 289-299 (2021)

[5] Rishabh Gupta, Ashok Mishra: Climate change induced impact and uncertainty of rice yield of agro ecological zones of India. Agricultural Systems. Pp. 1-11 (2019)

[6] Siriwat Boonwichai, Sangam Shrestha, Mukand S. Babel, Sutat Weesakul, Avishek Datta: Climate change impacts on irrigation water requirement, crop water productivity

and rice yield in the Songkhram River Basin, Thailand. Journal of Cleaner Production. pp. 1157-1164 (2018)
[7] Chao Chen, Guang-sheng Zhou, Li Zhou: Impacts of Climate Change on Rice Yield in China From 1961 to 2010 Based on Provincial Data. Journal of Integrative Agriculture. pp. 1555-1564 (2014)
[8] T.O. Ojo, L.J.S. Baiyegunhi: Climate change perception and its impact on net farm income of smallholder rice farmers in South-West, Nigeria. Journal of Cleaner Production. pp. 127373 (2021)
[9] Retnowati, Arry, Esti, Anantasari, Muh, Aris M, Andreas Dittmann: environmental ethics in local knowledge responding to climate change: an understanding of seasonal traditional calendar pranata mangsa and its phenology in karst area of GunungKidul, Yogyakarta, Indonesia. Procedia Environmental Sciences. pp. 785-794 (2014)
[10] Divine Odame Appiah, Lawrence Guodaar: Smallholder farmers' perceptions and knowledge on climate variability and perceived effects in vulnerable rural communities in the Offinso Municipality, Ghana. Environmental Development. pp. 100691 (2022)
[11] Uttam Khanal, Clevo Wilson, Viet-Ngu Hoang, Boon Lee: Farmers' Adaptation to Climate Change, Its Determinants and Impacts on Rice Yield in Nepal. Ecological Economics. pp. 139-147 (2018)
[12] Amarnath Tripathi, Ashok K. Mishra: Knowledge and passive adaptation to climate change: An example from Indian farmers. Climate Risk Management. pp. 195-207 (2017)