Horticultural Farmer's Perceptions and Adaptations to Climate Change in East Java, Indonesia

Dita Atasa1*, Sri Widyanty1, Dona Wahyuning Laily1, Hery Toiba2

1Department of Agribusiness, Faculty of Agriculture, Universitas Pembangunan Nasional “Veteran”, Rungkut Madya Gn. Anyar, Surabaya (60294), Jawa Timur, Indonesia
2Department of Socio-Economics, Faculty of Agriculture, Universitas Brawijaya, Veteran Boulevard, Malang (65145), Indonesia

*Corresponding Author: dita.atasa.agribis@upnjatim.ac.id

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ABSTRACT

The agricultural sector highly vulnerable to the risks and impacts of global climate change. Horticultural farmers in East Java have experienced climate change, which is marked by a decrease in the level of productivity produced in recent years. This study aims to determine how farmers’ perceptions of climate change and adaptation strategies are carried out. Data were collected through direct survey to horticultural farmers in Malang and Kediri Regencies, East Java. Data analysis was carried out descriptively, by describing the data that had been collected regarding the perception and adaptation of farmers. The results of the study shows that farmers have a high perception of climate change. Farmers’ strategies in dealing with climate change include the adaptation by changing cropping patterns, changing plant varieties, changing plant types, changing fertilizer inputs, doing irrigation, and increasing knowledge and skills about agriculture.

Keywords: farmer’s perception of climate change; farmer’s adaptation; climate change; horticultural farmer

How to cite:

1. Introduction

The impact of climate change is experienced globally in every sector and individual. The occurrence of climate change is defined as a change in climate elements from time to time (IPCC, 2014). Climate change in Indonesia is characterized by the occurrence of long dry spells that occurred on average every four years between 1844 and 1960, but between 1961 and 2006 increased to every three years. In 1997-1998 was the worst El Nino event for 50 years, in 1998 was the hottest year in the 20th century. Not only that, floods are also getting worse in recent years, and there have been 530 floods in almost all provinces with damage levels increasingly (United Nations Development Program Indonesia, 2007).

The occurrence of climate change has a negative impact on the agricultural sector. It is naturally one of the sectors most vulnerable to the risks and impacts of global climate change (Backlund et al., 2012; Chen S, Chen X G, 2016; Di Falco et al., 2012; IPCC, 2014). Farming activities is depending on the weather such as temperature, rainfall, and extreme events (drought and flooding) (Shankar & Shikha, 2018). Uncertain seasons such as increased rainfall during the rainy season, increase the potential for floods and landslides which lead to crop failure. On the other hand, the occurrence of drought and a prolonged decrease in water availability will affect the water supply for the agricultural sector (Hairiah et al., 2016). In the end, climate change will result in decreased crop production (Hatfield et al., 2013) increased prices, decreased food security (Shankar & Shikha, 2018) and income (Abid et al., 2016; Delaporte & Maurel, 2018).
One of the important commodities besides food commodities is chili horticulture. Chili is not a staple food for the Indonesian people, but that’s become a role as a complementary seasoning for cooking. It is also supported by the price which is always fluctuating since the chili production in Indonesia is highly dependent on the weather, often contributes to inflation for the national economy (Kementrian Perdagangan, 2016). The facts show that chili production in Indonesia is highly dependent on the weather. Almost every year there is a crop failure on this commodity. The existence of data showing a tendency to increase chili prices in 1990-2016 due to crop failure due to erratic weather changes (Pusat Data dan Informasi Pertanian, 2017).

In responding to the impacts of climate change, farmers have different perceptions in dealing with climate change and extreme weather. Differences in perception lead to different responses in adapting. Farmers in relation to climate change are classified into farmers who adapt and farmers who do not adapt the climate change (Abid et al., 2016; Bryan et al., 2009; Deressa et al., 2011a), as well as happened in Indonesia (Adiyoga & Lukman, 2017). Adaptation to climate change is very important for farmers regarding to deal with the negative impacts caused. The appropriate adjustments make an effort to reduce the detrimental effects of climate change or take advantage of its positive effects (Hairiah et al., 2016).

2. Theoretical Underpinning

According to the Big Indonesian Dictionary (KBBI), perception is a direct response (acceptance) of something, or the process of a person knowing something through his five senses. Meanwhile, according to Walgito (1989), perception is the process of someone knowing something through his five senses, as a process of receiving stimuli by individuals through the senses or also called sensory processes. In line with the above opinion, Robbins Stephen (2001), defined perception as the process by which an individual organizes and interprets their sense impressions to give meaning to their environment.

Research discusses the importance of perception in the adaptation process has been carried out. How farmers perceive and interpret climate change affects their adaptive responses. Taylor JG, Stewart TR (1988), found farmers' perceptions of drought to be driven by direct experience. However, experience may limit farmers’ expectations for future environmental change. The wrong perceptions were led to inappropriate adjustment or adaptation actions.

Perceptions and knowledge of climate variability were found to count for adaptive responses and form the basis of decision-making in a sample of apple growers in India (Vedwan N, 2001). Not all knowledge possessed by farmers is rational knowledge. Nigerian study shows the most farmers attributed the decline in their agricultural productivity to mystical rather than environmental changes (Apata TG, Samuel KD, 2009). Therefore, it is important to understand one's perception of climate change before understanding the adaptation strategies undertaken.

Research on climate change perception and adaptation have been conducted in several countries include: America (Leiserowitz, 2006) and African, countries such as in Nigeria (Apata TG, Samuel KD, 2009), Ethiopia (Deressa et al., 2011b), South Africa (GA, 2009), Tunisia (Mertz O, Mbow C, Reenberg A, 2009). However, rarely conducted in Southeast Asia, some studies such as THP (2011) examined farmers’ perceptions of changes in climate variability (e.g. temperature, rainfall and drought) and corresponding adaptation responses in Vietnam’s central provinces. Schad et al (2011), discussed how farmers' perceptions of the causes and impacts of flooding affect adaptation responses in the mountainous region of northwest Vietnam.

3. Research Method

The research location was determined by multistage sampling. The first step is determining the location. Determining location of the province of East Java, and then divided into 2 regencies namely Kediri and Malang regency as well as sub-districts and villages. Second step is there are 2 villages will be randomly selected in each district (Pujon and Pandesari Villages, Pujon District, Malang Regency, and Kebonrejo and Kencong Villages, Kepung District, Kediri Regency). Though, the respondents in this study were horticultural farmers, namely red chilies farmers who adapted to climate change and farmers who did not adapt, with total of 200 respondents (each village 50 respondents). Descriptive analysis was used to test the data.
4. Results and Discussion

4.1. Characteristics of Respondents

Characteristics of respondents generally be seen based on age, education, farming experience, main occupation, land ownership status, and land area owned. In the following Table 1 is presented in detail the socio-demographic characteristics of the respondents. Based on the table above, it shows that the age of the respondents in this study was dominated by farmers aged 30-60 years with a percentage of 82.67%. The youngest respondents are 21 years old and the oldest respondent is 81 years old. By seeing the respondent's latest education, the percentage of farmers who graduated from elementary school or equivalent dominates, with a percentage of 46.04%, and an average of 8 years of education. Respondents in this study predominantly had 20-40 years of farming experience with a percentage of 50.5%.

Table 1. Characteristics of Respondents

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>46.61</td>
<td>11.76</td>
<td>21</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>&lt;30 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.95</td>
</tr>
<tr>
<td>30-60 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>82.67</td>
</tr>
<tr>
<td>&gt;60 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.38</td>
</tr>
<tr>
<td>Highest Education Level</td>
<td>8.27</td>
<td>2.601</td>
<td>3</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Not completing primary school</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.48</td>
</tr>
<tr>
<td>Graduated from primary school</td>
<td>46.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduated from junior high school</td>
<td>27.23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduated from senior high school</td>
<td>23.27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduated from university</td>
<td>0.99</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farming Experience</td>
<td>21.24</td>
<td>10.79</td>
<td>3</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>&lt; 20 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>45.54</td>
</tr>
<tr>
<td>20 – 40 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50.5</td>
</tr>
<tr>
<td>&gt; 40 years</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.1</td>
</tr>
</tbody>
</table>

4.2. Farmers’ Perceptions of Climate Change

Knowing how the strategies adopted by farmers in dealing with climate change, first it is necessary to know how farmers perceive in responding to climate change. Understanding farmers’ perceptions of climate change and climate change adaptation strategies will help them to develop relevant solutions based on local potential (Balasha et al., 2023). According to (Mase et al., 2017), farmers’ perception of climate change towards agriculture is a determining factor in the adaptation strategy that will be carried out by farmers. Figure 1 shows the various perceptions experienced by horticultural farmers on climate change. The changes experienced by farmers are changes in the last 10 to 20 years.

Based on the results of the study, most farmers have a relatively high perception of changes in rainfall experienced over the last 10 years. A total of 79% of farmers have a perception of changes in rainfall in the dry season that changes a lot, about 17% of farmers have a slightly changed perception, and 4% of farmers have a perception of rainfall in the dry season that does not change. In the previous studies in several countries reported the same findings that the majority of farmers have a perception of climate change and the trend of decreasing rainfall that has occurred in recent years (Deressa et al., 2011; Gebrehiwot & Van Der Veen, 2013; Moniruzzaman et al., 2023; Silvestri et al., 2012).

Climate change experienced by farmers with the perception of an increase in temperature and a higher decrease in rainfall (Deressa et al., 2011). However, when the results of this study are compared with developed countries, the percentage of farmers’ perceptions of climate change is still less than the results reported (Battaglini A, Barbeau G, Bindi M & F, 2009).

Based on the results of the study, most farmers have a relatively high perception of changes in rainfall during the rainy season that have been felt for the last 10-20 years. As many as 78% of farmers have a lot of changes in the perception of changes in rainfall during the rainy season. About 17% of farmers have a slightly changed perception, while 5% of farmers have an unchanged perception of changes in rainfall during the rainy season. The same results are also in accordance with the findings of (Prokopy et al., 2015), the perception of climate change is widely experienced by farmers in the United States, Australia, and New
Zealand showing changes in the timing of rainfall which play an important role in agricultural production activities.

Farmers assume that there has been a change in climate, for example with rainfall or the length of the season that extends or for example it should have entered the dry season but it is still the rainy season. In addition, according to respondents in every year there is an increase in the temperature felt by farmer. So that, it causes attacks by pests and plant diseases to increase and also plant vegetation increases.

Farmers’ perception of temperature changes in general shows a relatively high perception. As many as 61% of farmers have a perception of a change in temperature that changes a lot, 35% of farmers have a slightly changed perception, while 4% of farmers have a perception that there is no change in temperature felt by farmers in recent years.

The interesting thing found in the result study is farmers do not feel much changes in the vegetation on their land. As many as 17% of farmers have a perception of much change in vegetation, 47% have changed slightly, and 36% have no change in vegetation. Whereas according to research, climate change is marked by changes in temperature and changes in rainfall patterns (Shankar & Shikha, 2018).

Figure 1. Farmer’s Perceptions of Climate Change

Farmers’ perception of temperature changes in general shows a relatively high perception. As many as 61% of farmers have a perception of a change in temperature that changes a lot, 35% of farmers have a slightly changed perception, while 4% of farmers have a perception that there is no change in temperature felt by farmers in recent years.

The interesting thing found in the result study is farmers do not feel much changes in the vegetation on their land. As many as 17% of farmers have a perception of much change in vegetation, 47% have changed slightly, and 36% have no change in vegetation. Whereas according to research, climate change is marked by changes in temperature and changes in rainfall patterns (Shankar & Shikha, 2018).
Most farmers have a relatively high perception of changes in plant pests and diseases found on their land. As many as 84% of farmers have the perception that there are many changes in pests and diseases. 36% of farmers have a perception that there is little change in plant pests and diseases, while 17% of farmers have a perception that there is no change in plant pests and diseases in recent years.

4.3. Farmers Adaptation to Climate Change

Climate change adaptation refers to natural systems or human systems to adapt as impacts of climate change are unavoidable (Delaporte & Maurel, 2018). There are several adaptation strategies of horticultural farmers to climate change in this study, including adaptation to changes in cropping patterns, crop varieties, changes in plant types, changes in the quantity or type of fertilizer used for irrigation and adaptation by increasing knowledge and skills about agriculture.

Adaptation to changes in cropping patterns is an attempt to change growers on a plot of land by adjusting the layout and order of plants during a certain period by pay attention to rainfall. In horticultural crops such as red chilies, high rainfall is susceptible to disease and pest attacks (Swastika Sri, Pratama Dian, Hidayat Taufik, 2017). Based on the results of the study, the majority of farmers adapted their cropping patterns and types of plants, with a percentage of 62% while farmers who did not adapt were 38%. Farmers adapt cropping patterns and changes in plant types where red chili is the main commodity by rotating crops with other commodities such as shallots, tomatoes, cabbage, and carrots. This is performed as an effort to reduce the impact of climate change which is marked by changes in rainfall that cause crop failure.

Adaptation to changes in plant varieties is defined as changes in plant varieties that are resistant to pests and plant diseases. Selection of the right plant varieties is very important to do as an effective control against pests and plant diseases due to climate change. Based on the results in Figure 2 is showing that most farmers adapted plant varieties by 58% compared to those who did not adapt only about 42%. Farmers adapt cropping patterns and changes in plant types where red chili is the main commodity by rotating crops with other commodities such as shallots, tomatoes, cabbage, and carrots. This is performed as an effort to reduce the impact of climate change which is marked by changes in rainfall that cause crop failure.

Irrigation adaptation is needed as an effort to continue to be able to irrigate the land planted in the dry season so that it no longer relies on erratic rains. Hence, even in dry conditions, farmers able to increase the production of agricultural products with irrigation system.

Irrigation adaptation has been carried out in many countries when there is a prolonged dry season (Alauddin & Sarker, 2014; Bryan et al., 2009; Mengistu, 2011; Tripathi & Mishra, 2017). Based on the

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results of the study, according to Figure 2, it is seen that some farmers adapted to irrigation by 51%, while farmers who did not adapt only 49%. The majority of farmers who perform an irrigation adaptation use pump irrigation, only 41.26% of rain-fed irrigation systems are used.

Adaptation Changes in input mean changes in fertilizer application during a certain period by taking into account the rainfall. This is because their differentiation in the dose of fertilizer given to red chili plants in the rainy and dry seasons. As the results, the majority of farmers adapted inputs by 56%, while farmers who did not adapt only 44%. This finding shows positive results, because according to the recommendation of the BPTP Kementrian Pertanian (2018), it is necessary to adapt inputs, especially fertilizers according to the season. Provision of fertilizer in the rainy season for chili plants about the composition of fertilization should not contain too much nitrogen compared to the dry season. Excess nitrogen will cause chili plants to contain too much water (succulents). Seed lent chili plants will be easily attacked by pests and diseases.

About 73% of farmers adapt to increase their knowledge and skills regarding agriculture and climate change, which is mostly done by them. Only 23% of farmers did not make this adaptation. Farmers in East Java have easy access to agricultural extension. According to (Bryan et al., 2009) the existence of such access will increase farmers' perceptions of climate change and can determine appropriate adaptation strategies. This finding is supported by statements from (Zhai, Song, Qin, Ye, & Leipnik, 2018) stated that farmers know the real causes and effects of climate change, they are more likely to take an action to make climate change. This is because farmers are aware of the impacts caused by climate change, and understand what human behavior can contribute to climate change. Farmers will be willing to adapt to climate change to avoid losses. After controlling for all other factors, an increase in knowledge about the causes of climate change will result in an increased possibility of adopting adaptation measures.

5. Conclusion

The result of the study shows that horticultural farmers in East Java have a relatively high perception of climate change. Dealing with climate change, farmers adapt by changing cropping patterns, changing plant varieties, changing plant types, changing fertilizer inputs, doing irrigation, and increasing knowledge and skills about agriculture.

Credit authorsip contribution statement: Dita Atasa: Methodology, Writing – original draft. Sri Widayanti: Supervision, Writing – review & editing. Dona Wahyuning Laily: Supervision, Writing – review & editing. Hery Toiba: Supervision, Writing – review & editing.

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