

THE EFFECT OF CLIMATE CHANGE ON THE SOCIO-ECONOMIC RESILIENCE OF HORTICULTURAL FARMERS IN MAGETAN REGENCY

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Abstract

This study aims to analyze the influence of climate change on the socio-economic resilience of horticultural farmers in Magetan Regency. Using a quantitative approach with a survey method, this study involved 100 respondents of horticultural farmers spread across several production center sub-districts. The results of the study show that the majority of farmers are aware of climate change which is characterized by erratic growing seasons, rising temperatures, and unstable rainfall. Climate change has a significant impact on farmers' economic aspects, such as declining crop yields, increasing production costs, and reduced net income. From a social perspective, involvement in farmer groups and access to climate information has been proven to strengthen farmers' resilience. However, there are still many farmers who have not implemented optimal adaptation strategies due to limited information, technology, and supporting institutions. This study recommends strengthening local institutions, more intensive climate counseling, and developing participatory adaptation programs as an effort to build resilience in horticultural agriculture in the midst of increasingly intense climate change.

Keywords: *Climate change, socio-economic resilience, horticultural farmers, adaptation, Magetan*

INTRODUCTION

Climate change has become a global issue that has a real impact on various aspects of life, including the agricultural sector (Surmaini et al., 2011). This phenomenon triggers changes in temperature, rainfall patterns, and an increase in the frequency of natural disasters that threaten agricultural productivity in many parts of the world. In Indonesia, climate change is strongly felt in the agricultural sector which is one of the economic backbones of the community, especially in rural areas (Adhi et al., 2023). Climate change causes unpredictability of the growing season, increased pest attacks, and crop damage due to extreme weather. Magetan Regency, as one of the horticultural agricultural center areas in East Java, is not spared from the impact of climate change (Marsini, 2023). Farmers in this region depend on horticultural farming such as vegetables, fruits, and medicinal plants. Horticultural agriculture has characteristics that are very sensitive to climatic conditions (Servina, 2019). Changes in daily temperature, light intensity, and erratic rainfall patterns can affect plant physiological processes as well as crop quality (Surasmi et al., 2022).

In the context of Magetan, which has a distinctive mountainous topography and microclimate, climate change poses new challenges for farmers in maintaining the sustainability of their farming businesses. Water availability, planting time, and price stability are becoming increasingly difficult to predict. Not only the production aspect is affected, climate change also has a great influence on the socio-economic resilience of farmers. This resilience includes aspects of income, adaptation skills, access to climate information, and the power of social networks between farmers. Socioeconomic resilience is important to understand as the ability of farmers to survive, adapt, and recover from disruptions caused by climate change (Subiyanto et al., 2022). Without this resilience, farmers will be increasingly vulnerable to economic losses and social instability. Horticultural farmers in Magetan often suffer losses due to flash floods, long droughts, and erratic planting patterns. This causes production costs to increase and crop yields to decrease, which ultimately impacts the welfare of farmer families. This situation is exacerbated by low climate literacy and limited access to technology and adaptive capital. Many farmers still rely on traditional

THE EFFECT OF CLIMATE CHANGE ON THE SOCIO-ECONOMIC RESILIENCE OF HORTICULTURAL FARMERS IN MAGETAN REGENCY

Widita Nareswari **et al**

knowledge that is no longer adequate to deal with the rapid dynamics of climate change (Wulansari, n.d.). The government has developed various climate change mitigation and adaptation policies, but its implementation at the farmer level still faces various obstacles. Low coordination between agencies and lack of a participatory approach are the main obstacles in the implementation of the policy. Therefore, it is important to examine in depth how climate change affects the socio-economic resilience of horticultural farmers in Magetan. The study aims to see the extent to which farmers are able to adapt and sustain their survival in increasingly extreme climatic situations. The study also seeks to identify key factors that shape the socio-economic resilience of farmers, including the role of institutions, social capital, and local knowledge in dealing with climate change.

This understanding will help design policy interventions and empowerment programs that are more responsive to the needs of farmers on the ground. Appropriate interventions will increase farmers' adaptation capacity and strengthen their household economic resilience. In the context of sustainable development, farmers must be seen not only as victims of climate change, but also as key actors in adaptation solutions. Strengthening local capacity is crucial in shaping climate-resilient agricultural systems. Magetan Regency has a large potential for natural and human resources to support the resilience of farmers (Sa'di, 2024). However, this potential has not been utilized optimally due to the weak integration between scientific knowledge and field practice. By looking at the complexity of this problem, a multidisciplinary approach is needed in assessing the impact of climate change on socio-economic resilience. Collaboration between scientists, governments, and farmers is key to delivering holistic solutions.

This study uses qualitative and quantitative approaches to comprehensively explore the dynamics of the resilience of horticultural farmers in the midst of climate change. Data was collected through field observations, in-depth interviews, and questionnaires tailored to the local context. The main focus of this study is to identify the main challenges faced by farmers as well as the adaptation strategies they have implemented. In addition, this study also assesses the institutional support available in the regions. It is hoped that the results of this research can contribute to policy making at the local and national levels in designing agricultural development strategies that are adaptive to climate change. Ultimately, success in dealing with climate change will be largely determined by the ability of farmers to build strong, empowered, and self-reliant socio-economic resilience. This research is present as a small effort to understand and strengthen the process in Magetan Regency.

RESEARCH METHODS

This study uses a quantitative approach with descriptive and associative design. A quantitative approach was chosen to objectively measure the relationship between climate change and the level of socio-economic resilience of horticultural farmers in Magetan Regency (Agustianti et al., 2022). Descriptive design is used to describe the actual conditions faced by farmers, while associative design is intended to analyze the extent to which climate change affects socioeconomic resilience. The location of the research was determined purposively, namely in the Magetan Regency area, especially sub-districts that are horticultural centers such as Plaosan, Panekan, and Sidorejo Districts. These areas were chosen because they have dominant geographical characteristics and horticultural agricultural activities and are indicated to experience significant climate change impacts. The population in this study is all horticultural farmers who are actively engaged in farming in the region. Samples were taken by stratified random sampling, based on the type of horticultural crops cultivated (e.g., leafy vegetables, fruit vegetables, and fruits), as well as the altitude of the region (Retnawati, 2017). The number of samples set was 100 respondents, which were considered to represent the diversity of socio-economic conditions and farmers' experiences of adaptation to climate change.

Data collection was carried out through questionnaires compiled on a Likert scale to measure farmers' perceptions of climate change and their level of socio-economic resilience. In addition, in-depth interviews were also conducted with a number of key farmers and farmer community leaders to complement the quantitative data with qualitative information. The research instrument includes several main indicators, such as: (1) perception of climate change (rainfall, temperature, frequency of disasters), (2) the impact of climate change on production and income, (3) adaptation capacity (access to information, business diversification, agricultural technology), and (4) socio-economic resilience dimensions (purchasing power, household food security, social engagement, and institutional support). Before being used in data collection, the instrument was tested for validity and reliability by conducting trials on 20 farmers outside the main research site. The test results showed that all items had a validity value of >0.30 and a reliability value (Cronbach's Alpha) of >0.70 , which means they are acceptable (Sarstedt et al., 2019). The collected data were analyzed statistically descriptively to describe the characteristics of respondents and their socioeconomic conditions, as well as simple linear regression analysis to see the influence of climate change on the socioeconomic resilience of farmers. Classical assumptions such as normality, linearity, and heteroscedasticity are also tested to ensure the feasibility of the regression model. In addition to statistical analysis, the results of interviews were analyzed using data reduction techniques, data presentation, and thematic conclusion drawn. This analysis aims

THE EFFECT OF CLIMATE CHANGE ON THE SOCIO-ECONOMIC RESILIENCE OF HORTICULTURAL FARMERS IN MAGETAN REGENCY

Widita Nareswari **et al**

to provide a richer and more in-depth context to the quantitative findings obtained. With the combination of these methods, it is hoped that the research will be able to provide a comprehensive picture of the reality faced by horticultural farmers in Magetan, as well as formulate relevant recommendations for policymakers and stakeholders in the agricultural sector.

RESULTS OF RESEARCH AND DISCUSSION

1. Farmers' Perceptions of Climate Change

Most horticultural farmers in Magetan Regency are aware of significant climate change in recent years. The majority of farmers said that the planting season became erratic, rainfall tended to be unstable, and the air temperature felt hotter than usual. In fact, some farmers experience crop failure due to rain that comes early or too late. Based on the results of a survey of 100 respondents, as many as 82% of farmers stated that the current climate cannot be predicted with certainty, while 68% felt that climate change had a direct impact on their horticultural production.

Table 1. Farmers' Perceptions of Climate Change

Yes	Perception Indicators	Percentage (%)
1	Volatile climate	82%
2	Unstable rainfall	76%
3	Warmer air temperature	69%
4	More crop failures occur	61%
5	Climate change affects harvests	68%

The results of the study show that the majority of horticultural farmers in Magetan Regency are aware of the existence of quite drastic climate change, especially in terms of seasonal uncertainty, erratic rainfall, and increasing air temperatures. This is in line with the opinion of the IPCC (Intergovernmental Panel on Climate Change) which states that the impact of climate change can be felt most early and noticeably by people who depend on the agricultural sector for their livelihoods, because agriculture is greatly influenced by temperature, rainfall, and other weather factors (McCarthy, 2001). Farmers' awareness of climate change is an important indicator in building adaptive resilience. (Mertz et al., 2009) emphasizing that local perceptions of climate change play an important role in determining adaptation actions taken by farmers. In this context, the understanding of Magetan farmers towards climate phenomena is a potential initial capital to build a community-based adaptation system. However, despite the high awareness, not all farmers are able to scientifically identify climate change. This shows the need for technical assistance and climate education for farmers so that these perceptions can develop into effective mitigation and adaptation strategies.

2. The Impact of Climate Change on Farmers' Economic Resilience

Climate change has a direct impact on farmers' economic aspects, especially in terms of crop yields, production costs, and net income. From the survey results, it is known that around 74% of farmers have experienced a 10-30% decrease in crop yields in the last two years. In addition, 63% of farmers admitted that production costs have increased, especially for pesticides and additional irrigation. This condition causes some farmers to turn to side jobs such as farm laborers or seasonal traders to cover household needs. Farmers' economic resilience has become fragile because there is no adequate alternative source of income and not all farmers have savings or access to credit.

Table 2. The Impact of Climate Change on Economic Aspects

Yes	Economic Impact	Percentage (%)
1	Decreased yield	74%
2	Increase in production costs	63%
3	Decreased net income	69%
4	Looking for a side hustle	47%
5	Not having savings/credit access	58%

The finding that more than 70% of farmers have experienced a decline in yields and incomes due to climate change confirms that horticultural farmers are in an economically vulnerable position. Rising production costs, the need for additional irrigation, and more intense pest attacks due to temperature changes cause the cost structure of farming to become unbalanced. According to (Ellis, 2000) In the theory of sustainable rural livelihoods, the economic resilience of farmers is highly dependent on the ability to manage livelihood assets, such as natural resources, financial capital, and access to markets. When yields decline and costs increase, those assets are disrupted, which ultimately lowers farmers' ability to meet basic needs, invest, or survive in the long term. In this situation, income diversification is a form of economic adaptation carried out by some farmers. However, not all farmers have the access or skills to diversify their businesses. The high dependence on one type of horticultural commodity makes most farmers very sensitive to climate and market fluctuations.

3. Adaptation and Social Resilience Strategy of Farmers

In the face of climate change, some farmers in Magetan are trying to adapt through several strategies. Among them are the adjustment of planting time, the use of extreme weather-resistant varieties, and the adoption of a drip irrigation system. However, this level of adaptation is still relatively low and uneven. Only about 35% of farmers have actively implemented more than two adaptation strategies. From the social side, the attachment of farmers in farmer groups and cooperatives has a considerable influence on their social resilience. Farmers who are active in groups tend to access climate information, training, and agricultural equipment assistance more quickly. However, as many as 41% of farmers have not been actively involved in farmer groups or local agricultural institutions.

Table 3. Adaptation Strategies and Social Aspects of Farmers

Yes	Social Strategy/Aspect	Percentage (%)
1	Planting time adjustment	58%
2	Use of extreme climate-resistant varieties	42%
3	Efficient irrigation system	31%
4	Active in farmer/cooperative groups	59%
5	Receive climate-related training	36%

Data shows that some farmers have begun to implement adaptation strategies such as planting timing, the use of extreme climate-resistant varieties, and efficient irrigation systems. This illustrates an active response to environmental stress. However, the low implementation of adaptation strategies widely shows the existence of structural obstacles such as limited capital, information, and technology. In the perspective of the theory of socio-ecological adaptation developed by (Adger, 2000), resilience to climate change is determined not only by physical and economic factors, but also by people's social ability to self-organize, share information, and form collective solidarity. The involvement of farmers in farmer groups and cooperatives has a strategic role in strengthening adaptation because it is a forum for sharing experiences and access to training and government assistance. Unfortunately, there are still many farmers who are not active in local institutions or have not received adequate

THE EFFECT OF CLIMATE CHANGE ON THE SOCIO-ECONOMIC RESILIENCE OF HORTICULTURAL FARMERS IN MAGETAN REGENCY

Widita Nareswari **et al**

climate training. This shows that there is a gap between the government's adaptation policies and their implementation at the grassroots level (Arham, 2024). Agricultural institutions should be a bridge between scientific knowledge and the practical needs of farmers in dealing with climate change. By strengthening local institutions, increasing access to information, and providing training based on the real needs of farmers, the socio-economic resilience of horticultural farmers in Magetan Regency can be improved in a more sustainable manner.

CONCLUSION

This research shows that climate change has become a real challenge for the sustainability of horticultural farming businesses in Magetan Regency. The majority of farmers are aware of climate change which is characterized by unpredictability of the planting season, rising temperatures, and unstable rainfall. This perception reflects a fairly good level of awareness of environmental conditions, but it has not been fully followed by adequate technical adaptability. The impact of climate change on economic aspects is very felt in the form of declining crop yields, increasing production costs, and reduced farmers' net income. The economic resilience of farmer households is weak due to the high dependence on single farming, low income diversification, and limited access to capital and financial institution support. This condition has triggered some farmers to look for additional work outside the agricultural sector as a response to economic pressure. In terms of adaptation, several strategies have been implemented by some farmers, such as resetting planting times, using climate-resistant varieties, and water use efficiency efforts. However, the level of implementation is still limited due to various constraints, including lack of technical training, weak access to information, and low participation in farmer institutions. Involvement in farmer groups has proven to be one of the determining factors in increasing social resilience, because this group is a medium for access to information, assistance, and collaboration between farmers. Overall, the socio-economic resilience of horticultural farmers in Magetan Regency is still at a level that is vulnerable to climate change. To strengthen this resilience, a collaborative approach is needed between farmers, local governments, extension agencies, and other supporting institutions in providing mentoring, adaptation training, and strengthening local institutions. Thus, farmers can become active actors in building agriculture that is resilient to climate change, not just being victims of the impacts it causes.

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THE EFFECT OF CLIMATE CHANGE ON THE SOCIO-ECONOMIC RESILIENCE OF HORTICULTURAL FARMERS IN MAGETAN REGENCY

Widita Nareswari **et al**

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