

Strengthening the Capacity to Adapt to Climate Change among Farmers in a Banana Center in Java, Indonesia

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Abstract

Climate change causes basic problems in the lives of farmers in a banana center, such as a decrease in the quality and quantity of bananas. The various impacts of climate change will not cause food insecurity if the community has an adequate adaptive capacity. The purpose of this study is to analyze the capacity of farmers in a banana center to adapt to a change in the quality and quantity of bananas due to climate change. In-depth interviews, observation and focus group discussions were used to collect data. The unit of analysis is at the individual level in society. The data analysis was carried out through the stages of data reduction, data presentation, and drawing a conclusion. The results show that the development of community capacity to maintain the quality and quantity of bananas is carried out by strengthening the capacity of individuals, groups, and institutions that play an important role in adapting to climate change. This has an impact on the collective action of the community to maintain the sustainability of the banana center.

Keywords

adaptive capacity; banana center; capacity building; climate change; collective action

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INTRODUCTION

The influences of climate change on the agricultural sector are multidimensional, ranging from resources, agricultural infrastructure, and agricultural production systems to food security and independence, as well as the welfare of farmers and society in general. These influences can be distinguished by two indicators, namely vulnerability and impact. Literally speaking, vulnerability to climate change is a condition that decreases the ability (of people, plants, and farm animals) to adapt and/or to carry out their physiological or biological function, such as the failure to achieve optimal (natural) development, growth, production, and reproduction due to the threat of climate change. Meanwhile, the impact of climate change is the disruptions or conditions of loss or profit, whether physical, social, or economical, caused by the threat of climate change (Abdoellah, 2020).

The level of vulnerability in developing countries such as Indonesia, especially among small farmers, is higher than in other more developed countries. The influencing factors include level of education, awareness of climate change, access to information about adaptive farming, ability to adapt, and access to financial resources. Government policies regarding research on adaptive agricultural development are another important factor for increasing the capacity of farmers to adapt (Fagariba et al., 2018; Khan et al., 2020). Vulnerability is a geographic, social, economic, and cultural condition or characteristic of a community in a particular area, for a certain period of time, which reduces the ability of the community to prevent, suppress, prepare for, and respond to the effects of certain dangers. In simple terms, vulnerability and capacity can be understood as the condition of a place or community which causes the community or place concerned to become more vulnerable or more resistant to the threat of danger (Chou & Huang, 2021; Dilshad et al., 2019). In the context of farming, for instance, a lack of knowledge about adaptive farming methods to deal with climate change is an example

of social vulnerability, while access to credit funds, a high education level, easy access to and availability of agricultural technical personnel are examples of social and economic capacity. Disaster risk levels can be understood in simple terms as being directly proportional to vulnerability and threat, and inversely proportional to capacity (Monte et al., 2021).

The understanding of community vulnerability in relation to the impact of climate change can be divided into three models of understanding: (1) studies of social vulnerability that focus on identifying a condition of vulnerability of an individual or place as the consequence of an extreme weather event, (2) studies of vulnerability that are based on the assumption that vulnerability is a social condition which is a measure of social resistance and resilience to a disaster, and (3) studies that explain interaction between potential exposure and social resilience in a particular place or area (Kim et al., 2021).

The third model was chosen by the researcher to explain community vulnerability in a banana center, due to the effects of climate change, to help with the formulation of social indicators. The third model is resilience or flexibility to danger that is triggered by climate change. Resilience stems from a concept in the discipline of ecology (Béné & Doyen, 2018). The concept of resilience has subsequently been used by social scientists to explain the impact of climate change. Resilience has numerous definitions. In a social context, the definition of resilience is explained by incorporating aspects of individual, community, regional, and national capacity (Alessi et al., 2020; Mallick, 2019).

There are two categories of indicators for reading social resilience, namely indicators that are closely related to economic and institutional factors, and indicators that are linked closely to demographic changes in a region (Giacometti & Teräs, 2019; Rao et al., 2019). The key factor in the category of indicators that are closely related to economic and institutional factors is economic growth, which is accompanied by stability level, and population income distribution.

The next factor is environmental variability, which can be used to measure the extent to which people depend on a particular resource. Other important factors observed include livelihood stability and cultural values (Rao et al., 2019).

The second category of indicators is closely related to the demographic changes of a particular region. Mobility and migration are a series of indicators that are linked closely to resilience (Rao et al., 2019). Nevertheless, the relationships between these variables cannot be simplified in a causality relationship because every case and every region has a different pattern of resilience and migration relationships. Adger (2000, 349) also emphasizes that community resilience can be studied through a number of empirical indicators, but there is no one indicator that can comprehend resilience as a whole (Feldmeyer et al., 2020; Ji et al., 2021), for example by developing two social domains in an observation of social vulnerability. According to (Feldmeyer et al., 2020), the perspective of vulnerability must be viewed distinctly either on an individual level or collective level. Furthermore, he states that vulnerability on an individual level can be viewed based on the access to resources, diversity of income sources, and social status of an individual or household in a community, while vulnerability on a collective level can be viewed in terms of institutional and market structure.

Climate change has a real impact on the life of society. A change in rainfall patterns and an increase in the frequency of extreme weather such as rain accompanied by strong winds, storms, and floods caused by rising sea levels are indicators that climate change is taking place (Cianconi et al., 2020; Fouque & Reeder, 2019; Leisner, 2020). Adaptation to climate change can be understood as a form of adaptive response that is made to overcome the effects of climate change (Clayton, 2020; Malhi et al., 2020). Adaptation to Climate Change, according to Regulation by the Minister of Public Works Number 11 Year 2011, is the efforts that are made to increase the ability of an individual to adapt to climate change, including di-

verse weather and extreme weather events, so that the potential of damage caused by climate change can be reduced, the opportunities arising from climate change can be taken advantage of, and the resulting consequences can be overcome.

Farmers' adaptation to the effects of climate change can be defined as the farmers' behavior and experiences in interacting with the changing environment (Nguyen et al., 2019). The conditions of the present day are the result of a process that has been taking place for a long time, with various kinds of changes. Changes may occur over a short period of time or a long period of time. Climate changes are changes that take place over a long period of time. These changes cause farmers to develop behavior to respond to the changing environmental conditions, such as shifting seasons, intensity of rainfall, availability of water, and population of pests. These changes also force farmers to make adaptations so that they can continue to sustain their lives which depend on the agricultural sector (Marlina, 2022). Strengthening the climate change adaptation capacity of farmers in banana centers was carried out by research using sociological and anthropological theories. Sociological theory is used to understand more deeply the social and cultural dynamics that influence farmers' responses to climate change. The sociological theories used in this research are: first, system theory and social structure. This theory is to identify the social structures that influence banana farmers, such as agricultural systems, government policies, and social relations in their communities. This theory is to analyze how these factors limit or support farmers' adaptive capacity to climate change. Second, conflict theory. This theory is to describe potential conflicts that may arise in adaptation efforts, for example regarding resources or policies. Furthermore, the anthropological theories used as analytical tools in this research are the concept of culture and cultural materialism. This research will identify cultural elements that influence farmers' adaptation patterns, including local knowledge, traditional practices and cultural heritage. Apart

from that, observing changes in cultural materials, such as agricultural tools, which may be related to adaptation to climate change. Second, applied anthropology. This theoretical perspective is used to explain collaboration with farming communities in designing and implementing adaptation strategies. Apart from that, it is also to see the active participation of the community in the process of adapting to climate change among farmers in banana centers.

The philosophy of extension is in line with the principle of empowerment, which (Ife & Tesoriero, 2008) describes as preparing and planning the capacity of a community or an individual with resources, opportunities, expertise, and knowledge. This will improve the life of a community or an individual so that they can determine their own future, leading to a balance and sustainability of the natural, social, cultural, and economic environment. Community empowerment is a process of developing capacity, or human resource development. The goal of this research is to analyze the capacity of farmers in a banana center to adapt to the availability and sustainability of quality and quantity of bananas as a result of climate change.

METHOD

The research was conducted in Menjing Village, in Jenawi District, Karanganyar Regency, between April and August 2022. This area was chosen based on the consideration that it still preserves numerous traditions and local wisdom that have been passed down from the ancestors of the village and continue to be practised today in response to climate change. It is qualitative research with a case study strategy. A case study strategy was chosen because of the unique nature of the problem, and its ability to explain social phenomena in more depth (Bibri et al., 2020; Rashid et al., 2019). These social phenomena are (1) increasing awareness, education provides information about the causes, impacts and consequences of climate change. With better understanding, communities can increase their awareness of the urgency to act;

(2) changes in attitudes and values. Through education, people can develop positive attitudes towards the environment and sustainability. A deeper understanding of the impacts of climate change can change the values underlying individual actions, such as energy use, consumption, and consumer decisions; (3) participation in environmental conservation efforts. Education about climate change can motivate people to participate in environmental conservation efforts, including conservation, reforestation, and supporting environmental policies.

In the qualitative research tradition, a case study enables interaction between the researcher and the research object as in the tradition of a constructivist paradigm. According to (Bibri et al., 2020), social reality that is “constructed” is a domain that can be traced empirically, an objective world that is different from the order of objectivity in the scientific domain. They are not concerned with objectivity, either in the social sciences or natural sciences, but rather endeavor to develop a different kind of theoretical approach. Researchers adopt this view by conducting: first, social construction analysis. Researchers analyze the ways in which social reality is “constructed” by social interactions, culture, and language. Researchers describe how concepts, norms, and values are produced and maintained by social groups. Second, researchers do participatory observation to gain a deeper understanding of how individuals and groups construct and understand reality. Third, deconstruction and criticism. Deconstruction of thought can be used to reveal and analyze the assumptions underlying social construction. Researchers highlight contradictions, inequalities, and power coercions that may be hidden in recognized social realities. Fourth, cultural and interpretive studies. Researchers approach social reality in a complex and contextual way.

The social reality studied here is the level of natural vulnerability of a particular social system to climate change, or the social and economic conditions of the local community in response to the changing climate. These conditions are affected by exposure,

adaptive capacity, and sensitivity which can create risks. Collective action to reduce vulnerability and increase resilience is carried out to construct adaptation strategies in order to reduce the negative impacts of climate change. Strategies to adapt to climate change can be developed by teaching about risk and impact management, acquiring new knowledge, and designing an effective perspective. The researcher uses a phenomenological approach, with reference to the works of (Schutz, 1970; Urcia, 2021) about phenomenology in the social domain, but adapts it in the form of a conventional social explanation (Fourcade & Johns, 2020). For the purpose of obtaining more accurate data, the researcher also interviewed strategic groups (community figures/leaders) and other related institutions. All the informants were selected through purposive sampling, in accordance with the goal of the research and the understanding of the problem studied. The following are several ways used by researchers in the phenomenological approach. First, researchers conduct in-depth interviews or group discussions to understand individual or group personal experiences with climate change. Second, descriptive analysis. Researchers developed a descriptive analysis of subjective experiences related to climate change. It includes recognizing the essential elements, meanings, and interpretations that emerge from an individual's or group's experiences. Third, researchers understand cultural perspectives. Researchers understand how climate change can affect the cultural perspectives and values of certain societies. This can help design adaptation strategies that suit cultural contexts and account for diversity of experiences. Fourth, participation and direct experience. Researchers are involved directly at the research location to describe the imagined daily experiences of individuals or groups on climate change. This can provide a deeper understanding and enrich the phenomenological analysis.

Based on its sources, the data obtained can be divided into two categories, namely primary data and secondary data. The primary data was obtained directly from a number

of respondents. The technique for collecting primary data included in-depth interviews, participative observation, documentation, and Focus Group Discussions (FGDs). The main format used for the interviews was in-depth interviews. The writer also carried out informal conversational interviews which were conducted spontaneously and freely (Guba & Lincoln, 1994). The secondary data was obtained from a number of related institutions, such as government institutions, and written data from various sources, such as books, journals, and research reports.

The data analysis was carried out in three stages. The first stage was the process of data reduction, which focused on the selection, simplification, abstraction, and transformation of raw data from the field notes. In this process, data was chosen that was relevant to the focus of the research and separated from data that did not meet the exclusive inclusive criteria. The second stage was the data presentation in which the information was arranged to form statements that enabled the drawing of a conclusion. The data was presented in the form of a narrative text, which was initially scattered and separated into various information sources, then classified according to the theme and needs of analysis. The third stage was the drawing of a conclusion based on the reduction and presentation of data. The conclusion was drawn over a series of stages, from a general conclusion in the data reduction stage, then becoming more specific in the data presentation stage, and even more specific in the actual stage of formulating a conclusion. This series of processes indicates that the qualitative data analysis in this research combined the stages of data reduction, data presentation, and the drawing of a conclusion in a repeated and cyclic manner (Miles et al., 2018). The validity of data was also tested in in four ways, namely credibility; transferability; dependability; confirmability.

RESULTS AND DISCUSSION

Most of the banana farmers in the banana center in Jenawi District, Karanganyar Regency manage an area of land measuring

less than 0.2 hectares. In general they already have knowledge about climate change and the way it impacts farming, such as by causing an increase in air temperature and higher rainfall which can lead to both drought and flooding. They understand that climate change results in a change or a decline in banana production yield. These influences can be distinguished by two indicators, namely vulnerability and impact. Literally speaking, vulnerability to climate change is a condition that decreases the ability (of people, plants, and farm animals) to adapt and/or to carry out their physiological or biological function, such as the failure to achieve optimal (natural) development, growth, production, and reproduction due to the threat of climate change. The impact of resilience in adapting to climate change on the development of the banana center can be seen in table 1.

Vulnerability to change in the agricultural sector can be defined as the powerlessness of a farming system to maintain

and preserve its level of production on an optimal level when facing the clutches of climate change. Vulnerability is dynamic in nature, in line with technological reliability, social and economic conditions, and natural and environmental resources. Vulnerability is influenced by level of exposure to danger and adaptive capacity, as well as the dynamics of climate itself.

In general, climate change will lead to the shrinkage and degradation (decline in function) of land, water, and infrastructure resources, especially irrigation, which causes a risk of either drought or flooding. On the other hand, land requirements for various uses such as housing settlements, transportation, and agriculture continue to rise, in line with the increase in population and the advances taking place in each era. In absolute terms, the land available remains relatively unchanged, and even tends to shrink and experience degradation, both as a result of incorrect management and due to the impact of climate change. These condi-

Table 1. Impact of resilience in adapting to climate change on development of the banana center

Resilience Indicators	Resilience Dimensions	Impacts
Indicators closely related to economic and institutional factors	Economic growth	Strengthening of the local economy will expedite the handling of pest attacks on banana plants caused by climate change An increase in community income will enable control of a greater area of land for banana cultivation by making use of critical land Strengthening of social capital in the community will expedite the handling of problems related to development of the center in the face of climate change Increase in community participation in activities organized by groups in the community
	Stability level	
	Population income distribution	
	Environmental variability	
	Livelihood stability	
Indicators closely related to demographic changes in a region	Local cultural values	Expanded networks enable greater access to information related to solutions for banana cultivation and post-harvest management in the face of climate change Migration of people has an impact on the development of local wisdom in cultivation and post-harvest management in the face of climate change An open social system in the community expedites the diffusion of innovations in banana cultivation and post-harvest management
	Mobility	
	Migration	

Data source: Analysis of primary data through in-depth interviews, 2022

tions make it more difficult to stem the rate of land conversion and also mean that land management becomes more intensive, and even inclined to exceed its carrying capacity.

The adaptation of banana farmers to the effects of climate change can be seen in the farmers' behavior and experiences in interacting with their changing environment. The conditions of the present day are the result of a process that has been taking place for a long time, with various kinds of changes. Changes may occur over a short period of time or a long period of time. Climate changes are changes that take place over a long time. These changes cause farmers to develop behavior to respond to the changing environmental conditions, such as shifting seasons, intensity of rainfall, availability of water, and population of pests. These changes also force farmers to make adaptations so that they can continue to sustain their lives which depend on the agricultural sector. The natural elements that exist in a region provide a process that creates special characteristics in the region. These special

characteristics may be in the form of vegetation, rainfall, or social and cultural conditions. The different physical conditions of different regions will have an impact on the farming culture. This also means that in spite of the fact that all regions experience the same effects of climate change, the different physical conditions of each region will lead farmers to make different forms of adaptation.

An increase in institutional capacity as an individual and organizational process in countries all over the world, with the aim of strengthening the ability to mobilize the resources needed to deal with economic and social problems, and to achieve a better living standard in the community concerned (Ziervogel et al., 2022), requires the support of good policy capacity. The presence of a social system can also influence the speed of adoption of innovations, as outlined in the study of (Vargo et al., 2020), which shows that social structures can impede or facilitate the spread and adoption of innovations because they are influenced by a social sys-

Table 2. Capacity Strengthening to Adapt to Climate Change

Level of Capacity Strengthening	Form of capacity strengthening	Positive impact on banana center development
Individual	Extension from Department of Agriculture and institutions of higher education	Farmers have knowledge about tackling plant diseases and pests so they can anticipate and overcome the effects of climate change
	Mentoring from group managers, BUMDES, and village officials	Development of banana processing businesses to increase added value
Group	Facilitation of cooperation between groups from different districts	Addition of new groups to the banana center community (women farmers' groups, productive economy business groups)
Institutional	Institutional capacity building	Leadership patterns in farmers' institutions change from a top down model to a bottom up model to build communication and aspiration in the institution
	Institutional resource capacity building	Training about management and information technology to anticipate climate change so that the banana center becomes sustainable
	Increased service capacity	Easier access for farmers to obtain credit or production facilities without complex bureaucracy or specific requirements
	Expansion of cooperation networks or partnerships	Cooperation with financial institutions that can provide capital and cooperation with institutions of higher education that can help with banana cultivation and post-harvest management

Data source: Analysis of primary data through in-depth interviews, 2022

tem that has already adopted the same innovations. Societies that are more modern are relatively quicker to adopt innovations than traditional societies. Cosmopolitan societies will also be relatively quicker to make these adoptions than communities that are localized.

The adaptive capacity of farmers who belong to farmer-based organizations is the most important factor that influences farmers' adaptation to climate change. Similarly, according to (Ndamani and Watanabe, 2015), the main obstacle in the practice of adaptation is the lack of provision of projects and programs related to climate change. In addition, the coordination and synchronization of adaptation measures to climate change requires the strengthening of organizations of farmers' groups to build common perceptions, commitment, and integration between the agricultural sub-sectors, between different sectors, and between central and regional organizations. Table 2 shows the strengthening of capacity to adapt to climate change.

Efforts to adapt to climate change require a process of extension as a way of adopting ideas, practices, or objects through a learning process to change behavior, beginning with knowledge, attitudes, and skills, and implementing innovations (an adaptation process). This has an impact on collective action through a process of adaptation in relation to the capacity of banana farmers to adapt to climate change, which includes the adoption of innovations in technology transfer, institutional capacity, partnerships, social capital, and access to business capital in post-harvest management. According to Margono *"a community leader) the farmers in the banana center here have started to establish relationships with outsiders in their community in selling bananas and they know information about market prices so that farmers have a bargaining position."* in-depth interview on August 29, 2022.

Collective action in the banana center community to maintain the sustainability of the banana center includes: (1) making an inventory of places to collect water for drink-

ing in the river (intake) and irrigation areas; (2) repairing irrigation networks in every part of the river to detect changes in water supply and to use as equipment for water management and as a water source; (3) making an inventory of contaminated watershed areas where the water is still being widely used, to determine the priority for treatment; (4) implementing a program for building a reservoir that is integrated with the banana plantation and animal farm; (5) improving the carrying capacity of the watershed areas by preventing damage and improving catchment areas for water absorption through land conservation efforts, both with mechanical methods (such as building a terrace and infiltration well) and vegetative methods such as reforestation.

CONCLUSION

The social and economic conditions of the community in response to climate change have a positive impact on the development of the banana center. Efforts to adapt to climate change require a process of extension through capacity strengthening as a way of adopting ideas, practices, or objects in a learning process to change behavior, beginning with knowledge, attitudes, and skills, and implementing innovations (an adaptation process). The strengthening of individual, group, and institutional capacity in adapting to climate change is proven to have the ability to increase farmers' access to institutions. Institutional strengthening is carried out in aspects of organizations, resources, services, and networks. Capacity strengthening in adapting to climate change is proven to encourage farmers to increase their productivity which has a positive impact on the development of the center. Therefore, there is a need for building synergy between farmers' institutions so that cooperation and partnerships can grow and develop along with the development of the banana center. In addition, there is a need for support from the government and institutions of higher education to provide mentoring. The results of the research show that developing the capacity of the community to maintain the

quality and quantity of bananas, by strengthening the capacity of individuals, groups, and institutions to adapt to climate change, is proven to contribute to the development of the banana center. This has an impact on the collective action of the community in the banana center to maintain the sustainability of the banana center.

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