

LOCAL ECOLOGICAL RESILIENCE IN BUILDING LOWLAND RICE FOOD SECURITY IN EAST KOLAKA, SOUTHEAST SULAWESI

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Abstract: Food security is an increasingly pressing global challenge, particularly in areas vulnerable to climate change and environmental degradation. This study aims to analyze local ecological resilience in the context of developing rice paddy food security in East Kolaka, Southeast Sulawesi. The main focus of this study is to explore the interactions between biodiversity, traditional agricultural practices, and adaptation to climate change and their impacts on food security in the region. Socio-ecological resilience theory is used as an analytical framework to understand the complex dynamics between social and ecological systems, as well as the reciprocal interactions that occur in creating sustainable food security. The research method used was a qualitative approach, with data collected through in-depth interviews, participant observation, and analysis of relevant documents. The results indicate that local ecological resilience in East Kolaka is strongly influenced by farmers' traditional knowledge of natural resource management and their ability to adapt to environmental changes. Furthermore, collaboration between local communities and the government in formulating sustainable agricultural policies has proven crucial in improving food security. This research is expected to make an important contribution to understanding the role of socio-ecological resilience in developing food security in East Kolaka.

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Introduction

Global climate change has become one of the most significant threats to the sustainability of food systems and food security worldwide. According to the Intergovernmental Panel on Climate Change (IPCC, 2021) report, the impacts of climate change not only affect the environment but also have direct implications for global food security. The agricultural sector, which is the backbone of the economy and a source of livelihoods for a large portion of the global population, is highly vulnerable to the impacts of extreme climate fluctuations. Research shows that increasing average temperatures, shifting unpredictable rainfall patterns, and increasing frequency of natural disasters, such as floods and droughts, directly impact agricultural productivity (Chen, 2021; Lobell et al., 2011).

In this context, food systems that rely on staple crops like rice are highly vulnerable. Rice is the primary source of carbohydrates for more than half the world's population, and this dependence further threatens food security. Food security, defined as a situation where all people have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs, is increasingly threatened (FAO, 2018). In developing countries, including Indonesia, the majority of farmers still rely on small-scale agricultural practices with limited technology. This makes them more vulnerable to climate change and market fluctuations.

This vulnerability is exacerbated by limited resources and an inability to adapt quickly to changing environmental conditions (Mbow et al., 2019; Thornton et al., 2014). As sustainable adaptation solutions are sought, a growing body of research recognizes the potential of local ecological knowledge as an effective response to environmental change (Berkes, 2008; Pretty, 2008). Local ecological knowledge, often passed down from generation to generation, encompasses time-tested natural resource management practices and techniques that have proven effective in addressing local environmental challenges.

In Indonesia, particularly in East Kolaka, Southeast Sulawesi, a local ecological knowledge system known as Mekambare exists, reflecting the practice of mutual cooperation in natural resource management. This system, a traditional rice paddy management practice, is believed to play a crucial role in maintaining the sustainability of the rice paddy ecosystem and local food security. Despite its significant historical and cultural significance, local traditional practices remain

underrepresented in the scientific literature. Existing research tends to be descriptive in nature and lacks a holistic theoretical framework (Hadi, 2022; Setiadi, 2018).

This gap is even more pronounced given East Kolaka's unique ecosystem characteristics, with diverse topography and complex hydrological patterns, which specifically influence agricultural practices (Sari et al., 2021). Therefore, an in-depth study of the local tradition of cooperation (*gotong royong*) can provide valuable new insights into the interactions between traditional agricultural practices, ecosystems, and climate change. This study aims to fill this knowledge gap with three main objectives. First, this study will comprehensively describe the practice of cooperation as a local tradition and its components within the context of the lowland rice ecosystem in East Kolaka. Second, this study will analyze the role of the local tradition of cooperation in increasing the resilience of the lowland rice ecosystem to climate fluctuations using relevant ecological indicators. Third, this study will evaluate the contribution of cooperation as a local tradition to the level of food security of farming households, both quantitatively and qualitatively, by integrating social and economic perspectives (Folke et al., 2010; Mastorillo et al., 2016).

In a global context, food security is influenced not only by local factors but also by international market dynamics and government policies. Research by Vermeulen et al. (2012) shows that disparities in access to technological innovation, capital, and information often trap farmers in a cycle of poverty and uncertainty. Therefore, innovative approaches that focus not only on increasing crop yields but also on strengthening the socio-ecological resilience of agricultural systems are crucial (Folke et al., 2010).

Local knowledge is often considered a vital asset that can complement and enrich science-based climate adaptation strategies (Smit & Wandel, 2006). Studies from various parts of the world, such as India and Nepal, have documented how local wisdom has successfully supported food security amidst environmental pressures (Pretty, 2008). This research seeks to strengthen the understanding that local wisdom is not an isolated relic of the past, but rather a relevant and crucial strategic asset in facing modern challenges.

By analyzing local traditions as an adaptive system, this research is expected to make a significant contribution to efforts to improve food security and ecosystem resilience in East Kolaka and serve as a model for other regions facing similar challenges (Smit & Wandel, 2006; Walker et al., 2004). Integrating local knowledge into a broader framework is a crucial step towards building a more resilient and sustainable food system in the future (Adger et al., 2010).

Overall, this research will not only provide an in-depth description of a cultural practice but will also analyze its function as an effective adaptive system in

addressing climate change. Thus, the results of this study are expected to provide strong empirical evidence that local knowledge, such as Mekambare, can be an effective and sustainable climate adaptation solution, unlike studies that focus solely on technological interventions. These findings can form the basis for developing more inclusive and sustainable agricultural policies, both at the local and national levels (Mastrorillo et al., 2016).

Southeast Sulawesi, an archipelago with a highly diverse ecosystem, possesses diverse local ecological knowledge systems developed by local communities over centuries. One such region, East Kolaka, boasts unique characteristics, including diverse topography and complex hydrological patterns that specifically influence rice farming practices (Sari et al., 2021). Communities in East Kolaka have developed local ecological knowledge systems integrated with rice farming practices to maintain sustainable production and food security.

However, empirical and theoretical understanding of how local ecological knowledge systems in East Kolaka specifically contribute to ecosystem resilience and food security remains limited. Available research is dominated by sectoral studies that only partially examine ecological, social, or economic aspects, resulting in gaps in integrated and holistic understanding (Adger et al., 2010; Gbetibouo, 2009). Furthermore, the limited scientific documentation on local ecological practices in Southeast Sulawesi has resulted in the potential of this traditional knowledge not being optimally utilized in climate change adaptation strategies and improving food security.

This study uses the socio-ecological resilience theoretical framework proposed by C.S. Holling (1973). The concept of resilience in an ecological context emphasizes the system's ability to survive and adapt to change. This theory was later developed by Folke et al. (2010) and Walker et al. (2004) who explain how systems consisting of human (social) and environmental (ecological) components interact and adapt to change. This theory emphasizes that agricultural system resilience is the result of complex interactions between biophysical and socio-economic factors. In the context of lowland rice farming, the socio-ecological system includes water management practices, the use of local rice varieties, cultivation techniques, and social institutions that regulate resource access and management (Ostrom, 2009).

The concept of food security in this study refers to the FAO (2018) definition, which encompasses four main dimensions: food availability, food access, food utilization, and food stability. The integration of socio-ecological resilience theory with the concept of food security provides a comprehensive analytical framework for understanding how local ecological knowledge functions as an adaptation mechanism in facing the challenges of climate change and environmental variability (Smit & Wandel, 2006).

Local Ecological Resilience In Building Lowland Rice Food Security In East Kolaka, Southeast Sulawesi

This research makes novel contributions in several aspects. First, it provides an in-depth study of the local ecological knowledge system in lowland rice farming in East Kolaka, Southeast Sulawesi. These findings significantly complement the literature on local wisdom, particularly in eastern Indonesia. This in-depth study of the local ecological knowledge system in lowland rice farming in East Kolaka, Southeast Sulawesi, thus making a substantial contribution to the literature on local wisdom in eastern Indonesia. Second, this research uses an integrated approach that combines socio-ecological resilience theory with multidimensional food security analysis, offering a more holistic understanding of how local knowledge functions as a climate adaptation strategy. Third, this research develops specific indicators to measure the contribution of local ecology to the resilience of lowland rice ecosystems and the food security of farmer households.

The novelty of this research lies in the integration of spatial and temporal analyses to understand the dynamics of rice field ecosystem change within the context of local ecological practices. Unlike previous descriptive studies, this study adopts an integrated quantitative and qualitative approach to analyze the effectiveness of local ecological knowledge systems on agricultural productivity and sustainability.

This study aims to fill this knowledge gap with three main objectives. First, to identify and analyze the components of the local ecological knowledge system in lowland rice farming in East Kolaka, including water management practices, the use of local rice varieties, cultivation techniques, and related social institutions. Second, to evaluate the role of the local ecological knowledge system in increasing the resilience of lowland rice ecosystems to climate variability and environmental change using relevant ecological indicators, such as biodiversity, soil quality, and water use efficiency. Third, to analyze the contribution of the local ecological knowledge system to household food security by integrating the dimensions of food availability, access, utilization, and stability.

Specifically, this study aims to answer three main questions, namely (1) what are the characteristics and components of the local ecological knowledge system in rice paddy farming in East Kolaka, (2) to what extent does this knowledge system contribute to the resilience of the rice paddy ecosystem and (3) the implications of the local ecological knowledge system for food security in East Kolaka. Through answers to these questions, this study is expected to provide strong empirical evidence regarding the effectiveness of local ecological knowledge as a sustainable adaptation strategy to the challenges of climate change and food security in East Kolaka, Southeast Sulawesi.

Literature Review

1. Climate Change and Challenges to Global Food Security

Global climate change has become a major threat to the sustainability of food systems and food security worldwide. The Intergovernmental Panel on Climate Change (IPCC, 2021) report confirms that the impacts of climate change directly impact food security, particularly in the agricultural sector. Rising temperatures, shifting rainfall patterns, and the frequency of natural disasters such as floods and droughts have been shown to impact agricultural productivity (Chen, 2021; Lobell et al., 2011).

Food systems that rely on key commodities such as rice, a source of carbohydrates for more than half the world's population, are highly vulnerable to climate fluctuations. The Food and Agriculture Organization (FAO, 2018) defines food security as a condition in which all people have physical, social, and economic access to sufficient, safe, and nutritious food. However, in many developing countries, including Indonesia, the majority of smallholder farmers with limited technology are the most vulnerable to climate and market shocks (Mbow et al., 2019; Thornton et al., 2014). Limited resources and the inability to adapt quickly exacerbate this vulnerability.

2. Local Ecological Knowledge as an Adaptation Mechanism

As challenges arise, a growing body of research recognizes the potential of local ecological knowledge (LED) as an effective adaptive response. This legacy of knowledge, passed down from generation to generation, encompasses natural resource management practices and techniques proven resilient to local environmental challenges (Berkes, 2008; Pretty, 2008). This local knowledge is often considered a critical asset that complements and enriches science-based climate adaptation strategies (Smit & Wandel, 2006). Studies in countries such as India and Nepal have documented how local wisdom supports food security amidst environmental stress (Pretty, 2008).

In Indonesia, numerous local ecological knowledge systems have developed over centuries. However, empirical and theoretical understanding of how these systems specifically contribute to ecosystem resilience and food security remains limited. Existing studies tend to be sectoral, examining only ecological, social, or economic aspects separately, creating gaps in holistic and integrated understanding (Adger et al., 2010; Gbetibouo, 2009).

3. Gaps in the literature and research contributions.

Although traditional practices such as mutual cooperation have profound historical and cultural significance, comprehensive scientific research on this subject is still very limited, especially in the East Kolaka region, Southeast Sulawesi. Existing research tends to be descriptive and has not integrated a holistic theoretical

framework (Hadi, 2022; Setiadi, 2018). This gap is even more striking considering the unique characteristics of the ecosystem in East Kolaka, characterized by diverse topography and complex hydrological patterns, which specifically influence agricultural practices in the area (Sari et al., 2021). This study aims to address this gap and provide new contributions through three main aspects: (1) an In-depth study of local ecological systems. This study will provide an in-depth analysis of local ecological knowledge systems, particularly local traditions such as Mekambare (gotong royong), in East Kolaka, which have previously been underrepresented in the scientific literature. (2) Integrated and holistic approach. Different from previous sectoral studies, this study adopts an integrated approach that combines qualitative and quantitative analysis. Using the theory of socio-ecological resilience, this study will analyze how local practices interact with ecosystems and contribute to food security. (3) Development of specific indicators. This study will develop specific indicators to measure the contribution of local traditions such as Mekambare (gotong royong) to the resilience of rice paddy ecosystems and the food security of farming households. This includes measuring biodiversity, soil quality, and water use efficiency.

Overall, this research seeks to strengthen the understanding that local knowledge is not a relic of the past, but rather a relevant and crucial strategic asset in facing modern challenges. By analyzing local traditions as an adaptive system, this research is expected to provide strong empirical evidence that the local tradition of Mekambare (gotong royong) can be a sustainable solution to improve food security and ecosystem resilience in East Kolaka and serve as a model for other regions facing similar challenges.

Conceptual Foundation

This study uses the socio-ecological resilience theoretical framework proposed by C.S. Holling (1973). This theory emphasizes the system's ability to survive and adapt to change through interactions between social and ecological components. This theory was later developed by Folke et al. (2010) and Walker et al. (2004) who explained that agricultural system resilience is the result of complex interactions between biophysical and socio-economic factors. In the context of lowland rice farming, the socio-ecological system includes water management practices, the use of local rice varieties, and social institutions that regulate resource access (Ostrom, 2009). The concept of food security, as defined by the FAO (2018), encompasses food availability, access, utilization, and stability. The integration of socio-ecological resilience theory with food security provides an analytical framework for understanding adaptation to climate change and environmental variability (Smit & Wandel, 2006). The application of this theory to the rice farming community in East Kolaka is important for analyzing the complex dynamics between human and environmental systems (Folke et al., 2010; Walker et al., 2004).

The resilience of agricultural systems is influenced by adaptive management practices and social institutions, such as local traditions of mutual cooperation (gotong royong), which strengthen the adaptive capacity of communities (Mastrorillo et al., 2016; Rian et al., 2021). This theory emphasizes that humans play an active role in shaping responses to environmental change, demonstrating the adaptive capacity of socio-ecological systems (Walker et al., 2004; Olsson et al., 2004). By combining the frameworks of these two conceptual foundations, this study identifies the relationship between traditional practices and increased food security and highlights the importance of local ecological knowledge in addressing the challenges of climate change.

Research Methods

This research will use a qualitative approach with a case study method to deeply explore the role of local traditions in East Kolaka in building ecosystem resilience and rice paddy food security. This approach was chosen because it provides an opportunity to comprehensively understand the context, processes, and meaning of social and cultural practices in the East Kolaka community. This approach is highly relevant for analyzing complex and specific phenomena. Furthermore, the application of the case study method allows researchers to investigate contemporary phenomena in real-life contexts, especially when the boundaries between phenomenon and context cannot be clearly separated (Yin, 2018).

Location, Subject, and Role of Informant

This research was conducted in East Kolaka, Southeast Sulawesi, an area with unique rice paddy ecosystem characteristics and strong traditional agricultural practices.

Research Subjects: The primary subjects were individuals with in-depth knowledge and direct experience related to the research topic. Subject selection was conducted through purposive sampling, a technique in which researchers intentionally select informants deemed most relevant and knowledgeable to answer the research questions (Creswell & Creswell, 2017). The number of informants was 15, which was adjusted in the field until data saturation was reached, where no new information was obtained from additional informants (Glaser & Strauss, 1967).

The informants in this study were 15 people, consisting of rice farmers, traditional and community leaders, as well as local agricultural experts, consisting of extension workers and agricultural service staff with the following role division: (1) rice farmers act as the main informants. They will provide primary data regarding the daily practices of local traditions, challenges faced in agriculture, and their perceptions of climate change. (2) Traditional and community leaders play a role in

providing information regarding the history, values, and philosophy behind local traditions. Their role is important in explaining how these traditions are passed down from generation to generation. (3) local agricultural experts (Extension Workers/Agricultural Service Staff), act as key informants. They will provide scientific and institutional perspectives to compare traditional practices with modern approaches and evaluate their potential within a policy framework.

Data Types and Sources

This research will collect two main types of data, namely (1) Primary Data, namely data obtained directly from research subjects through interview and observation techniques. In-depth Interview: This interview allows researchers to obtain in-depth views and rich descriptions from informants (Seidman, 2013). Participatory Observation: This observation will allow researchers to experience directly the practice of local traditions, social interactions between farmers, water and land management techniques, and the use of local rice varieties. (2) Secondary Data, namely relevant supporting data from various sources including Documents and Archives in the form of local government reports, village monographs, agricultural statistics data from the local Agriculture Service, and other related documents. Furthermore, Library studies in the form of references from scientific journals, books, and previous research reports.

Data Analysis Techniques

Data analysis will be carried out in stages and continuously from the time the data is first collected, following an interactive model. Data analysis refers to Miles, Huberman, and Saldaña (2014) which consists of: (1) Data Reduction, at this stage the researcher will summarize, group, and select data that is relevant to the research objectives. (2) Data Presentation, where the reduced data will be presented in the form of narratives, matrices, or charts to facilitate understanding. (3) Conclusion Drawing, the researcher will begin to interpret the data to find in-depth meanings and patterns. This analysis process will be supported by data triangulation, namely comparing information from various sources (interviews, observations, and documents) to ensure the validity and reliability of the findings (Patton, 2015).

RESULT AND DISCUSSION

Result

1. Local Ecological Knowledge System of Lowland Rice Farming in East Kolaka

The local ecological knowledge system in rice farming in East Kolaka is a form of local wisdom that has accumulated and stood the test of time. One striking

practice in this context is local traditions such as the tradition of *Mekambare*, is a form of cooperation that involves the active participation of community members. This practice not only serves as an efficient agricultural method but also reflects the cultural, social, and spiritual values that bind the community. In this context, the *Mekambare* tradition, or *gotong royong*, becomes a symbol of solidarity and cooperation, where farmers help each other in agricultural activities and maintain social and environmental relations. As expressed by informant 1, an experienced rice farmer:

"Local traditions *Mekambare*" *Gotong royong*, known as cooperation in our culture, is a crucial form of solidarity. In practice, we help each other in various agricultural activities. This activity not only strengthens cooperation but also maintains social ties among us. Furthermore, the local tradition of *mekambare* also contributes to environmental preservation. Thus, mutual cooperation has become an integral part of our daily lives."

This statement confirms that the local *Mekambare* tradition is not merely a physical practice, but also a manifestation of a deep knowledge of natural cycles. The people of East Kolaka understand that wet rice farming is highly dependent on environmental conditions, such as rainfall, soil fertility, and the presence of pests. Therefore, they have developed farming techniques suited to local conditions. This is as stated by informant 2, a young farmer, who added:

"We always choose rice varieties that have proven pest resistance. These varieties must also be suited to the characteristics of our soil. This knowledge of variety selection is a legacy we inherited from our ancestors. We believe this practice can improve our yields. In this way, we maintain tradition while adapting to the challenges of modern agriculture."

This statement demonstrates that selecting the right plant variety is a crucial aspect of their local knowledge system. As rice farmers, local communities possess extensive knowledge of rice varieties that grow optimally on their land and methods for increasing yields. Furthermore, the application of environmentally friendly agricultural techniques is also an integral part of the local ecological knowledge system. This is according to informant 3, a farmer actively involved in organic farming practices, who explained:

"We prefer to use natural fertilizers in our agricultural practices. This use of natural fertilizers aims to sustainably maintain soil health. Furthermore, we employ environmentally friendly pest control methods. This approach is essential to prevent ecosystem damage that can occur due to the use of chemicals."

This practice not only plays a role in maintaining environmental health but also ensures the sustainability of natural resources for future generations. Thus, this knowledge system makes a significant contribution to sustainable agricultural practices that align with ecological principles. The importance of this local ecological knowledge system is reflected in how the people of East Kolaka adapt to environmental changes. In facing challenges such as climate change, they rely on traditional knowledge passed down from generation to generation, and this knowledge forms the basis of their adaptation strategies. As explained by informant 1, as a farmer:

"We manage water wisely and adjust planting times according to changing weather. As a community of rice farmers, we not only survive but also thrive in the face of challenges. Through our knowledge, skills, and innovation, we are prepared to face any obstacles."

Overall, the local ecological knowledge system in lowland rice farming in East Kolaka represents a rich and complex form of wisdom. Local traditional practices such as Mekambare, combined with a deep understanding of natural cycles and the application of environmentally friendly agricultural techniques, demonstrate that local communities have the capacity to manage natural resources sustainably. This is not only crucial for agricultural sustainability but also for maintaining social and environmental balance within the community. Thus, this knowledge system provides a strong foundation for sustainable agricultural practices in East Kolaka.

Local traditions, such as Mekambare, serve as mutual cooperation practices that reflect the time-tested characteristics and components of local ecological knowledge systems within the context of wet-rice farming in East Kolaka. These practices encompass not only efficient agricultural techniques but also integrate cultural, social, and spiritual values that strengthen community cohesion. As informant 3, a farmer, expressed:

"Our Mekambare tradition, in our culture, is a manifestation of collective work solidarity, where we support each other in agricultural activities while maintaining social and environmental relationships. As farmers who have been managing rice fields for generations, the local Mekambare tradition is more than just ordinary mutual cooperation. It's a life philosophy that teaches us about togetherness and the balance of nature."

When planting season arrives, all villagers work together to cultivate the rice fields in turns, from cleaning the water channels to preparing the seeds. This tradition has saved the farming community from the limitations of modern agricultural equipment. This statement emphasizes that community collaboration is a crucial element for achieving success in agriculture. Components of this knowledge system

include a deep understanding of natural cycles, selecting appropriate plant varieties, and implementing environmentally friendly agricultural techniques. This was stated by informant 4, a rice farmer, who added:

"We chose local rice varieties that have proven pest resistance and are suited to the soil conditions in this region. This knowledge has been passed down from generation to generation. Based on our decades of experience, local varieties such as Mekongga, Ciherang, Inpari 22, Inpari 32, and Inpari 42 are highly resistant to planthoppers and have excellent environmental adaptability. We also store our seeds traditionally by drying them and storing them in a special, cool room. This method, passed down from our ancestors, has proven effective."

This demonstrates that local communities possess a deep understanding of the interaction between humans and the environment, which forms the basis for sustainable agricultural practices. The cultivation techniques employed reflect accumulated local wisdom. Informant 5 explained:

"We employ a shifting cultivation method that not only increases plant density but also increases yields. We have practiced this method for years. This technique is not only efficient but also contributes to agricultural sustainability. To cultivate the land, many people still prefer to use hoes and harrows instead of tractors. Not only is tractor rental expensive, but this traditional method also maintains a looser soil structure. We also have an informal rule to allow a two-week break after harvest before starting to cultivate the land again. This is a customary practice to give the soil time to rest."

Maintaining soil quality is a crucial aspect of community agricultural practices. Good soil quality contributes to sustainable agricultural productivity. Furthermore, healthy soil supports plant growth and increases resistance to pests and diseases. Environmentally friendly agricultural practices are essential to maintaining soil fertility. Therefore, attention to soil quality must be a priority in agricultural resource management. This is as explained by informant 6, a rice farmer, who stated:

"Soil fertility has a significant impact on crop yields. Therefore, it is crucial to implement environmentally friendly farming methods to ensure the sustainability and productivity of agricultural land in the future. We adopt the use of organic fertilizers in an effort to improve soil fertility. Furthermore, implementing crop rotation in our farming practices is also an important strategy for maintaining soil quality. These two methods are an integral part of our knowledge. We recognize the importance of

maintaining ecosystems for the sustainability of effective and efficient agriculture."

This statement demonstrates that rice farmers in East Kolaka are deeply concerned about environmental sustainability and soil health. Access to information and social support play a crucial role in this knowledge system. Informant 8, a lowland rice farmer, added:

"We often gather in farmer groups to share knowledge. These meetings also provide a platform for exchanging experiences. By gathering together, we can discuss the various challenges we face in farming. This helps us stay informed about modern agricultural techniques. Furthermore, this collaboration strengthens the relationships between farmers in our community."

The local ecological knowledge system in East Kolaka encompasses a broad spectrum, extending beyond sustainable agricultural practices. Community strengthening is a key focus, with collaboration among community members playing a crucial role in sharing information and experiences. Furthermore, environmental sustainability is a key concern, given the potential impacts of climate change and natural resource degradation that threaten food security. By integrating environmentally friendly agricultural practices, community strengthening, and ecosystem preservation, this knowledge system significantly contributes to achieving sustainable food security in the East Kolaka region.

2. Implications of Local Ecological Knowledge Systems on Food Security in East Kolaka.

Implications of local ecological knowledge systems, as reflected in traditional practices *Mekambar* plays a crucial role in food security in East Kolaka. The findings from this discussion indicate that the practice of cooperation (gotong royong) has a significant impact. First, this practice not only contributes to increased agricultural yields but also strengthens social solidarity among community members. Second, collaboration in agricultural activities creates stronger bonds within the community. Third, the practice of cooperation contributes to the shared well-being of the community. This was expressed by informant 7, a rice farmer, who stated:

"We often hold community service projects. These activities aim to address the challenges faced by farmers. By working together, we can help each other. Community service also strengthens bonds between community members. Through these activities, we strive to create effective solutions to address existing problems."

By leveraging collaboration and social capital, communities can increase agricultural productivity and ensure a balanced food distribution. The local Mekambare tradition also encourages crop diversification and the adaptation of local technologies to suit local climate conditions, contributing to greater food security.

Overall, the results of this discussion indicate that the characteristics and components of local ecological knowledge systems in lowland rice farming in East Kolaka play a crucial role in building ecosystem resilience and food security. Preserving and developing traditional Mekambare practices is a priority in efforts to achieve sustainability and food security in the future. Support for integrating traditional practices with modern approaches will be crucial to improving the food security of lowland rice farming communities in East Kolaka.

3. Traditional Agricultural Practices in Improving Food Security and Resilience of Rice Field Ecosystems in East Kolaka

Traditional agricultural practices implemented by rice farming communities in East Kolaka, including crop rotation systems, the use of organic fertilizers, and sustainable water management techniques, have shown a significant impact on food security. These practices not only contribute to increasing soil fertility but also play a role in maintaining ecosystem balance. By implementing this local wisdom, farmers can reduce negative impacts on the environment and improve agricultural sustainability. Dependence on expensive agricultural inputs can increase the resilience of agricultural systems to climate change. Local ecological knowledge systems integrated into local traditional practices such as *Mekambare* or cooperation an important role in increasing the resilience of the rice paddy ecosystem. The findings from this discussion indicate that communities are able to adapt their agricultural practices to changing environmental conditions. Informant 11, a farmer and female leader, emphasized:

"In our agricultural tradition, planting times are carefully adjusted to the seasons and natural conditions. This collective effort demonstrates our collaboration to ensure the soil remains fertile and water sources are sustainably available for agricultural needs. By adapting to natural cycles, we not only ensure the sustainability of our harvests but also preserve the ecosystems that are our lifeblood."

Implications of local ecological knowledge systems, as reflected in traditional practices, *Mekambare* (gotong royong) has a very important role in food security in East Kolaka. The findings from this discussion indicate that the practice of cooperation has a substantial impact. First, this practice not only contributes to increased agricultural yields but also strengthens social solidarity among community members. Second, collaboration in agricultural activities creates stronger bonds

within the community. Third, the practice of mutual cooperation contributes to the shared well-being of the community. According to informant 13, a staff member of the Department of Agriculture, he stated:

"Our local wisdom is a priceless treasure that has been passed down from generation to generation. We practice this tradition by learning directly from nature and the experiences of our ancestors. Every year, we hold a special meeting to evaluate the harvest and develop new strategies to ensure our practices remain relevant and successful."

This demonstrates that collaboration and communication among farmers are crucial for improving food security. The local Mekambare tradition serves as an effective adaptation mechanism to climate change, allowing communities to share knowledge and experiences in addressing environmental challenges. This creates a symbiotic relationship between humans and the ecosystem, strengthening the resilience of lowland rice in East Kolaka. Empirical evidence demonstrates the adaptive capacity of farmers to modify their agricultural practices in response to changing environmental conditions. As expressed by Informant 12, a community leader, he said:

"As community leaders and farmers, we work together to adjust planting times to seasonal patterns and natural conditions. Frequent climate change requires us to constantly adapt. This collective approach is crucial for maintaining soil fertility and ensuring the availability of vital water for our agriculture."

Our traditional agricultural practices demonstrate adaptive adaptation to natural changes. The local Mekambare tradition serves as an effective framework for addressing climate variability. It fosters the exchange of knowledge about environmental challenges, collectively enhancing the sustainability of agricultural systems and ecosystems. Informant 7, a young rice farmer, explained:

"In our farmer groups, we systematically share strategies for pest management. We also discuss the best techniques for responding to weather anomalies. This exchange of information significantly improves our preparedness for unexpected pest attacks. This allows us to protect our crops more effectively. This collaboration is key to our success."

Traditional agriculture in East Kolaka plays a crucial role in improving food security and the resilience of the rice paddy ecosystem. By utilizing sustainable local cultivation techniques, farmers can maintain the balance of nature, increase productivity, and ensure sufficient food availability for the community, while preserving biodiversity. As 13 female traditional leaders stated,

"It is crucial to improve food security and preserve the cultural identity of our communities. Agriculture is part of our identity. By preserving this practice, we also preserve our long-standing culture and values. We emphasize the close relationship between tradition and sustainability."

Thus, traditional agricultural practices in East Kolaka not only contribute to food security but also strengthen ecosystem resilience and preserve the community's cultural heritage.

4. Contribution of Knowledge Systems to the Resilience of Lowland Rice Ecosystems

Local ecological knowledge systems integrated into local traditional practices, such as *Mekambare* Mutual cooperation, contribute significantly to the resilience of the rice paddy ecosystem. Findings indicate that communities are able to adapt their agricultural practices to changing environmental conditions. According to informant 9, a farmer and community leader, emphasized that:

"We adjust planting times to suit the seasons and natural conditions. This is crucial to ensure optimal plant growth. This collaborative effort in determining planting times also helps maintain soil fertility. This way, we ensure that water resources are available for agricultural needs. All these steps are taken for the sustainability and productivity of our farm."

Local traditions in *Mekambare* it serves as an effective adaptation mechanism to climate change, allowing communities to share knowledge and experiences in addressing environmental challenges. This creates a symbiotic relationship between humans and the ecosystem, strengthening the resilience of lowland rice crops in East Kolaka.

Integrated local ecological knowledge systems, reflected in traditional practices such as *Mekambare* (mutual cooperation), have significantly contributed to increasing the resilience of rice paddy ecosystems in East Kolaka. Empirical evidence suggests that farmers have the adaptive capacity to modify their agricultural practices in response to changing environmental conditions. As stated by informant 10, a female farmer and community leader:

"We consistently adjust planting times based on seasonal patterns and natural conditions. Our collective collaboration within the rice farming community not only increases agricultural yields but also strengthens our community bonds. By maintaining soil fertility, we create a solid foundation for sustainable agriculture. Furthermore, we ensure abundant water availability to support healthy plant growth. All of these efforts are a shared

effort to realize a better and more sustainable agricultural future for future generations."

Cooperation among lowland rice farming communities reflects traditional and complex planting timing mechanisms that contribute to improving the sustainability of agroecosystems. Furthermore, local traditions *Mekambare*. The tradition, known as *gotong royong* (mutual cooperation), serves as an effective framework for adaptation to climate change. This tradition enables the exchange of knowledge among community members regarding the environmental challenges they face. Thus, these practices not only strengthen food security but also preserve long-standing cultural values. Therefore, integrating traditional knowledge and adaptation to climate change is key to achieving sustainable food security in East Kolaka.

5. Adaptation to Climate Change to Strengthen Food Security in the East Kolaka Region

Climate change is one of the biggest challenges facing the agricultural sector worldwide, including in East Kolaka Regency, Southeast Sulawesi. However, the farming communities in East Kolaka have demonstrated strong resilience and local wisdom in facing this challenge. They have developed various adaptation strategies aimed not only at maintaining food security but also at ensuring the sustainability of the agricultural ecosystem in their region. These adaptation strategies combine traditional practices, local knowledge, and close collaboration between the community, government, and agricultural extension workers.

One of the main foundations of adaptation in East Kolaka is the implementation of sustainable traditional agricultural practices. Farmers there have long understood the importance of maintaining the balance of nature. An interview with informant 10, a respected community figure, confirmed this:

"By changing cropping patterns, we can increase agricultural resilience to extreme weather. These modifications include selecting more adaptive crop varieties and appropriate planting schedules. Furthermore, utilizing local resources contributes to the sustainability of agricultural practices. Through this approach, the risk of crop failure can be effectively minimized."

Practices such as crop rotation, which contribute to maintaining soil fertility, the use of organic fertilizers to reduce dependence on chemicals and improve soil structure, and efficient water management have proven effective. All of these practices represent adaptations that have been carried out for generations by the community, particularly the rice farming community in East Kolaka. Furthermore, the local knowledge system integrated into agricultural practices also plays a crucial role. This knowledge is not only maintained but also shared through a strong

tradition of mutual cooperation. This tradition allows the community to learn from each other and adapt to constantly changing environmental conditions. According to informant 10, a farmer and female figure who served as an informant, stated:

"This knowledge is not only preserved but also shared through a strong tradition of mutual cooperation. This tradition serves as a means to strengthen social bonds among community members. Through this practice, communities can learn from each other's experiences. Furthermore, this tradition also allows them to adapt to constantly changing environmental conditions. Thus, mutual cooperation is key to developing knowledge and community resilience."

Adapting cropping patterns through modified planting schedules and crop rotations has proven effective in increasing the resilience of agricultural systems to climate variability. This approach allows farmers to optimize crop growth periods according to expected weather conditions. These findings emphasize the importance of developing agricultural policies grounded in local ecosystems, which can encourage broad adaptation to quantify long-term impacts on regional food security.

6. Technical Adaptation and Government Support in Facing Climate Change in East Kolaka

Technical adaptations to climate change in East Kolaka include practical steps, where communities recognize that planting times can no longer be based solely on traditional calendars but must be adjusted to accommodate unpredictable weather patterns. Selecting plant varieties that are more resilient to extreme weather conditions is a crucial step in this adaptation process. One female informant emphasized:

"For us, selecting adaptive local varieties is crucial. We choose seeds that have proven resistance to drought and flooding. This is part of the local wisdom that we must preserve. This practice ensures that even when weather anomalies occur, the potential for a harvest remains."

On the other hand, the resilience of East Kolaka's rice farming community is greatly influenced by substantial support from the government and related institutions. An interview with a representative from the East Kolaka Regency Agriculture Service revealed a commitment to:

"We are committed to providing farmers with better access to up-to-date weather information. The government is committed to strengthening food security. Furthermore, we are conducting training on relevant adaptive farming techniques. This training is designed to increase farmers'

understanding of how to deal with climate change. In doing so, we hope to accelerate the adaptation process at the farmer level. This effort aims to improve food security and agricultural productivity in East Kolaka."

Synergy between the government, extension workers, and farmers is key to success in addressing the challenges of climate change. Agricultural extension workers also play a crucial role, not only providing modern knowledge but also facilitating the exchange of information between farmers. One extension worker interviewed stated:

"Our mission is to bridge local wisdom with technological innovation. We believe that combining traditional knowledge with modern technology can provide significant benefits. This approach will give farmers access to a variety of improved agricultural strategies, enabling them to choose the most effective and efficient methods for their land. Therefore, we are committed to supporting farmers in increasing their agricultural productivity and sustainability."

This demonstrates that extension is not simply a one-way transfer of knowledge, but rather a collaborative process that values farmers' experiences. Thus, the combination of technical adjustments and support from the government and agricultural extension workers provides a strong foundation for community resilience in East Kolaka in the face of climate change. Training and extension on adaptive agricultural techniques are expected to increase farmers' capacity to face the challenges posed by climate change.

Overall, adaptation to climate change in East Kolaka focuses not only on increasing food production, but also on preserving the environment and culture. By integrating traditional agricultural practices and local knowledge, East Kolaka people can strengthen their food security and create an agricultural system that is more resilient to future climate challenges.

Discussion

1. Local Ecological Knowledge System of Lowland Rice Farming

The local ecological knowledge system in East Kolaka embodies accumulated and time-tested wisdom. In the context of wet rice farming, local communities have developed practices that demonstrate not only technical efficiency but also a wealth of social and cultural values. One significant practice in the East Kolaka agricultural system is the local tradition. *Mekambare* which represents a form of agrarian collectivity based on cooperation. Within this traditional framework, systematic collaboration occurs among community members throughout the entire agricultural

productivity cycle, encompassing land preparation, crop maintenance, and post-harvest processes. This collaborative mechanism serves not only as an instrument of agricultural productivity but also as a medium for reproducing socio-cultural values within the structure of an agrarian society. Local traditions, *Mekambare* not only serves as an efficient agricultural method, but also strengthen social solidarity among community members. The practice of cooperation is embodied in local traditions, *Mekambare* it creates strong social bonds and serves as a mechanism for maintaining environmental balance. As a symbol of collective solidarity, this tradition integrates communities into a sustainable network of socio-ecological relations. Thus, this tradition not only strengthens social cohesion but also effectively contributes to the formation of resilient communities capable of facing various challenges, both social and environmental.

2. Selection of Rice Varieties

Selecting the right rice variety is a crucial aspect of the local knowledge system in East Kolaka. Lowland rice farmers possess in-depth knowledge of optimal rice varieties for local soil and climate conditions. This knowledge encompasses the selection of varieties that are resistant to pests and suited to soil characteristics, and is part of a cultural heritage passed down from their ancestors. This knowledge not only increases crop yields but also contributes to food security. By selecting the right varieties, farmers can minimize losses from pests and diseases and increase land productivity. This demonstrates the crucial role traditional knowledge plays in increasing crop yields, food security, and maintaining agricultural sustainability in East Kolaka.

3. Environmentally Friendly Agricultural Techniques

The application of environmentally friendly agricultural techniques is an integral part of the local ecological knowledge system in East Kolaka. Practices such as the use of natural fertilizers and sustainable pest control methods not only maintain soil health but also ensure the sustainability of natural resources. The importance of maintaining soil fertility and implementing crop rotation are emphasized as strategies to improve soil quality. By using organic fertilizers, farmers can improve soil structure and fertility without damaging the ecosystem. Furthermore, environmentally friendly pest control techniques help prevent ecosystem damage that can occur from the use of chemicals. These practices reflect accumulated local wisdom and demonstrate the capacity of the East Kolaka community to manage natural resources sustainably.

4. Adaptation to Climate Change

The rice farming community of East Kolaka demonstrates a high degree of adaptability in the face of climate change. They manage water wisely and adjust planting times according to weather changes. Traditional knowledge passed down from generation to generation provides a solid foundation for their adaptation strategies. This demonstrates that local ecological knowledge systems serve not only to maintain agricultural practices but also to adapt to changing environmental challenges. By understanding weather patterns and soil conditions, farmers can make informed decisions about land management, thereby enhancing food security amidst increasingly unpredictable climate change.

5. Implications for Food Security

The implications of local ecological knowledge systems are significant for building food security in East Kolaka. The practice of mutual cooperation not only increases agricultural yields but also strengthens social solidarity among community members. Collaboration in agricultural activities creates stronger bonds and contributes to shared well-being. By relying on collaboration and social capital, communities can increase agricultural productivity and ensure equitable food distribution. This is crucial for creating sustainable food security, where every member of the community has adequate access to sufficient and high-value food.

6. Contribution to Ecosystem Resilience

Local ecological knowledge systems integrated into traditional practices such as Mekambare contribute significantly to the resilience of lowland rice ecosystems. Communities are able to adapt their agricultural practices to changing environmental conditions, creating a symbiotic relationship between humans and the ecosystem. This strengthens food security and preserves long-standing cultural values. By maintaining ecosystem balance, lowland rice farming communities in East Kolaka not only ensure agricultural sustainability but also preserve the biodiversity that is a vital part of their lives.

7. Government Support and Agricultural Extension

Support from the government and agricultural extension workers is crucial to strengthening food security in East Kolaka. Training in adaptive agricultural techniques and access to up-to-date weather information helps farmers address the challenges of climate change. Synergy between the government, extension workers, and farmers is key to successfully addressing these challenges. With adequate support, farmers can adopt better and more sustainable agricultural practices, thereby increasing productivity and food security in the East Kolaka region.

Conclusion

This study concludes that local ecological resilience in East Kolaka in achieving rice paddy food security is greatly influenced by the richness of local ecological knowledge systems. Traditional practices such as *Mekambare* (gotong royong), the selection of adaptive rice varieties, and the application of environmentally friendly agricultural techniques have been identified as key factors in achieving sustainability. The findings of this study demonstrate a strong relationship between local wisdom and communities' ability to adapt to climate change and other environmental challenges. This suggests that traditional knowledge and practices passed down through generations play a crucial role in enhancing community resilience to the impacts of environmental change. Furthermore, institutional support from the government and the role of agricultural extension workers have proven essential in strengthening farmer capacity. The synergy between traditional knowledge and modern agricultural innovations, facilitated through mentoring programs, forms a solid foundation for sustainable agricultural development. Thus, the collaboration between traditional knowledge and modern approaches provides a strong foundation for achieving sustainable food security in East Kolaka.

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