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Ethnoecology of Madura Farmers in Managing Peatlands in Malikian Village, Mempawah Hilir District, Mempawah Regency

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Abstract:
Peatlands are vulnerable ecosystems that require sustainable management patterns based on local wisdom. Madura farmers in Malikian Village, Mempawah Hilir District, Mempawah Regency have ethnoecological knowledge that has been passed down from generation to generation in managing peatlands. This study aims to analyze the form of ethnoecological knowledge of Madura farmers and the peatland management practices they implement. The research uses a qualitative approach with ethnographic methods. Data were collected through field observations, in-depth interviews, and documentation, then analyzed using an interpretive descriptive approach. The results show that Madura farmers apply the principle of natural balance, selection of planting time based on natural signs, traditional soil cultivation techniques, and adaptive water control suited to peat characteristics. The discussion emphasizes that these ethnoecological practices contribute to maintaining soil fertility and minimizing damage to peat ecosystems. This study concludes that the ethnoecological knowledge of Madura farmers plays an important role as the basis for sustainable peatland management that is relevant for development in environmental management policies.
Keyword: *Etnoekologi; Petani Madura; Lahan Gambut; Kearifan Lokal; Pengelolaan Lingkungan*

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INTRODUCTION

Peatlands are one of the most important and vulnerable ecosystems in the world, especially in the context of global climate change and environmental degradation. Globally, peatlands play a significant role as natural carbon stores that can bind large amounts of carbon and contribute to the control of greenhouse gas emissions (Harenda et al., 2017; Ribeiro et al., 2021). However, in recent decades, pressure on peatlands has increased due to agricultural expansion, land conversion, and unsustainable management practices. This condition not only causes damage to ecosystems but also leads to biodiversity loss and increased risk of ecological disasters such as peatland fires (FAO, 2018). In this context, global attention is beginning to shift to a peatland management approach based on sustainability and local wisdom as an alternative to a technocratic approach that often ignores the socio-cultural dimensions of local communities (Bielawski, 2021; KAMAL et al., 2023).

Peatland management problems do not arise alone but are influenced by various interrelated factors. One of the main factors is the change in land use patterns that tends to prioritize short-term economic interests over ecosystem sustainability (Ritung et al., 2016). In addition, non-contextual agricultural modernization often ignores the ecological characteristics

of peatlands, so that the practices applied accelerate soil degradation. Another factor is the weakening of the role of local knowledge due to the introduction of modern agricultural systems that are uniform and less adaptive to local environmental conditions (Toledo, 2002). In the context of local communities, the marginalization of traditional knowledge also worsens the community's ability to maintain a balance between the use and conservation of natural resources.

The impact of these factors is evident in various environmental and social aspects. Ecologically, inappropriate peatland management leads to decreased soil fertility, disruption of the hydrological system, and increased vulnerability to land fires (Page & Hooijer, 2016). From a social perspective, peatland degradation has an impact on declining agricultural productivity and food security for local communities. In the long term, this condition can trigger resource conflicts, structural poverty, and loss of cultural identity that has been closely tied to traditional environmental management practices. Therefore, an approach that only focuses on technical aspects without considering the socio-cultural dimension has proven unable to address the complexity of peatland problems (Davies et al., 2016; Flood, 2023; Palmer et al., 2025; Thornton et al., 2020).

In this context, ethnoecology is an important approach to understanding the relationship between humans, culture, and the environment. Ethnoecology studies how local communities construct ecological knowledge based on empirical experience, cultural values, and long-term interactions with their environment (Rambo, 1983). In the Madura farming community who live on the peatlands of Malikian Village, Mempawah Hilir District, Mempawah Regency, ethnoecological knowledge is reflected in various land management practices, ranging from planting timing, soil tillage techniques, to water management systems. This knowledge is not only technical but also contains local wisdom values that emphasize the balance between humans and nature (Abas et al., 2022; Effendi et al., 2020; Halim et al., 2025; Pesurnay, 2018; Qodim, 2023). Thus, ethnoecology is inseparable from sustainable peatland management practices.

This research has an element of novelty that distinguishes it from previous studies. Most peatland research in Indonesia still focuses on biophysical aspects or macro management policies, while studies that specifically raise the ethnoecological perspective of Madura farmers are still limited. This study places Madura farmers as the main subjects who have distinctive ecological knowledge in managing peatlands. In addition, this research integrates an ethnographic approach to explore in depth the practices, values, and meanings inherent in peatland management based on local wisdom (Armanto et al., 2025; Flood et al., 2025; Heindorf et al., 2024; Lounela, 2025; Osawa, 2023). Thus, this study not only describes agricultural practices but also uncovers the underlying cultural and ecological logic.

The urgency of this research is getting stronger considering the increasing pressure on peatlands in West Kalimantan, especially in Mempawah Regency. Government peatland rehabilitation and restoration efforts often face implementation constraints due to a lack of integration with local knowledge. Without an adequate understanding of traditional knowledge systems and practices, peatland management policies have the potential to be ineffective and even counterproductive. Therefore, this research is important as an effort to document and

analyze the ethnoecological knowledge of Madura farmers as the basis for more contextual, participatory, and sustainable peatland management.

Based on this description, the purpose of this study is to analyze the forms of ethnoecological knowledge of Madura farmers in managing peatlands in Malikian Village, Mempawah Hilir District, Mempawah Regency. This research also aims to identify the peatland management practices that are applied and understand the values of local wisdom that underlie these practices. By understanding the relationship between local knowledge and peatland management, this study is expected to provide a comprehensive overview of the role of ethnoecology in maintaining the sustainability of peat ecosystems.

The benefits of this research can be seen from several aspects. Academically, this research contributes to the enrichment of ethnoecology and environmental anthropology studies, especially in the context of peatland management in Indonesia. Practically, the results of this research can be a reference for local governments and stakeholders in formulating peatland management policies based on local wisdom. In addition, socio-culturally, this research plays a role in supporting the preservation of traditional knowledge of Madura farmers so that it remains relevant and recognized in sustainable development.

RESEARCH METHOD

This research employed a qualitative descriptive approach to examine the social, cultural, and ecological realities of Madura farming communities in relation to peatland management. The research was conducted in Malikian Village, Mempawah Hilir District, Mempawah Regency, selected for its peatland-dominated landscape and the long-standing presence of Madura farming communities practicing local wisdom in environmental management. Data collection occurred over a period aligned with community social conditions and agricultural cycles to observe peatland management practices comprehensively.

The study covered three interrelated aspects: ethnoecological knowledge of Madura farmers (e.g., understanding peatland characteristics, natural signs, and human-environment relations); applied peatland management practices (e.g., tillage, water management, planting timing); and underlying local wisdom values (e.g., cultural norms, beliefs, natural balance principles).

The subjects were Madura farmers in Malikian Village directly involved in peatland management as landowners or cultivators. The sample was selected purposively based on criteria including length of residence, peatland management experience, and active agricultural involvement.

The main instruments were an open interview guide, observation sheets, and supporting documentation. Interviews explored farmers' knowledge, experiences, and views on peatland management; observations captured agricultural practices and environmental interactions; documentation included field records, photographs, and archives.

Data analysis involved descriptive-interpretive techniques, organizing and categorizing data by relevant themes, interpreting meanings behind ethnoecological practices, and linking findings to broader social, cultural, and ecological contexts. Data validity was ensured through source triangulation (comparing multiple informants) and method triangulation (combining

interviews, observations, and documentation), with member checks via informant discussions. The research adhered to ethical principles, including informant consent, confidentiality, and respectful community relations.

RESULTS AND DISCUSSION

The research location is in Malikian Village, Mempawah Hilir District, Mempawah Regency, which is geographically dominated by peatland landscapes with high acidity levels and a distinctive hydrological system. This village is a residential area for the Madura farming community who have migrated and settled for a long time. The ecological conditions of peatlands in this region demand special adaptations in agricultural practices, both in terms of land tillage, commodity selection, and water management. Field observations show that peatlands in Malikian Village are intensively used for small- to medium-scale agricultural activities with a relatively stable pattern from year to year, despite facing various ecological challenges.

In terms of socio-culture, the Madura farming community in Malikian Village has a strong social structure with kinship ties and the value of mutual cooperation that is still maintained. Agricultural activities are not only seen as economic activities, but also as part of cultural identity and ancestral heritage. This condition forms a pattern of close interaction between humans and the environment, which then gives birth to a local or ethnoecological knowledge system in managing peatlands.

The results of the study showed that Madura farmers in Malikian Village have ethnoecological knowledge formed from long experience interacting with peatlands. This knowledge is not documented in writing, but is passed down orally from generation to generation through hands-on practice in the field. The ethnoecology of Madurese farmers is reflected in the way they understand the characteristics of peatlands, water cycles, and the relationship between natural conditions and agricultural output.

Farmers understand that peatlands have different properties than mineral soils, especially in terms of soil carrying capacity and sensitivity to drying. Therefore, they develop management strategies that are adaptive and prudent. This knowledge is the basis for determining land management steps, from land clearing to plant maintenance.

The results of the study show that soil cultivation on peatland is carried out manually and gradually. Farmers avoid excessive soil reversal because it is believed to damage peat structures and lower fertility. This tillage technique is based on the empirical experience of farmers who understand that peatlands need special treatment to remain productive.

Water management is a crucial aspect of peatland management. Madura farmers built simple waterways to keep the soil moisture from being too dry or too inundated. The results of observations show that this traditional water system is able to maintain peatland stability and minimize the risk of land fires, in line with the findings of previous research on the importance of peat hydrological management (Page et al., 2011).

Planting time is determined based on natural signs, such as rainfall, groundwater conditions, and weather changes. Farmers rely on collective experience to determine the right

time for crops to grow optimally. This practice shows the close link between local knowledge and the ecological dynamics of peatlands.

The results of the study revealed that peatland management practices are inseparable from the values of local wisdom embraced by Madura farmers. The value of balance between humans and nature is the main principle in every agricultural activity. Farmers see nature as part of life that must be protected, not just a resource that is exploited. This value is reflected in the prudent attitude in clearing land and using limited agricultural inputs.

The results of the study show that the ethnoecology of Madura farmers contributes to the sustainability of peatlands. The practices implemented have been proven to be able to maintain soil fertility and reduce the impact of environmental degradation. These findings reinforce the view that local knowledge has a strategic role in sustainable natural resource management (Berkes, 2012).

Overall, the results of this study show that the ethnoecology of Madura farmers in Malikian Village is a knowledge system that is integrated between ecological, social, and cultural aspects. This knowledge is the main foundation for sustainable peatland management that is adaptive to local environmental conditions. The results of this study provide a strong empirical picture of the role of local wisdom in answering the challenges of peatland management at the local level.

Ethnoecology as a Response to the Peatland Management Crisis

The results of the study show that peatland management practices by Madura farmers in Malikian Village are not just hereditary habits, but rather a form of adaptive response to the ecological characteristics of vulnerable peatlands. These findings reinforce the urgency of the research as explained in the introduction, that peatland management approaches that ignore the socio-cultural dimension tend to fail to address the complexity of ecological problems (Page et al., 2011). In the global context, peatland degradation is largely triggered by a uniform technocratic approach and is not based on local contexts. Therefore, the ethnoecology of Madura farmers can be understood as an alternative knowledge system born from long experience in facing the ecological limitations of peat.

This study shows that the peatland management crisis is not solely caused by natural factors, but also by inconsistencies in management strategies implemented from outside the local community. The practices of Madura farmers actually show a strong ecological awareness in maintaining the balance of soil and water. This is in line with the view of Berkes (2012) who asserts that local knowledge often develops as a survival mechanism in a vulnerable environment.

Causes of Peatland Problems in a Socio-Ecological Perspective

The peatland problems behind this study are rooted in several main factors. First, the pressure on peatlands due to agricultural intensification and land-use changes has disturbed the balance of peat ecosystems (Ritung et al., 2016). Second, the introduction of modern agricultural technology that is not adapted to the characteristics of peat leads to soil degradation and decreased productivity. Third, the marginalization of local knowledge due to the dominance of formal scientific approaches also weakens the adaptive capacity of the community.

The results of the study show that Madura farmers are able to mitigate these factors through management practices based on empirical experience. Non-aggressive tillage techniques and simple but effective water management show that local knowledge is able to reduce the negative impacts of peat exploitation. These findings reinforce the argument that peatland problems cannot be solved through structural approaches alone, but require an understanding of the local knowledge systems that live in communities.

The Meaning of Land Management Practices in an Ethnoecological Framework

Gradual and minimal disturbance of land cultivation as found in the results of the study has a deep ecological meaning. This practice reflects Madura farmers' understanding of the properties of peat that are easily damaged if treated excessively. From an ethnoecological perspective, tillage is not only a technical act, but a manifestation of the harmonious relationship between humans and nature (Rambo, 1983).

Compared to modern agricultural practices that often prioritize short-term efficiency, the approach of Madurese farmers is actually oriented towards sustainability. This is the main differentiation (novelty) of this study compared to previous studies that focused more on the biophysical aspects of peatlands. This research shows that simple local practices actually have strong ecological rationality and are relevant to the principles of sustainable agriculture.

Water Management as the Key to Peatland Sustainability

Water management is a crucial aspect in maintaining the sustainability of peatlands, as reflected in the results of the research. The traditional water channel system applied by Madura farmers serves to maintain the moisture balance of the soil. These findings are in line with the research of Page and Hooijer (2016) which confirms that excessive drying of peatlands is a major factor in the cause of fires and peatland degradation.

In this context, the ethnoecology of Madurese farmers can be seen as a local solution to global problems. Adaptive water management practices can minimize the risk of fire and maintain land productivity. If this practice is integrated into peat management policies, the ecological and social impacts can be significantly reduced.

Determination of Planting Time and Adaptation to Natural Dynamics

The results of the study show that the determination of planting time by Madura farmers is based on natural signs and collective experience. This practice reflects a high adaptability to the dynamics of the peat environment. In ethnoecological literature, the ability to read natural signs is a characteristic of people who have a strong attachment to their environment (Toledo, 2002).

Compared to modern farming systems that rely on a standard planting calendar, this approach is more flexible and contextual. The novelty of this research lies in the disclosure of how local knowledge functions as an effective ecological decision-making system. This shows that the solution to the problem of peat farming does not always have to come from high-tech innovation, but can come from the optimization of local knowledge.

Local Wisdom as the Foundation of Environmental Ethics

The values of local wisdom found in this study show the existence of strong environmental ethics in the Madura farming community. The principles of prudence and balance are the main foundations in every land management activity. These findings reinforce

the view that environmental sustainability is not only determined by policies and technology, but also by social values and norms embraced by the community (Berkes, 2012).

From the perspective of sustainable development, environmental ethics based on local wisdom have a long-term impact on maintaining the sustainability of peat ecosystems. If these values are maintained and strengthened, then local communities can become major actors in peatland conservation.

Ethnoecological Implications for Peatland Management Solutions

Based on the results of research and discussion, the ethnoecology of Madura farmers offers a real solution to peatland problems. These solutions include adaptive soil management, contextual water management, and the use of natural signs in agricultural decision-making. This solution is low-cost, easy to implement, and in accordance with local socio-cultural conditions.

If these ethnoecological practices are ignored, the risk of peatland degradation will increase. On the other hand, the integration of local knowledge in peat management policies has the potential to produce positive impacts in the form of increasing land productivity, reducing fire risk, and strengthening the social resilience of local communities.

Impact and Contribution of Research to the Development of Science and Policy

The impact of the implementation of ethnoecology-based peatland management is not only ecological, but also social and academic. Ecologically, this practice supports the sustainability of peatlands. Socially, this research strengthens the position of local communities as the main subject of environmental management. Academically, this research enriches the ethnoecological study by presenting the context of Madura farmers in the peatlands of West Kalimantan, which is still rarely studied in depth.

Compared to previous research that was more general descriptive, this study offers novelty in the form of integration between local practices, cultural values, and environmental sustainability. Thus, this research not only answers local problems, but also makes a conceptual contribution to the development of peatland management approaches based on local wisdom.

Overall, this discussion emphasizes that the ethnoecology of Madura farmers is a relevant and strategic knowledge system in answering peatland management problems. The main cause of peatland problems lies in the incompatibility of management approaches with local ecological and social characteristics. Solutions offered through ethnoecology have been proven to be able to maintain environmental balance and support sustainability. The resulting positive impact shows that local knowledge is worthy of being integrated into future peatland management policies and practices.

CONCLUSION

This study analyzed the ethnoecological knowledge of Madura farmers in managing peatlands in Malikian Village, Mempawah Hilir District, Mempawah Regency, revealing an adaptive, sustainability-oriented system manifested in careful soil and water management aligned with peat characteristics, and planting timed by natural signs and collective experience. These practices sustained agricultural productivity while minimizing environmental risks like soil degradation and hydrological disruption, positioning local wisdom as a vital, non-traditional framework for decision-making and participatory peatland policies—contributing

novel insights to ethnoecology literature on understudied Madura communities. Despite limitations in scope and informant numbers limiting generalizability, future research could expand to comparative studies across communities, integrating quantitative data for robust policy recommendations.

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