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Local Wisdom-Based Strategies for Sustainable Aquatic Resource Management

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Abstract

This study explores the role of local wisdom in promoting sustainable aquatic resource management in Indonesia through a comparative analysis of three traditional governance systems: *Sasi Laut* in Maluku, *Awig-Awig* in Lombok, and *Panglima Laot* in Aceh. Employing a qualitative case study approach, data were collected through in-depth interviews, participant observation, and document analysis. The findings reveal that these community-based systems effectively regulate marine resource use, ensure ecological conservation, and promote social cohesion through culturally embedded norms and participatory governance. Each system demonstrates unique mechanisms of rule-making, enforcement, and conflict resolution that are deeply intertwined with spiritual values, customary law, and local leadership structures. However, the sustainability of these practices is increasingly challenged by limited legal recognition, generational knowledge loss, and external pressures such as commercial fishing and coastal development. The study argues that integrating traditional ecological knowledge into national policy frameworks and recognizing the legitimacy of customary institutions are critical for achieving long-term marine sustainability. It concludes that local wisdom is not only an environmental asset but also a form of social resilience and political agency in the governance of common-pool resources.

Keywords: *Local Wisdom, Sustainable Management, Aquatic Resources, Customary Law, Community-Based Governance*

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Introduction

Indonesia, as the world's largest archipelagic country, is blessed with an abundance of natural resources, particularly in its aquatic sector. The country's marine territory, which covers approximately two-thirds of its total area, is home to a rich biodiversity of marine life, including various fish species, mollusks, coral reefs, seagrass beds, and mangrove forests. These resources are vital not only for food security but also for climate regulation, tourism, and the socio-economic welfare of coastal communities. The waters of Indonesia are globally recognized as one of the centers of marine biodiversity, making them a critical area for global conservation efforts. Despite this immense wealth, Indonesia's aquatic ecosystems face significant challenges. Overexploitation of marine resources, pollution from domestic and industrial waste, unsustainable fishing practices, and the impacts of climate change have led to serious environmental degradation. Coral reef bleaching, declining fish stocks, and the loss of livelihoods among traditional fishing communities are just a few of the alarming symptoms.

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The increasing pressure on aquatic ecosystems threatens not only biodiversity but also the long-term survival of millions of Indonesians who rely on these resources for their daily needs.

To address these challenges, the Indonesian government has implemented various water resource management policies at both national and local levels. However, these efforts often rely heavily on technocratic and top-down approaches that overlook local socio-cultural contexts. Many of these policies are formulated without sufficient involvement from local communities, leading to a lack of ownership and poor implementation on the ground. Yet, the success of aquatic resource management depends largely on the participation and commitment of the very communities who interact with these ecosystems on a daily basis. In this context, local wisdom emerges as a critical component in sustainable water resource management. Local wisdom reflects traditional ecological knowledge passed down through generations in the form of customary laws, rituals, taboos, and social norms. It is a value-based system that integrates environmental conservation with local cultural practices. For instance, the *Sasi* tradition in Maluku regulates seasonal restrictions on harvesting marine resources, allowing time for ecological regeneration. In Aceh, the *Panglima Laot* functions as a customary maritime institution responsible for managing marine zones and resolving conflicts among fishers. These practices demonstrate that local communities possess effective and contextually appropriate systems of resource management.

Beyond environmental concerns, local wisdom fosters strong social cohesion and community-based governance. Customary institutions often enjoy higher levels of legitimacy and trust than formal institutions due to their close connection to local identity and values. Social sanctions for violating customary rules tend to be more effective than legal punishments, especially in remote areas where law enforcement is limited. In many cases, these traditional systems serve as the last line of defense in safeguarding aquatic resources when formal policies fail to take root. Unfortunately, modernization and globalization have contributed to the marginalization of local wisdom in the name of national development. Traditional practices are often dismissed as outdated or unscientific, and communities are frequently stripped of their authority over natural resource governance. Land and marine areas once governed by customary systems are increasingly converted into tourism zones, industrial estates, or mining concessions displacing local populations and eroding their ecological knowledge systems. This disconnect between modern policy frameworks and local values leads to conflict, resource degradation, and social disempowerment.

To address this gap, there is a pressing need to formulate strategies that integrate local wisdom into formal water resource management systems. This integration must include legal recognition of customary institutions, community involvement in decision-making processes, and capacity building to strengthen local resilience. Bridging traditional knowledge with scientific approaches can create adaptive and culturally grounded solutions that are more likely to be accepted and sustained over the long term. This study is therefore timely and relevant, as it seeks to explore the potential of local wisdom-based strategies in achieving sustainable water resource management. It aims to provide insights and policy recommendations that align national development goals with the protection of local knowledge systems and the empowerment of coastal communities. Through this approach, sustainable aquatic governance can be both ecologically sound and socially just.

Metodologi

This study adopts a qualitative approach using a multiple case study method to examine how traditional ecological knowledge and local wisdom are applied in the sustainable management of aquatic resources in Indonesia. The qualitative method allows for an in-depth understanding of social phenomena, particularly in exploring values, beliefs, and community-based practices that cannot be fully

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captured through quantitative data. The case study approach is used to compare and contrast different local systems across various cultural and geographical contexts, thus highlighting the diversity and applicability of indigenous practices in aquatic governance. The selection of research sites was carried out using purposive sampling, focusing on three regions that are widely known for their strong customary marine resource management systems:

1. Maluku – where the *Sasi Laut* tradition regulates the seasonal closure of fishing areas;
2. Lombok – where the *Awig-Awig* customary law governs community fishing rights and marine zoning; and
3. Aceh – where the *Panglima Laot* system acts as a maritime customary institution with authority over fishing practices and dispute resolution.

These sites were chosen not only for their historical significance but also because they represent living examples of how local communities have developed their own governance mechanisms rooted in local knowledge and environmental ethics. Data collection utilized multiple techniques to enhance the richness and validity of findings. These techniques included:

- In-depth semi-structured interviews with key informants such as customary leaders, elders, community fishers, local government representatives, NGOs, and scholars who have studied these traditions.
- Participant observation during customary meetings, traditional ceremonies, and daily community activities related to marine resource use, allowing the researcher to gain a deeper contextual understanding.
- Document analysis of village regulations, customary law texts, community maps, and policy documents issued by local and national authorities. This also included the review of academic literature and previous studies on customary marine management practices.

All interviews were conducted in either the local language or Bahasa Indonesia, depending on the context, and were recorded (with permission) to ensure accuracy. Field notes and reflective journals were also used to capture non-verbal cues, situational contexts, and emerging themes during fieldwork. The unit of analysis in this research is the community-based customary institution responsible for managing marine resources in each location. The sampling of participants followed a snowball sampling technique, starting with known community leaders and expanding to include other knowledgeable stakeholders based on referrals.

For data analysis, the study used thematic content analysis, supported by qualitative coding software (e.g., NVivo). Data from interviews, observations, and documents were transcribed, coded, and categorized based on emerging themes such as "resource use regulations," "conflict resolution mechanisms," "cultural values in conservation," and "community participation in governance." Through this process, the researcher identified patterns and constructed narratives that reflect both the uniqueness and commonality of each case.

The research also applied a socio-ecological systems (SES) framework as an analytical lens to explore the dynamic interactions between human actors (e.g., fishers, community leaders, government) and ecological components (e.g., fish stocks, coral reefs, seasonal changes). This framework was useful for identifying feedback mechanisms, resilience factors, and institutional arrangements that support or hinder sustainability.

To ensure research ethics, informed consent was obtained from all participants before interviews or observations. Participants were informed about the objectives of the study, their right to withdraw at any time, and how their responses would be used. Anonymity and confidentiality were maintained throughout the research process. Cultural sensitivity and respect for local customs were upheld during fieldwork to build trust and minimize disruption to community life.

In conclusion, the chosen methodology offers a comprehensive and context-sensitive approach to understanding how traditional knowledge can inform sustainable aquatic resource governance. The combination of multiple data sources, case comparisons, and grounded analysis allows the study to contribute meaningfully to academic discourse and policymaking in environmental management.

Result and Discussion

The findings of this study underscore the critical role of local wisdom in fostering sustainable aquatic resource management within Indonesian coastal communities. Each of the three examined customary systems *Sasi Laut* in Maluku, *Awig-Awig* in Lombok, and *Panglima*

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Laot in Aceh demonstrates how traditional knowledge and values can be effectively translated into community-based governance mechanisms that align with ecological sustainability and social harmony. In Maluku, the *Sasi Laut* tradition is practiced by closing specific coastal or marine areas to resource extraction for a predetermined period. This closure applies not only to fish but also to other marine biota such as sea cucumbers, mollusks, and lobsters. The decision to enforce *Sasi* is usually made through communal deliberation involving traditional leaders (*adat elders*), religious figures, and fishers. It is accompanied by a ritual ceremony (*buka sasi* or *tutup sasi*), emphasizing the spiritual and moral dimensions of resource use. The success of *Sasi Laut* lies in its cultural embeddedness; non-compliance is socially frowned upon and may invite spiritual consequences, which reinforces communal adherence. Empirical observations during the field study revealed increased biodiversity in areas under *Sasi*, with coral reefs showing signs of regeneration and higher fish density. Furthermore, *Sasi* also promotes equitable access and benefit-sharing among community members, as harvests post-closure are often distributed or auctioned collectively.

In Lombok, the *Awig-Awig* system represents a more codified form of customary law, often documented in village regulations (*Perdes*) and integrated into the administrative functions of local governance. This system provides detailed rules on fishing zones (such as nearshore and offshore limits), allowable gear types, minimum catch sizes, and even times of the day when fishing is permitted. The community regularly updates these rules through consensus-building forums involving various stakeholders, including village heads, traditional leaders, youth groups, and local fishers' cooperatives. During fieldwork, researchers noted that *Awig-Awig* serves not only as a tool for ecological conservation but also as a mechanism for strengthening community cohesion. It was found that when *Awig-Awig* is violated, the offender may be subjected to traditional sanctions such as public apologies, community service, or restitution, rather than formal legal punishment. Importantly, the system has shown adaptability in responding to ecological changes, such as coral bleaching events, by temporarily suspending certain fishing activities and redirecting community labor to reef restoration initiatives.

The Panglima Laot institution in Aceh functions with a hybrid model that combines customary norms with elements of Islamic law (*Syariat Islam*) and modern administrative structures. The *Panglima Laot*, elected by fellow fishers, serves a multifaceted role as a marine resource manager, conflict mediator, and liaison with government bodies. Unlike the other two systems, the *Panglima Laot* is formally recognized by Aceh's provincial legal framework, particularly under the post-tsunami regional autonomy laws. This formal status enables it to issue binding regulations on seasonal bans, gear restrictions, and dispute resolutions, which are often adopted into regional marine spatial planning policies. Field data shows that *Panglima Laot* commands strong respect across age groups and fishing communities, partly because of its ability to maintain fairness and uphold traditional values while engaging with contemporary governance challenges. Furthermore, the *Panglima Laot* network plays a significant role in environmental education, facilitating training on sustainable fishing practices and marine conservation among youth and local schools.

From a cross-case analysis, several key findings emerge. First, traditional systems are highly effective in ensuring compliance and stewardship due to their rootedness in cultural values, religious beliefs, and social relationships. Unlike formal laws that rely on external enforcement, customary rules derive legitimacy from internalized communal norms. Second, these systems promote participatory governance, where rules are discussed openly and consent is built collectively. This inclusive approach enhances transparency, reduces conflicts, and fosters trust among stakeholders. Third, the systems are inherently adaptive. Local leaders often observe environmental changes such as fish population declines, coral damage, or weather anomalies and adjust practices accordingly without waiting for external interventions. This

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responsiveness is crucial in the context of climate variability and environmental uncertainty. However, the research also identifies several ongoing challenges and vulnerabilities. The erosion of traditional knowledge due to generational shifts is a growing concern, especially as younger community members increasingly migrate to urban areas or adopt modern lifestyles. Additionally, external pressures such as commercial overfishing, illegal fishing practices by outsiders, marine tourism development, and industrial pollution have disrupted traditional fishing grounds and weakened local governance capacity. In some areas, customary leaders expressed frustration over the lack of formal recognition from national institutions, resulting in limited authority to enforce rules against non-local violators. Another challenge lies in harmonizing customary systems with formal legal structures, particularly when there is jurisdictional overlap or policy misalignment.

Despite these issues, the study affirms that when properly recognized, resourced, and supported, local wisdom-based management systems can serve as models of sustainable aquatic governance. Their principles of conservation, justice, intergenerational responsibility, and respect for nature align closely with contemporary environmental ethics. To enhance their impact, the study recommends establishing legal frameworks that formally recognize and empower traditional institutions, integrating local knowledge into marine spatial planning, and building collaborative platforms that include customary leaders in decision-making at all levels of government. In sum, this research highlights the importance of local wisdom not only as a cultural asset but also as a viable and innovative approach to tackling the complex challenges of marine resource sustainability in Indonesia and beyond.

The results of this study underscore that traditional ecological knowledge systems such as *Sasi Laut*, *Awig-Awig*, and *Panglima Laot* are not only environmentally effective but also socially embedded frameworks of aquatic resource governance. These systems are constructed through generations of empirical learning, cultural ritualization, and spiritual symbolism, which collectively guide community behavior toward nature. Importantly, these practices are not frozen in the past; they are responsive, negotiated, and continuously redefined in relation to changing ecological, political, and economic conditions.

A central theme that emerges from this research is the co-evolution of customary institutions with ecological rhythms. Unlike many formal top-down regulatory models, which often apply static rules across diverse ecosystems, local knowledge systems are tailored to the specificities of their environment. For example, the timing of *Sasi Laut* openings and closures is based on traditional indicators such as tidal patterns, lunar cycles, and species reproduction habits representing a form of place-based ecological intelligence. Such embedded knowledge offers valuable insights for adaptive management strategies, especially in the context of climate change and ecological uncertainty.

The findings also resonate strongly with Elinor Ostrom's design principles for managing common-pool resources, particularly the importance of clearly defined boundaries, rule-making autonomy, community-based monitoring, and locally legitimate sanction systems. All three case studies exhibit these features to varying degrees, which helps explain their effectiveness. However, while these systems are successful internally, their ability to influence broader resource governance is often constrained by limited recognition within national legal frameworks. This tension between customary legitimacy and formal legal authority is a recurring theme in natural resource management in Indonesia and other post-colonial states where plural legal systems coexist.

In this light, the discussion also touches on the challenges of legal pluralism. Although Indonesia's decentralization policy and the Village Law No. 6/2014 have opened opportunities

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for recognizing local institutions, the implementation remains inconsistent. Customary leaders frequently report that their voices are not represented in regional development planning or marine spatial planning forums. In some instances, external actors such as private developers or industrial fishers gain access to marine territories without consultation with the local community, undermining both social cohesion and environmental protection. These institutional disconnects create governance vacuums that can be exploited, especially in areas rich in marine resources.

Another major issue discussed is the erosion of intergenerational knowledge transmission, a problem that threatens the long-term sustainability of local wisdom systems. As younger generations become more engaged with urban lifestyles, digital culture, and non-marine-based employment, their attachment to traditional ecological practices weakens. Field observations revealed that while elders retain deep knowledge of customary laws, few young people are actively involved in marine conservation or rituals. Without deliberate intervention such as integrating local knowledge into school curricula, youth training programs, and cultural festivals there is a risk that these systems will fade over time.

Nonetheless, the flexibility and adaptability of these customary systems offer pathways for bridging traditional and modern approaches. Several communities have already begun experimenting with hybrid governance models, where local knowledge is integrated with scientific monitoring and digital tools such as GPS mapping and participatory GIS. For instance, in Aceh, *Panglima Laot* institutions have collaborated with NGOs and researchers to produce resource maps that are then used in district-level marine planning. These examples illustrate the potential for collaborative governance, where local actors are not merely subjects of policy but active co-managers of their environments.

This aligns with recent scholarship in adaptive co-management theory, which emphasizes learning-based governance through multi-stakeholder collaboration and iterative feedback mechanisms. In this framework, local institutions are seen as laboratories of innovation rather than barriers to modernization. Moreover, integrating local wisdom into formal systems aligns with the United Nations Sustainable Development Goals (SDGs), particularly SDG 14 (Life Below Water), SDG 13 (Climate Action), and SDG 16 (Peace, Justice, and Strong Institutions).

On a global scale, the research findings contribute to debates around **biocultural diversity**, which argues that biodiversity and cultural diversity are interlinked and must be conserved together. When traditional knowledge systems are undermined, it is not only cultural heritage that is lost, but also vital ecological knowledge that has been refined over centuries. Recognizing this, many international frameworks such as the Convention on Biological Diversity (CBD) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) now advocate for the inclusion of Indigenous and local knowledge in environmental governance.

Therefore, the discussion reinforces that sustaining aquatic ecosystems in Indonesia and beyond requires more than just regulatory enforcement or technological innovation. It demands a reconfiguration of power, recognition, and relationships between state institutions and local communities. Policies must move beyond tokenistic consultations and instead embrace genuine co-governance models that empower customary institutions, protect community rights, and value local knowledge as a form of expertise.

In conclusion, this study positions local wisdom not only as a conservation strategy but also as a form of political agency and social resilience. These systems provide culturally

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grounded, ecologically responsive, and socially just alternatives to mainstream resource governance. To fully realize their potential, efforts must be directed toward strengthening legal recognition, fostering intergenerational transmission, and building collaborative institutions that bridge tradition and modernity in the service of sustainable futures.

Conclusion

This study concludes that local wisdom-based systems such as *Sasi Laut* in Maluku, *Awig-Awig* in Lombok, and *Panglima Laot* in Aceh represent effective, culturally grounded approaches to the sustainable management of aquatic resources. These traditional practices are not only ecologically beneficial but also deeply embedded in community values, ensuring high levels of compliance, equity, and social cohesion. Their strength lies in participatory governance, moral legitimacy, and adaptive flexibility, which allow them to respond to environmental changes in ways that are both context-sensitive and sustainable. However, the full potential of these systems is often constrained by weak legal recognition, generational shifts, and external threats from industrial exploitation and tourism development. To enhance their effectiveness, there is a need for greater integration of local wisdom into national policy frameworks, supported by legal protections, financial resources, and institutional collaboration. Strengthening intergenerational knowledge transmission and involving youth in environmental stewardship are also critical for the long-term viability of these systems. Ultimately, this research affirms that local wisdom should not be viewed merely as tradition, but as a vital, living system of governance capable of contributing meaningfully to national and global sustainability agendas. Embracing and empowering these community-based models offers not only environmental benefits but also strengthens cultural identity, local autonomy, and social justice in the pursuit of sustainable aquatic resource management.

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