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| Literature Review

Local Wisdom in Mangrove Management and Conservation in Indonesia

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Abstract: Mangroves are coastal ecosystems widely distributed in tropical and subtropical regions, providing significant ecological and economic benefits. However, approximately 35% of mangrove forests have been lost over the past 50 years due to human activities, despite ongoing restoration efforts. This research article aims to analyze various forms of local wisdom applied in the management and conservation of mangroves in Indonesia, addressing the urgent need for a comprehensive review of traditional conservation methods. The research employs a literature review method, examining recent scientific articles (2020–2024) to explore the role of local wisdom in mangrove management. The data is analyzed descriptively by identifying key themes such as traditional practices, ecosystem sustainability, and the relationship between indigenous communities and conservation policies. The findings reveal that local wisdom plays a significant role in mangrove conservation through customary laws, exploitation restrictions, and mystical beliefs passed down through generations. Additionally, sustainable utilization, such as ecotourism and community-based management, supports mangrove ecosystem preservation without causing damage. Although different approaches are used in various regions, active community involvement remains the key factor in ensuring mangrove sustainability. The implications of this research emphasize that conservation approaches based on local wisdom can be integrated into national environmental policies to enhance the effectiveness of mangrove ecosystem protection in a sustainable manner.

Keywords: Local Wisdom; Mangrove; Conservation.

1. INTRODUCTION

Mangrove is a term referring to intertidal ecosystems or communities of woody plants that grow in coastal environments between 40°S and 30°N worldwide (Quadros et al., 2021). The distribution of mangroves extends to southern Japan (30.4°N) and Bermuda (32.4°N), as well as southern New Zealand (38.05°S), Australia (38.85°S), and the east coast of South Africa (32.98°S) (Tran et al., 2022). Mangrove distribution is generally limited to areas with an average temperature of 20–35°C, annual rainfall between 1,500–2,500 mm, and substantial freshwater input from rivers. Moreover, the number of freezing days per year also affects the presence of mangroves in high-latitude regions (Gouvêa et al., 2022). A decrease in the frequency of extreme cold weather may lead to an expansion of mangrove forests at the northernmost and southernmost boundaries of their range.

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The physical characteristics of mangroves, such as leaf area, basal area, tree height, canopy cover percentage, stem diameter, carbon storage, and biomass, are significantly influenced by climatic conditions. Sea level rise also plays a role in determining the structure and spatial distribution of mangroves. Factors such as temperature, rainfall, and storms influence approximately 74% of changes in tree canopy height and above-ground biomass globally (Serafim et al., 2025). Globally, 75% of mangroves are found in tropical regions. Asia has the largest mangrove cover and biodiversity (39%), followed by Africa (21%, mostly on the eastern side), North and Central America (15%), South America (12.6%), and Oceania (Australia, Papua New Guinea, New Zealand, and the Pacific Islands) (12.4%) (Friess et al., 2022).

Mangroves in equatorial regions have the highest biomass, with tree heights reaching 30–40 meters, but their physical parameters decline with increasing latitude (Aslan & Aljahdali, 2022). This ecosystem provides significant benefits, including coastal protection, water filtration, resource provision (such as fisheries, timber, fuel, and medicine), as well as cultural and tourism value. Mangroves also serve as natural barriers against coastal erosion and natural disasters, filter aquaculture waste, and store three to five times more carbon than terrestrial tropical forests (Arkema et al., 2023). Beyond ecological benefits, mangroves have high economic value, with over 2,000 tourism sites related to mangroves and ecosystem contributions estimated to exceed $800 billion annually (Nobi et al., 2021).

Despite their many benefits, approximately 35% of the world's mangrove forests have been lost in the past 50 years due to human activities and environmental pressures. Although mangrove restoration efforts have increased over the last 40 years, the rate of mangrove loss and species diversity remains high, reaching 1–2% per year (Lovelock et al., 2022). This decline harms coastal communities, leading to reduced coastal protection, increased property damage, loss of life, and infrastructure destruction due to natural disasters. Additionally, mangrove deforestation results in declining fishery yields, increased social conflicts, reduced carbon storage capacity, leading to higher greenhouse gas emissions, and disruptions in nutrient cycles and other ecosystem services (Hagger et al., 2022). These impacts also affect adjacent ecosystems such as coral reefs and seagrass beds, threatening many species that depend on mangrove habitats for survival.

A quarter of the world's total mangrove carbon stock, encompassing soil, above-ground, and below-ground biomass, is stored in Indonesia. According to data from the Ministry of Environment and Forestry (KLHK), Indonesia has approximately 3.39 million hectares of mangrove forests, accounting for 21% of the world's total mangrove coverage. However, between 2010 and 2020, Indonesia lost nearly 200,000 hectares of mangrove cover, with the peak loss occurring in 2016 at 60,000 hectares (Heriamsal & Amin, 2024). This decline is attributed to illegal logging, land conversion, and coastal reclamation, which threaten the mangrove ecosystem. To address this issue, the government has incorporated mangrove ecosystem management policies into the National Medium-Term Development Plan (RPJMN) 2020–2024, targeting the rehabilitation of 50,000 hectares of mangrove forests (Mubarak, 2024).

One strategy for ensuring the sustainability of mangrove ecosystems is leveraging indigenous knowledge that has been passed down through generations by coastal communities. Indigenous knowledge refers to the deeply rooted human perspectives within a cultural group that have been passed down over a long period. It reflects the relationship between humans, the environment, and culture, which develops through social interactions. This relationship forms traditions influenced by daily life and culture-based social institutions. Indigenous knowledge encompasses traditional knowledge that evolves within a community and is transmitted from generation to generation (Harto et al., 2021). It includes physical aspects such as traditional ceremonies, tourism, transportation, clothing, art, folklore, infrastructure, institutional systems, and land management (Putri et al., 2023).

The indigenous knowledge of coastal communities is crucial in shaping strategic policies for mangrove management. This is because indigenous knowledge represents an adaptive response by communities to environmental challenges. Mangrove management policies based on indigenous knowledge are more likely to be effectively implemented within local communities (Fariz et al., 2024). In various regions of Indonesia, coastal communities have developed unique methods for managing and conserving mangrove forests. For example, in some areas, customary laws prohibit the indiscriminate cutting of mangroves or require replanting after harvesting. Such practices demonstrate that local communities have long understood the benefits of mangrove ecosystems, even before the development of modern conservation concepts.

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Numerous studies have demonstrated that indigenous knowledge-based approaches are more effective in natural resource management than relying solely on formal policy approaches. This effectiveness is attributed to the emotional and social attachment between communities and their environment. On the other hand, although extensive research has been conducted on mangrove functions, a significant research gap remains regarding effective indigenous knowledge-based strategies for preserving mangroves and enhancing the livelihoods of coastal communities. Previous research has primarily focused on ecological aspects rather than integrating social, economic, and cultural dimensions into mangrove management policies. The mangrove management approach in Indonesia has predominantly emphasized ecological aspects, including biodiversity, vegetation structure, and ecosystem services. Research (Febryano et al., 2014) in Pahawang Island, Lampung, showed that local institutions contribute to mangrove management, but their sustainability is disrupted by external pressures such as land conversion and the lack of support from formal policies. Meanwhile, research by (Lumenta et al., 2017) in Bahoi, North Sulawesi, highlighted that local knowledge plays a significant role in mangrove conservation. However, the integration of this knowledge into formal policies is still minimal, which limits its long-term effectiveness.

Although local wisdom-based practices have long been implemented by coastal communities, scientific researches that integrate various forms of indigenous knowledge from different regions in Indonesia remains limited and scattered. This literature review aims to synthesize, analyze, and identify patterns, challenges, and potential areas of collaboration between indigenous knowledge and formal policies. Through this approach, mangrove conservation strategies can be designed to be more contextual, participatory, and sustainable, while also bridging the gap between modern scientific knowledge and indigenous wisdom in preserving mangrove ecosystems that are crucial for environmental sustainability and the socio-economic well-being of coastal communities.

This article presents a literature review focused on the role of indigenous knowledge in mangrove conservation and management in Indonesia. This literature review focuses on peer-reviewed journal articles published by 2020 that examine the role of indigenous knowledge in mangrove conservation across various regions in Indonesia. The selected researches emphasize community-based practices, traditional ecological knowledge, and their interactions with formal conservation policies. Sources were chosen based on their relevance to the integration of social, cultural, and ecological dimensions in sustainable mangrove management. As a review paper, it does not conduct primary field research but synthesizes findings from existing scholarly works. This methodological approach enables a more comprehensive understanding of cross-regional practices and their policy implications.

2. RESEARCH METHODS

This research employs the literature review method as its research design. This method was chosen because this research aims to analyze the role of local wisdom in the management and conservation of mangroves in Indonesia using secondary data obtained from various literature sources. The data used in this research comprises scientific articles that discuss the cultural, ecological, and policy aspects of mangrove management, drawing on local wisdom. Data sources were selected through a process that considered the accuracy, recency, and credibility of information relevant to the research topic. The articles used in this research are limited to those published within the last five years, specifically from 2020 to 2024.

The data collection technique involves identifying and gathering various literature references that support the analysis of the role of indigenous communities and local communities in sustaining mangrove ecosystems. The collected data is then analyzed using a descriptive analysis method to describe the obtained facts and provide explanations and understanding of the examined phenomenon. The analysis is conducted by identifying key themes that emerge in the literature, such as traditional practices in mangrove management, local wisdom that supports ecosystem sustainability, and the relationship between indigenous communities and conservation policies. These identified themes are further analyzed to gain a deeper understanding of the contribution of local wisdom to mangrove conservation efforts.

This research does not involve bibliometric analysis using tools. The reason for this is that the primary objective of this research is to explore and synthesize existing qualitative insights on local wisdom in mangrove conservation, rather than quantitatively mapping research trends or networks. The focus is on an in-depth

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examination of each research piece and its contextual relevance to the research topic, rather than generating broader patterns through bibliometric tools.

3. RESULTS AND DISCUSSION

Based on the screening and selection process, a total of 10 relevant articles were obtained. The analysis of the collected research findings indicates that local wisdom plays a significant role in the management and conservation of mangrove ecosystems in Indonesia. This research is based on data obtained through the analysis of various studies, which serve as samples. The analysis results identified 10 articles, which were subsequently classified into specific categories based on their research focus **(Table 1).**

Customary Rules and Prohibitions in Mangrove Management

Local wisdom plays a significant role in the conservation of mangrove ecosystems through the implementation of customary laws and prohibitions enforced by local communities. These regulations aim to preserve the environment and prevent excessive exploitation. Each region has its own unique mechanisms for protecting mangroves, ranging from written customary rules to mystical beliefs passed down through generations. In Bali, the customary legal system known as Awig-Awig has been implemented as a guideline for managing natural resources, including mangroves. Research (Redi et al., 2020) indicates that these regulations govern the utilization of mangrove forests to ensure their sustainability. A similar practice is found in the Sasi tradition in Papua, as explained by (Yanti & Leiwakabessy, 2023). This custom establishes a period of restriction on resource exploitation to allow ecosystem recovery.

In West Sulawesi, the community follows the Diposara' Mappaleo' system, which prohibits indiscriminate mangrove logging (Syarmilah et al., 2022). Meanwhile, the Bajo people in South Sulawesi also enforce strict regulations on mangrove cutting, as they believe such actions could cause ecological harm and have mystical consequences (Sulaiman et al., 2023). Beyond explicit restrictions, some communities have also designated conservation zones where any disturbance is strictly forbidden. In Jambi, customary rules prohibit tree cutting in specific areas to ensure ecosystem sustainability (Fariz et al., 2024). Likewise, the Bajo people have strictly protected conservation zones as part of their efforts to preserve mangroves.

Mystical beliefs also play a role in protecting mangrove ecosystems in certain regions. In Gorontalo, people believe that cutting down mangrove trees in the late afternoon can result in eerie noises at night and increase the risk of seawater rising onto the land (Ruruh & Suma, 2024). This belief makes the community more cautious and reluctant to cut mangrove trees recklessly. In West Sulawesi, there is a conviction that mangrove forests are guarded by spiritual beings in the form of crocodiles, leading the community to respect and protect them (Syarmilah et al., 2022). Meanwhile, in Langkat, North Sumatra, *ketapang* trees are considered sacred because they are believed to hold an ancestral pact, deterring people from harming them (Aulia et al., 2022).

These examples illustrate that customary laws and mystical beliefs serve as crucial tools for mangrove conservation in various regions of Indonesia. Although the approaches differ, the primary goal remains the same: preserving the mangrove ecosystem. In some areas, such as Bali and Papua, customary laws are systematically enforced. At the same time, in other regions, including Gorontalo and West Sulawesi, conservation efforts are driven more by spiritual and mystical aspects. This demonstrates that local cultural values can effectively contribute to environmental preservation.

Sustainable Utilization and Management of Mangroves

In addition to enforcing restrictions on exploitation, many local communities also have methods of utilizing mangroves while ensuring their sustainability. Through the application of sustainable approaches, they can benefit from mangrove ecosystems without disrupting the natural balance. This utilization is carried out in various ways, such as using natural resources for food, traditional medicine, and the development of ecotourism based on environmental education. In Dumai, Riau, the community has long utilized parts of mangrove trees, such as leaves and fruits, as food ingredients and traditional medicine (Harto et al., 2021). This practice is conducted while ensuring that the mangrove trees remain intact and continue to grow. A similar approach is applied by the Bajo people, who only collect mangrove wood from trees that have already died or stopped growing. Additionally, they use certain parts of mangrove trees for traditional medicinal purposes (Sulaiman et al., 2023).

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In several regions, mangrove ecosystems are also utilized as sources of income through ecotourism and educational programs. In Banyuwangi, East Java, the community has developed a mangrove-based edutourism concept to raise environmental awareness while providing economic benefits to residents (Purwowibowo et al., 2020). This concept allows visitors to learn about the importance of mangrove ecosystems while enjoying their natural beauty. In Siak Regency, Riau, community-based ecotourism management is implemented through the Sanak Sedagho concept, which emphasizes collective efforts in preserving the ecosystem. Mangrove-related fishing activities, such as Ngaco, Menanjow, and Sondong, support conservation efforts while simultaneously providing economic benefits to the local community (Pratama et al., 2021). This approach demonstrates how economic utilization and environmental protection can coexist harmoniously.

Beyond ecotourism, communities are also actively engaged in community-based conservation efforts. In Banyuwangi, mangrove planting initiatives have been carried out since 1997 on abandoned shrimp farms. This initiative has successfully restored the ecological function of mangroves and serves as an example of independent environmental rehabilitation efforts by the local community (Purwowibowo et al., 2020). Meanwhile, in Southwest Papua, the Moi people implement conservation principles through the customary teaching Nani Mi Wawolom Ti Eges Gu, which is a collective call to preserve nature. These customary values not only help sustain mangrove ecosystems but also strengthen the community's collective awareness of the importance of environmental conservation (Yanti & Leiwakabessy, 2023).

From these examples, it is evident that regions with high tourism potential, such as Banyuwangi and Siak, tend to adopt conservation approaches based on sustainable utilization and ecotourism. On the other hand, communities with strong cultural ties, such as the Bajo people and indigenous communities in Papua, rely more on conservation practices rooted in customary laws and exploitation restrictions. By integrating these various approaches, mangrove conservation can be implemented more effectively while aligning with the unique socio-cultural characteristics of each region.

Comparison of Local Wisdom Findings in Various Regions

Each region has a unique approach to mangrove conservation, adapted to its cultural values and local potential. One of the key differences lies in the implementation of customary laws and ecotourism as preservation strategies. In Bali, Jambi, and Papua, mangrove conservation is enforced through customary regulations that bind communities to environmental protection. Conversely, in Banyuwangi and Siak, ecotourism-based approaches are more developed, where communities utilize mangrove ecosystems as tourist attractions while also serving as platforms for environmental education.

Additionally, mystical beliefs play a role in mangrove conservation in certain areas. In Gorontalo, West Sulawesi, and North Sumatra, local communities believe that cutting down mangrove trees can bring misfortune, such as the emergence of strange noises at night or an increased risk of flooding. These beliefs indirectly foster community compliance in preserving mangrove ecosystems, differing from regions that rely more on formal regulations or ecotourism-based economic incentives.

Despite these differences, a commonality among various regions is the active involvement of local communities in mangrove conservation. The Bajo people and communities in Banyuwangi, for instance, both implement participatory systems where residents take direct roles in planting, maintaining, and protecting mangrove ecosystems to ensure sustainability. Whether through customary laws, mystical beliefs, or ecotourism, community engagement remains the primary factor in maintaining the sustainability of mangrove ecosystems across different regions.

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Table 1. Analysis Results of 10 Articles

No.	Researcher	Article Title and Year	Locus	Local Wisdom Findings	Description
1.	Syafri Harto, Rd. Siti Sofro Sidiq, dan Okta Karneli	Development Strategy Mangrove Ecotourism Based On Local Wisdom (2021)	Dumai City, Riau	Custom-based mangrove forest management	Local communities have customary rules in maintaining the sustainability of mangrove forests, such as a prohibition on cutting down trees indiscriminately and an obligation to replant felled trees.
				Use of wood and mangrove products	Residents utilize mangrove forest products such as leaves and fruit for food and traditional medicine without damaging the ecosystem.
				Rituals and traditions of sea thanksgiving	Local communities routinely hold customary ceremonies as an expression of gratitude to nature, as well as a reminder to maintain the balance of the mangrove ecosystem.
2.	Trida Ridho Fariz, Pawit Indra Permana, Abdul Jabbar, Rafi Nadhifa Saoki, dan Cintiya Egi Purwadi	Local Wisdom on Mangrove Management in Nipah Panjang Village, Indonesia (2024)	Kubu Raya Regency, West Kalimantan	Mangrove conservation as a bee habitat	The community maintains the sustainability of mangrove forests because they function as a natural habitat for honey bees.
				Rules prohibiting cutting down trees in certain zones	There are customary rules that prohibit cutting down trees within a radius of 50 meters from the outer boundary of the mangrove forest to maintain the ecosystem.
3.	Ahmad Redi, Fakhrana Izazi Hanifati, Tundjung Herning Sitabuana, dan Putri Nabila Kurnia Arsyad	The Role of Local Wisdom in Protecting Mangrove Forest in Bali Province (2020)	Bali Province	Awig-awig	Customary rules that regulate community behavior in maintaining the environment and balance of life.
				Tri Hita Karana	A philosophy that emphasizes the balance of human relations with God (Parahyangan), fellow human beings (Pawongan), and the environment (Palemahan).
				Custom-based mangrove management	The Balinese indigenous people preserve mangrove forests with the principle that the environment is a trust for future generations.
4.	Alexander Ruruh, dan Zeinab Nurlena Y. Suma	Local Wisdom of Bulalo Mangrove Forest Management, Kwandang District, North Gorontalo Regency (2024)	North Gorontalo Regency, Gorontalo	Prohibition of cutting mangroves indiscriminately	Cutting mangroves without permission from the community in the afternoon is prohibited because it is believed that it will cause strange sounds at night and cause sea water to suddenly rise to the land.
				Prohibition of wearing red clothes in the mangrove forest	The community believes that wearing red clothes in the middle of a mangrove forest can cause dehydration and attract insects.
				Prohibition of eating yellow rice in the mangrove forest	Eating yellow rice in the mangrove forest is considered to invite evil spirits and attract insects that can disrupt activities in the forest.
5.	Purwowibowo, B. Santoso, K Hendrijanto, S. Hariyono, dan B. H. Nufus	Local Wisdom for Mangrove Conservation and Ecotourism: Case Study from Wringinputih, Muncar, Banyuwangi (2020)	Banyuwangi Regency, East Java	Community-based mangrove conservation	The community has been independently replanting mangroves since 1997 in abandoned shrimp ponds.
				Utilization of mangroves in ecotourism and edutourism	Development of mangrove-based ecotourism, such as educational tourism (edutourism) to increase environmental awareness.
				Social and cultural involvement in conservation	Active community participation in planting and caring for mangroves as part of a hereditary tradition.

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6.	Umar Sulaiman, David E. Wilkins, Rahmawati, Subair, Wahyuddin Bakri, Alwan Suban, Mihrani, Ilham, Andries Kango, dan Muhammad Obie	Contribution of Local Wisdom of the Bajo Tribe to Preserve Indonesia's Mangrove Forests (2023)	Kabupaten Luwu, South Sulawesi	Taboos on destroying mangrove forests	The Bajo tribe believes that mangrove forests are where the spirits of their ancestors reside. They do not cut down mangrove trees carelessly because it is considered to bring disaster.
				Customary rules in the use of mangroves	If there is an urgent need to cut down mangrove trees, such as to build a house, there are customary rules that require replanting two trees for every tree cut down.
				Management and supervision by the community	The Bajo tribe voluntarily monitors mangrove forests and enforces customary rules that prohibit illegal logging. Violators will be subject to customary sanctions in the form of fines and the obligation to replant the trees that are cut down.
				Mangrove forest zoning	The Bajo tribe designates certain areas as conservation zones that must not be disturbed in order to maintain the sustainability of the mangrove ecosystem and surrounding marine biota
				Customary rituals in the life cycle	The Bajo tribe has customary rituals related to the environment, such as hanging a baby's placenta on a mangrove tree after the birth procession as a symbol of the close relationship between humans and nature.
				Sustainable use of mangroves	The Bajo tribe only takes wood from dead or no longer growing mangrove trees for the purpose of building houses and boats. They use mangroves as traditional medicine and as a habitat for marine biota.
7.	Farid Aulia, Badaruddin, R. Hamdani Harahap, dan Budi Utomo	The Local Wisdom of Mangrove Ecosystem Management based on Time Allocation in Coastal Community (2022)	Langkat Regency, North Sumatra	Communal identity and relationship with mangroves	The community has a communal identity that is born from their closeness to the coastal area and mangrove ecosystem
				The sacredness of the ketapang tree	The ketapang tree is considered sacred because of its agreement with Abu Bakar Bin Awang when clearing land and establishing a village that reflects local beliefs about nature.
				Natural mangrove conservation	The community understands that most mangrove ecosystems can grow naturally on their own without the need for replanting.
8.	Syarmilah, Suparjo Razasli Carong, Makmur, dan Qaizar	Kearifan Lokal Dalam Pengeloaan Ekosistem Hutan Mangrove : Studi Kasus Di Gonda Mangrove Park Kecamatan Campalagian Kabupaten Polewali Mandar (2022)	Polewali Mandar Regency, West Sulawesi	Diposara' Mappaleo' (No Cutting Allowed)	Customary rules prohibiting the felling of mangroves because of their role in preventing abrasion and the belief that the trees have invisible guardians.
				Mystical beliefs of society	The belief that there are forbidden areas in the mangrove forest guarded by guardians in the form of crocodiles, as well as oral traditions that teach respect for nature.
9.		Ekowisata Mangrove Berbasis Komunitas	Jeflio Island, Sorong	Nani Mi Wawolom Ti Eges Gu	Advice in the Moi language which means an invitation to jointly protect nature.

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	Dwi Indah Widya Yanti, dan Ivonne M. Leiwakabessy	Di Pulau Jeflio Distrik Mayamuk Kabupaten Sorong Papua Barat Daya (2023)	Regency, Southwest Papua	Sasi Custom	A conservation system that prohibits the taking of certain marine resources for a certain period of time to maintain their sustainability.
				Barapen traditional ceremony	The tradition of cooking together by burning stones as part of a traditional ritual.
10.	Septian Yuda Pratama, M. Rawa El Amady, dan Achmad Hidir	Ka Bakau: Ekowisata Mangrove Berbasis Pengetahuan Lokal (2021)	Siak Regency, Riau	Sanak Sedagho	The concept of family that strengthens solidarity in ecotourism management without distinguishing between ethnicity, religion, or origin.
				Local wisdom of fishermen	The local community has seven fishing activities that are closely related to the mangrove ecosystem, namely Ngaco (fishing by stirring up the water), Menanjow (fishing with a bamboo rod stuck in the ground), Menudu (sticking a short rod on the beach to catch shrimp), Kiso (catching fish with a net pulled in a circle to the beach), Sondong (using crossed bamboo with a net to catch fish when the tide is low), and looking for Lokan, Siput, and Gegamo (a type of small crab that appears during a storm)

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4. CONCLUSION

Mangrove conservation in various regions of Indonesia is carried out through diverse approaches, ranging from customary laws and mystical beliefs to ecotourism-based utilization. Communities in Bali, Jambi, and Papua implement binding customary laws, while regions such as Banyuwangi and Siak develop ecotourism as a conservation strategy. Additionally, in areas such as Gorontalo and West Sulawesi, mystical beliefs play a role in preserving mangrove ecosystems by instilling a sense of respect and caution toward the environment. Despite the differences in methods, a striking similarity is the active involvement of local communities in maintaining mangrove ecosystems. Whether through customary regulations, mystical beliefs, or ecotourism activities, participatory-based conservation has proven effective in ensuring the sustainability of mangrove ecosystems. This phenomenon demonstrates that local wisdom-based approaches can serve as highly beneficial strategies for environmental preservation that align with cultural values.

Future research in mangrove conservation should address several key gaps identified in the reviewed articles. These include integrating ecological practices with socioeconomic factors, exploring the impact of mystical beliefs on ecosystem sustainability, and evaluating the long-term effectiveness of customary laws in mangrove management. Additionally, research on the long-term ecological impacts of ecotourism, comparative studies across regions, and the role of community education in enhancing participation is needed. Investigating how traditional practices are adapting to climate change and how modern technology can support these practices, such as through satellite monitoring or GIS mapping, would also be valuable in strengthening mangrove conservation efforts.

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