

INTEGRATING TRADITIONAL ECOLOGICAL KNOWLEDGE INTO CO-MANAGEMENT OF MARINE PROTECTED AREAS IN EAST NUSA TENGGARA

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ABSTRACT

This study analyzes the governance of Marine Protected Areas (MPAs) in East Nusa Tenggara and develops a governance model grounded in Traditional Ecological Knowledge (TEK). It employs a descriptive multiple-case study design across four research sites. Data were collected through in-depth interviews, participant observation, focus group discussions, and document analysis, and were analyzed thematically using the perspectives of political ecology, TEK, and co-management. The findings indicate that MPAs governance remains predominantly state-centered, with limited substantive involvement of Indigenous communities. However, the integration of customary and state legal systems strengthens governance through the recognition of local institutions and culturally grounded social legitimacy, while recent national policy developments create opportunities for more participatory co-management despite persistent institutional constraints. Based on these findings, the study proposes a TEK-based marine conservation governance model comprising normative recognition of Indigenous Peoples, participatory mapping, institutional integration, substantive co-management, legal harmonization, and adaptive monitoring. The study contributes to the conservation governance literature by advancing an integrative model that combines TEK and customary institutions as a foundation for more effective, equitable, and sustainable management of Marine Protected Areas.

Keywords: conservation; TEK; local initiative; collaboration; sustainability

INTEGRASI PENGETAHUAN EKOLOGIS TRADISIONAL KE DALAM PENGELOLAAN KOLABORATIF KAWASAN KONSERVASI PERAIRAN DI NUSA TENGGARA TIMUR

ABSTRAK

Penelitian ini menganalisis kondisi Kawasan Konservasi Perairan (KKP) di Nusa Tenggara Timur serta mengembangkan model tata kelola berbasis Pengetahuan Ekologis Tradisional (PET). Penelitian menggunakan pendekatan deskriptif dengan desain studi kasus ganda di empat lokasi. Data diperoleh melalui wawancara, observasi, diskusi kelompok terarah, dan telaah dokumen, kemudian dianalisis secara tematik menggunakan perspektif politik ekologi, PET, dan co-management. Hasil penelitian menunjukkan bahwa pengelolaan KKP masih berorientasi pada negara dengan keterlibatan masyarakat adat yang terbatas. Namun, integrasi regulasi adat dan hukum negara memperkuat tata kelola melalui pengakuan kelembagaan lokal dan legitimasi sosial, sementara kebijakan nasional membuka peluang penerapan co-management yang lebih partisipatif meskipun masih menghadapi kendala kelembagaan. Berdasarkan temuan tersebut, penelitian ini mengusulkan model tata kelola konservasi laut berbasis TEK yang mencakup pengakuan normatif terhadap masyarakat adat, pemetaan partisipatif, integrasi kelembagaan, co-management substantif, harmonisasi hukum, dan monitoring adaptif. Penelitian ini berkontribusi pada literatur tata kelola konservasi dengan menawarkan model integratif berbasis PET dan kelembagaan adat sebagai landasan bagi pengelolaan kawasan konservasi perairan yang lebih efektif, adil, dan berkelanjutan.

Kata kunci: konservasi; TEK; inisiatif lokal; kolaborasi; keberlanjutan

INTRODUCTION

The blue economy has become a global strategy for coastal and island nations to balance economic growth, social justice, and marine sustainability. This approach is promoted by the United Nations and the World Bank as a response to marine degradation, overfishing, and inequality in access to resources (Delgado, 2024). As a development framework, the blue economy prioritizes sustainability principles

operationalized through community participation, resource efficiency, waste control, and equitable distribution of economic benefits (Gourvenec et al., 2025; Trenggono et al., 2025).

Although promoted as an inclusive approach, the implementation of the blue economy in many regions remains technocratic, oriented towards economic growth alone, and lacking a basis in local socio-cultural realities. The main critique of this framework is its tendency to ignore local social structures and tradi-

tional knowledge systems that have already existed (Akbar et al., 2022; Satria et al., 2017). The implementation of blue economy policies, which are expected to produce just sustainability, instead tends to give rise to new exclusions through processes of claiming, fragmentation, and commodification of marine space on a massive scale, which at the same time increases the risk of environmental degradation (Mallin, 2025)

Indonesia, as the largest archipelagic country in the world, has made the blue economy a national priority. This commitment is reflected in Perpres RI No. 16/2017 and in the national development priorities for 2025–2029 (Asta Cita), which highlight Indonesia's marine potential as well as its ambition to enhance the welfare of coastal communities (Wibowo & Fahroji, 2024). The implementation of the blue economy is realized through five strategies of the Ministry of Marine Affairs and Fisheries: marine resource conservation, measured fishing, sustainable aquaculture, coastal and small island management, and marine waste control (Yusuf et al., 2024). These five strategies are concretely based on Marine Protected Areas (MPAs) or are key instruments.

MPAs function to protect biodiversity, improve fisheries sustainability, and maintain marine carbon reserves that are vulnerable to anthropogenic pressures (Sala et al., 2021). One important benefit of conservation areas is their ability to ensure the protection and sustainable use of traditional practices, cultural heritage, and archaeological resources (Boubekri et al., 2022). Therefore, conservation areas cannot be understood merely as technocratic instruments but rather as social processes that depend on the involvement and capacity of coastal communities (Dam Lam et al., 2019).

The social foundation of community-based conservation is concretely realized through Traditional Ecological Knowledge (TEK). Marine and fisheries TEK refers to a body of knowledge and practices that emerge from long-term interactions between communities and their environment, are reinforced by local norms, and are transmitted across generations (Stori et al., 2019). Its practices include no-take zones, seasonal regulations, maritime rituals, and collective management. The empirical and adaptive nature of TEK demonstrates coastal communities as central actors in marine governance. The integration of TEK into MPAs policies has the potential to increase inclusivity, participation,

legitimacy, and the social foundation of the blue economy (Massimi et al., 2025).

The gap in MPAs practice that is integrated with TEK in the field aligns with the gap in the literature. At the level of practice, the gap between formal state policy and TEK practice instead triggers friction between indigenous communities and the government, reflected in tenure conflicts on Moyo Island as well as community resistance in NTT due to restrictions on access and customary fishing rights and overlapping fishing ground conflicts (Dasion, 2019; Kobesi et al., 2019; Markum et al., 2022).

Globally, the generic MPAs model is unable to accommodate the role of indigenous peoples and local communities (Beuret et al., 2025). In Thailand, there is a mismatch between conservation objectives and local socio-economic realities as well as power structures at the local level (Bennett & Dearden, 2014). In South Africa, top-down MPAs tend to exclude coastal communities despite providing ecological benefits (Peer et al., 2022).

At the level of literature, MPAs studies are dominated by ecological perspectives and biophysical approaches so that studies on TEK integration remain limited (Boubekri et al., 2022; Cresswell et al., 2019; Hoppit et al., 2025). Meanwhile, spatial studies regarding the integration of TEK and MPAs in East Nusa Tenggara are still relatively limited, although this region has a wealth of TEK practices such as Letu Ai, Muro, Lilifuk, and Hoholok/Papadak (Molan et al., 2023; Tania et al., 2024).

Although studies on TEK and MPAs have been extensively conducted, research that integrates the perspectives of political ecology, TEK, and co-management within a single analytical framework to design an adaptive and inclusive governance model in eastern Indonesia remains limited. The novelty of this study lies in the development of such an integrative framework, which is significant because no similar model, either conceptually or empirically, exists in eastern Indonesia.

The theoretical framework of this research utilizes political ecology to analyze resource inequality, access conflicts, and power relations in management (Watts, 2015). TEK is positioned as a knowledge system that guides the sustainable use of resources (Mcgregor, 2014). Meanwhile, co-management acts as a middle-ground mechanism that shares authority between the state and communities while strengthening the recognition of local knowl-

edge (Carlsson & Berkes, 2005; Pomeroy & Berkes, 1997). This integrative theoretical framework (political ecology, TEK, and co-management) is aimed at resolving two main issues: the inability to meaningfully activate participatory space and the complicated bureaucratic procedures that hinder community participation.

Addressing gaps in the literature and practice, this study examines: (1) the conditions and challenges of MPAs implementation in East Nusa Tenggara from the perspectives of political ecology, TEK, and co-management; and (2) how a participatory co-management model integrating TEK and local wisdom can be developed as an alternative to the dominant technocratic approach. Accordingly, the study aims to analyze MPAs implementation and develop an integrative governance model based on TEK and co-management.

METHOD

This study employed a descriptive multiple-case study design (Mills et al., 2010) to examine the integration of TEK into MPAs governance in East Nusa Tenggara. The analysis covered two levels: provincial policy and local practice across four purposively selected sites where active TEK practices intersect with marine conservation governance. A total of 15 informants were selected through purposive sampling, comprising customary leaders, village officials, small-scale fishers, provincial fisheries officers, and NGO representatives.

Data were collected through observations, in-depth interviews, focus group discussions (FGDs), and document analysis. Thematic analysis was conducted in three stages: (1) coding and categorizing recurring themes; (2) contextual analysis using the perspectives of political ecology, TEK, and co-management; and (3) synthesis to develop an integrative marine governance model grounded in empirical evidence. The credibility of the findings was ensured through source triangulation, member checking, and an audit trail.

RESULTS AND DISCUSSION

Regulation-Based Governance of Marine Protected Areas

MPAs are marine areas legally protected through a zoning system for fisheries sustain-

ability, with authority divided between the central and provincial governments. National Marine Protected Areas (KKPN) are under the management of the Ministry of Marine Affairs and Fisheries, with technical implementation carried out by the Marine Protected Area Management Office (BKKPN) under Permen KP RI No. 31/2020.

KKPN covers interprovincial or nationally strategic areas, so its management is directly carried out by the Ministry of Marine Affairs and Fisheries through Technical Implementation Units (UPT), such as BKKPN Kupang, which manages the Sawu Sea National Marine Park.

The provincial government is responsible for managing regional marine protected areas (KKPD) located within 0–12 nautical miles from the coastline. Management is carried out through a Marine Protected Area Management Unit (SUOP), which may take the form of a regional government agency, a technical implementation unit, a regional branch office, or another management body designated by the minister or governor, in accordance with Pergub Prov. NTT No. 70/2021. The provincial government can also delegate management to relevant agencies or form new management bodies. In this case, the Ministry of Marine Affairs and Fisheries continues to oversee and support the entire implementation of KKPD (Rusandi, 2020).

As of December 2019, the ministry of Marine Affairs and Fisheries manages 166 MPAs in Indonesia, consisting of 10 KKPN managed directly by the Ministry and 156 KKPD under the management of provincial governments. For KKPN, there are two Regional Technical Implementation Units (UPTD): LKKPN Pekanbaru (managing two KKPN in the western and central regions) and BKKPN Kupang (managing eight KKPN in the eastern region) (Rusandi, 2020).

Customary law communities are involved in the planning, implementation, and monitoring of coastal management (Permen KP RI No. 12/2024), while the government encourages multi-actor partnerships (communities, NGOs, corporations, universities) with management units to integrate TEK and local practices into the government's technical capacity (Permen KP RI No. 21/2015).

Zonation of marine protected areas is regulated under national policy (Permen KP RI No. 30/2010) divides the area into a core zone, a

sustainable fisheries zone, a utilization zone, and other zones. The core zone (minimum 2%) is for absolute protection of biodiversity and ecological processes (research and non-extractive education). The Sustainable Fisheries Zone consists of the General Sub-Zone, Traditional

Sub-Zone, and Cetacean Protection Sub-Zone. The Utilization Zone is for tourism, environmental services, research, and education. Other zones include the Local Wisdom Sub-Zone and the Tourism and Aquaculture Utilization Sub-Zone (Permen KKP RI No. 6/2014).

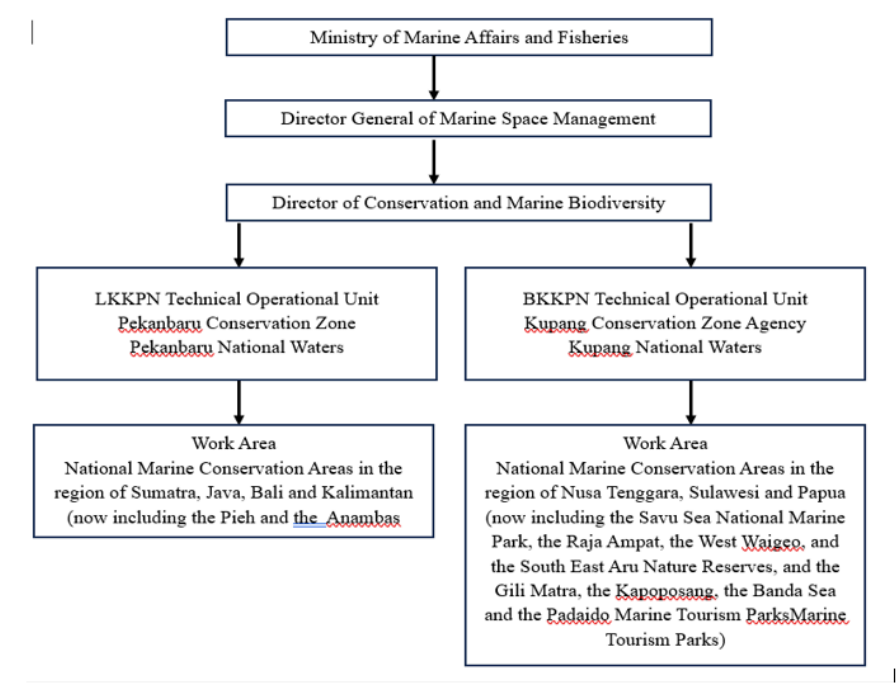


Figure 1 Organisational structure for the management of National Marine Protected Areas (KKPN)
Source: Rusandi (2020)

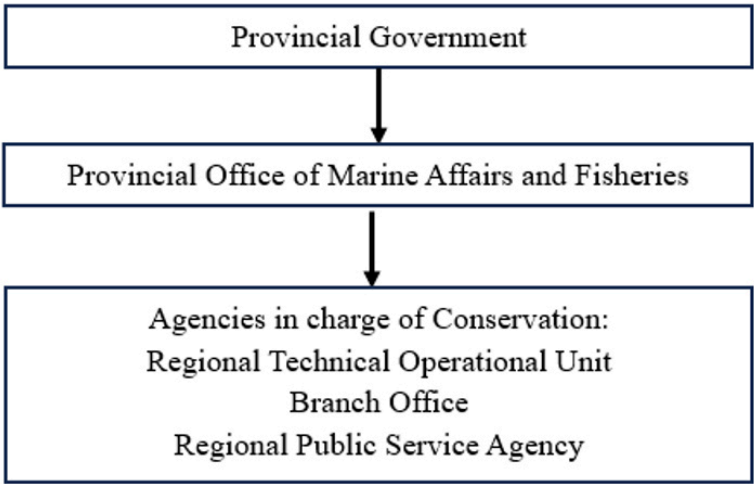


Figure: 2 Organizational structure for the management of Regional Marine Protected Areas (KKPD)
Source: Rusandi (2020)

Table 1. Status of Local Wisdom Traditions within the Sawu Sea National Marine Park

No	Regency	Local Wisdom Tradition	Status
1	Kupang	Lilifuk	Active
2	Sabu Raijua	Kowa hole	Active
3	Sabu Raijua	Panadahi	Active
4	Rote Ndao	Papadak	Active
5	Rote Ndao	Hohorok	Active
6	Manggarai	Ritual Lambagor	Active
7	West Manggarai	Nempung cama	Revitalization
8	West Manggarai	Nareng	Inactive
9	East Sumba	Mehi parotu	Inactive
10	East Sumba	Nihi parotu	Inactive
11	West Sumba	Luat	Inactive
12	West Sumba	Samba	Inactive
13	Southwest Sumba	Watuweri	Active
14	Central Sumba	Kalibuka	Inactive
15	South Central Timor	Banu	Inactive

Source: (Permen KKP RI No. 6/2014)

Regulations on zoning that explicitly accommodate local wisdom are found in the management of the Sawu Sea National Marine Park. In practice, local wisdom is placed as part of the Other Zones in the form of a Local Wisdom Sub-Zone, which is designated to protect and accommodate customary practices that have cultural value and support conservation efforts. There are 15 local wisdom traditions that have developed among the coastal village communities of the Sawu Sea National Marine Park, with active, revitalization, or needing strengthening status (Permen KKP RI No. 6/2014).

In detail, the Local Wisdom Sub-Zone includes the *Lilifuk* practice in Kuanheun Village, Kupang Regency, covering an area of 3.79 hectares, as well as *Panadahi* in Sabu Raijua Regency, which covers the villages of Bolua, Ledেকে, and Ledeeunu with an area of 764.93 hectares. The total area of the Local Wisdom Sub-Zone in the Sawu Sea National Marine Park is recorded at 768.72 hectares, or approximately 0.02% of the total area of the Sawu Sea National Marine Park.

Identification of TEK in East Nusa Tenggara Province

TEK in coastal conservation in East Nusa Tenggara reflects the cultural and ecological resilience of indigenous communities. Traditional practices regulate the sustainable use of coastal resources through norms, sanctions, and rituals, serving as effective community-based governance models that protect ecosystems and socio-ecological resilience.

'*Lilifuk*' in Kupang Regency refers to natural coastal ponds managed under a customary open-closed system to maintain fish stock sustainability. Ownership and utilisation regulations are based on customary claims and traditions such as *Lilifuk* in Kuanheun Village (Asagabaldan, 2017; Yulisti et al., 2015). Meanwhile, *Hoholok* and *Papadak* in Rote Ndao originate from natural resource management systems of the former kingdom era (Nusak), passed down across generations and now adapted within the management of the Sawu Sea National Marine Park. The implementation of these customary values is achieved through collaboration among indigenous communities,

conservation institutions, and local governments to realise sustainable and harmonious coastal governance (Muthmainnah et al., 2020; Oktavia et al., 2018).

Furthermore, *Muro* or *Badu* in Lembata is an indigenous-based marine conservation practice. This system protects coastal ecosystems, regulates sustainable resource use, and serves as an adaptive model for climate change. Over time, its implementation areas have expanded and are now supported by accurate zoning mapping involving local NGOs and modern technology (Tania et al., 2024).

Meanwhile, *Letu Ai* in East Flores Regency refers to coastal areas closed to fishing and shell-collecting during specific periods to maintain marine ecosystem balance. This tradition has been passed down for generations by the Lewomuda Village community and is governed entirely by customary law, without government or NGO intervention. Customary rules regulate prohibitions, a five-month closure period, and sanctions for violators. Thus, *Letu Ai* represents an authentic form of local wisdom for governing coastal resources through ecological and social norms, independently sustained by the community (Molan et al., 2023).

Interaction of Regulation, Traditional Knowledge, and Institutions in Marine Protected Area Management in East Nusa Tenggara

This section analyzes findings and contextual theory.

First, Marine protected area management in Indonesia follows a dual approach: top-down and bottom-up (Rusandi, 2020). The state dominates zoning and regulation (Nugroho et al., 2019), emphasizing uniformity and technical efficiency, but facing low public trust and unmet expectations on equity and fish stocks (Rodrigues et al., 2024; Kusumawati & Huang, 2015). Bottom-up approaches allow community participation in proposing and designing zones (Maestro et al., 2024), yet strategic decisions remain state-controlled, making participation largely supplementary within a centralized system.

Despite efforts to strengthen participation, stakeholder engagement, and cross-institutional coordination, strategic decision-making remains predominantly state-centered. As a result, participatory mechanisms tend to reinforce existing governance arrangements rather than

bring about substantive institutional transformation (Hafferty et al., 2025). Moreover, coordination across multiple levels of government, diverse local interests, and overlapping legal frameworks prolong the establishment of Marine Protected Areas, with the process often taking up to five years (Rusandi, 2020).

Within technocratic planning, space for participation remains. The village head, (interview, 2026) stated, *"We appreciate this activity because the community now understands their rights to utilize marine resources sustainably. This activity also strengthens our understanding of the community's duties and roles in preserving the ecosystem of the marine conservation area."* This appreciation indicates that the community values the socialization activities, even though structurally, community participation in strategic decision-making remains very limited. However, in general, the discrepancy between planning and the realization of conservation benefits contributes to the fragility of the social legitimacy of marine protected areas in the long term. This indicates that conservation effectiveness is not solely determined by policy design and ecological achievements but also by the governance capacity to manage expectations, timing, and equitable distribution of benefits throughout the conservation policy cycle (Chaigneau & Brown, 2016).

From a political ecology perspective, marine protected area policy in East Nusa Tenggara demonstrates limited recognition of local knowledge, with the state remaining dominant through regulatory centralization (Roberts, 2020). Although 15 local wisdom traditions are formally recognized (Permen KKP RI No. 6/2014), they occupy only 0.02% of the total protected area, while ecology-based zoning prevails. This reflects symbolic rather than substantive recognition, as scientific knowledge continues to be prioritized over local knowledge. Therefore, achieving equitable governance requires the redistribution of power and stronger recognition of Indigenous rights and knowledge (Blythe et al., 2021; Campos & Ramiro, 2012).

As long as the redistribution of power and substantive recognition have not been realized, community resistance is unavoidable, manifested in everyday resistance such as passive noncompliance, symbolic protest, and the strengthening of customary institutions (Scott, 1985). Therefore, conservation management needs to transform toward TEK-based co-man-

agement with equal authority sharing between the state and indigenous communities to achieve social justice and ecosystem sustainability.

Second, the zoning system of marine protected areas, as regulated by national law, normatively provides space for community participation. The division of zones based on resource potential, carrying capacity, and ecological processes reflects a comprehensive planning approach, while core zones provide an ecological foundation for conservation. This approach aligns with the social-ecological systems framework, emphasizing harmonious human–nature relationships (Biggs et al., 2021). Moreover, participatory zoning supports fair decision-making and balances ecological protection with sustainable resource use (Day et al., 2019; Horta e Costa et al., 2022). Thus, the regulatory framework provides opportunities for consultation and the inclusion of local wisdom zones.

Lessons from the long process of establishing the Sawu Sea National Marine Park reaffirm that the success of marine protected area management is strongly influenced by a collaborative approach, meaningful community involvement through public consultation, recognition of local culture in zoning arrangements, engagement of local figures and facilitators, and alignment of zoning and management plans with spatial policies from the national to district levels (Rusandi, 2020).

Through this collaborative approach, the management of the Sawu Sea has successfully identified 15 local wisdom traditions with active, revitalizing, or inactive status and has designated them as a Local Wisdom Sub-Zone within the Other Zones (Permen KKP RI No. 6/2014). Although its spatial allocation remains very limited (only 0.02% of the total area of the marine park), in principle this success confirms that the participatory space normatively available can function optimally if implemented collaboratively.

On the other hand, indigenous communities, together with an NGO from Lembata, are currently struggling for the recognition of *Muro* as a local wisdom zone. A staff member of the NGO (interview, 2026) stated, *"We, together with the indigenous community, are currently in the public consultation stage to include Muro into the local wisdom zone."* However, the main weakness of this zoning proposal system is the long waiting time and the complicated and convoluted bureaucratic procedures. As a result,

even though the regulations allow community participation, in practice the process is not carried out seriously, so local proposals are often ignored or stalled by lengthy administrative procedures.

Thus, the core challenge lies not in the absence of participatory provisions, but in their ineffective implementation due to lengthy and complex administrative procedures. Meaningful community participation is essential for ensuring equity, legitimacy, and effective conservation outcomes. The experience of the Sawu Sea Marine Protected Area demonstrates that a collaborative approach can produce more equitable and inclusive zoning. Future efforts should replicate this approach in other Marine Protected Areas by streamlining bureaucratic procedures, recognizing *Muro* in Lembata, and expanding spatial allocation for customary-based conservation zones.

Third, empirical findings regarding the integration of local wisdom into the zoning of the Sawu Sea National Marine Park indicate significant progress in Indonesian conservation policy that aligns with developments in TEK theory. TEK represents a normative knowledge system, embedded within values and collectively administered by Indigenous customary institutions, where its meaningful and equitable engagement in global discourse depends on the adoption of ethical and inclusive governance frameworks (Hill et al., 2020). The discovery of 15 local wisdom traditions with varying statuses (active, revitalization, inactive) under Permen KKP RI No. 6/2014 reflects the diversity and dynamism of local knowledge as conceptualized in TEK theory.

However, the decline of 7 out of 15 local wisdom traditions in the Sawu Sea National Marine Park actually reflects the global phenomenon of a vacuum in TEK practices, which is also experienced by many indigenous communities around the world. CBMRM practices in the Pacific Islands, for example, have experienced a similar decline due to westernization (Johannes, 2002), lack of inclusivity in decision-making, loss of opportunities to develop TEK (Trotman & Berggren, 2026), failure to integrate TEK into formal frameworks (Abikoye & Abikoye, 2025), as well as the tendency to view indigenous communities as passive actors.

Nevertheless, the process of hybridization where traditional knowledge, practices, and beliefs merge with new forms of knowledge and technology to form new knowledge systems

offers opportunities for TEK revitalization (Baggethun et al., 2013). This aligns with how indigenous communities perceive nature and supports the vision of the Convention on Biological Diversity (CBD) 2050, which is living in harmony with nature (García et al., 2022).

From a political ecology perspective, these findings highlight the importance of recognizing marginalized actors, rights, and knowledge as a prerequisite for equitable marine governance (Blythe et al., 2021). In the Indonesian context, the establishment of a local wisdom sub-zone within the Sawu Sea Marine Protected Area, although covering only **0.02%** of the total area, represents an initial step toward the formal recognition of traditional practices.

Fourth, the establishment of the three-stage participation framework (planning, implementation, and monitoring) in Permen KP RI No. 12/2024, marks a significant normative step toward the application of participatory governance in coastal conservation areas in Indonesia. This framework represents a substantial evolution toward the co-management model advocated in community-based resource management literature. This approach is crucial because it can preserve natural resource diversity, strengthen social cooperation, provide economic benefits, and promote sustainable development (Masud et al., 2022).

Normatively, the planning stage of the three coastal management models demonstrates good practice. *Papadak* in Rote Ndao involves the community from the outset through deliberation. *Lilifuk* in West Kupang is reinforced by Perdes Kuanheum No. 1/2012, which regulates prohibitions and sanctions. In contrast to both, *Letu Ai* operates organically without external intervention. On a broader scale, the Sawu Sea National Marine Park has a planning framework through a ministerial decree that mandates active participation of all stakeholders (Mujiyanto, 2018). A fisherman expressed (interview, 2026), "*The benefits are great for the community; I think socialization is needed so that everyone understands the rules and how to utilize them.*" Thus, the three models already have a good participatory planning framework.

In the implementation of marine governance, *Papadak* in Rote involves three institutional components: the customary forum (rule holder), *manaholo* (supervisor), and the community (supporter). *Lilifuk* in Kupang involves five institutional actors: customary leaders, religious leaders, village government, community

members, and outsiders. Fishing activities are permitted only during a two-day opening period preceded by customary rituals and are regulated under Perdes Kuanheum No. 1/2012 which specifies seven prohibitions and twelve sanctions (Asagabaldan, 2017; Ketti, 2021).

Letu Ai are led by the customary institution of *Lewomuda* which leads rituals, chants customary verses, enforces customary law, and performs atonement rituals, while the community obeys the five-month closure period. The Sawu Sea National Marine Park integrates customary law (*Papadak*, *Hoholok*, *Keruga*, *Lilifuk*) to regulate fishing zones, fishing gear, harvest limits, and waste management, while involving the community in mangrove restoration and sea turtle conservation.

Nevertheless, community participation faces significant challenges. Initiatives to manage local wisdom zones are often not recognized as marine protected areas (MPAs) unless proposed and designated by the government (Rusandi, 2020). This condition is further complicated by limited staff capacity, inadequate budgets, shifts in authority from district to province levels that disrupt management continuity, and difficulties in building effective partnerships with communities and other stakeholders (Jompa et al., 2023). Therefore, community awareness and active participation must be supported by cross-sectoral collaboration and advocacy mechanisms.

Fifth, theoretically, the institutional structure of the Ministry of Marine Affairs and Fisheries (KKP) in Indonesia reflects the principle of subsidiarity that supports decentralization of management to the most effective level of government through a complex multi-level governance system. KKPN is managed by Technical Implementation Units (UPT) such as BKKPN Kupang for cross-provincial areas, while KKPD within 0–12 nautical miles from the coastline falls under the authority of provincial governments, which have the flexibility to form management bodies involving academics, NGOs, and local communities, although their effectiveness heavily depends on the capacity and commitment of local governments.

In practice, the integration of formal and customary institutions shows significant variation. The *Papadak* governance system in Rote is run by three interconnected components: the customary forum as the rule holder, *manaholo* as the supervisor, and the community as the implementation supporter, and is integrated

into the management of the Sawu Sea National Marine Park (*TNP Laut Sawu*) (Ketti, 2021). More substantive integration occurs in *Lilifuk* in Kupang, where Perdes Kuanheum No. 1/2012 becomes an instrument of formal legal recognition of Traditional Ecological Knowledge (TEK), with implementation involving five elements: customary leaders, religious leaders, village government, community, and outsiders (Asagabaldan, 2017).

In contrast, *Letu Ai* in East Flores operates autonomously without a formal legal umbrella, relying on social sanctions and spiritual values. This practice is led by the Lewomuda customary institution, which leads rituals, chants customary verses, enforces customary law, and performs atonement rituals, with the community obeying the five-month closure period. The Lewomuda community (interview, 2026) stated, "*For us, even though there are no government regulations, we remain obedient because the important thing is to carry out customs and rituals. That is what makes us comply.*" This confirms that moral and cognitive legitimacy prove more effective in driving collective compliance than regulatory legitimacy (Suchman, 1995).

On a broader scale, the Sawu Sea National Marine Park integrates customary laws (*Papadak*, *Hoholok*, *Keruga*, *Lilifuk*) to regulate fishing zones, fishing gear, harvest limits, and waste management, with the community actively involved in mangrove restoration and sea turtle conservation. This reflects the central government's efforts to recognize local wisdom within a formal conservation framework, although challenges of central-local coordination persist.

Thus, marine governance in East Nusa Tenggara proves that local wisdom and formal systems can complement each other toward sustainable management. *Lilifuk* has successfully integrated custom into village regulations, *Papadak* is symbolically integrated into the Sawu Sea National Marine Park, and *Letu Ai* excels in compliance based on cultural values without formal intervention. This diversity is a strength, not a weakness, and reinforces the argument that management effectiveness does not always require a formal legal umbrella, as moral and cognitive legitimacy are often stronger in driving collective compliance. Moving forward, sustained cross-sectoral collaboration, increased capacity of local governments, and more equal recognition of customary insti-

tutions will further strengthen marine conservation and the welfare of coastal communities in East Nusa Tenggara.

Creating an Integrative Model for Marine Protected Areas

Stage 1: Recognition

The affirmation regarding regulatory recognition and institutional practice in the context of integrating TEK into marine conservation governance in Indonesia shows that the initial stage of transformation toward co-management demands normative recognition that goes beyond mere symbolism. That is, by explicitly integrating TEK into marine protected area management plan documents as a foundation for decision-making equal to scientific knowledge. However, the Indonesian case through Permen KKP RI No. 6/2014 actually shows that although 15 local wisdom traditions have been formally recognized, such recognition remains symbolic.

The diversity of TEK recognition in East Nusa Tenggara is reflected in four models: *Papadak* (symbolic recognition within the Sawu Sea Marine Park), *Lilifuk* (substantive recognition through Village Regulation No. 1/2012), *Letu Ai* (autonomous recognition based on moral and cognitive legitimacy), and the Sawu Sea Marine Park (top-down recognition integrating customary laws into formal zoning via ministerial decree). However, spatial allocation remains minimal at only 0.02%.

This finding shows that the variation in TEK recognition in East Nusa Tenggara—from symbolic, substantive, and autonomous to top-down formal recognition—highlights the need for national minimum standards in marine conservation policy. Without such standards, TEK recognition remains uneven and dependent on local initiatives and government capacity. Therefore, an integrated national framework should ensure equitable spatial allocation for local wisdom zones beyond the current 0.02%, provide substantive legal recognition through village or district regulations, and recognize customary authorities as equal partners in marine protected area governance.

Finally, strengthening moral and cognitive legitimacy as the foundation of collective compliance is needed. Thus, standardization does not mean eliminating local diversity. Standard-

ization instead establishes minimum standards that ensure that every TEK practice, wherever it is located, receives fair, equal, and meaningful recognition toward sustainable marine conservation governance.

Stage 2: Participatory Mapping

This stage aims to build a socio-ecological database rooted in the experiences and knowledge of indigenous communities. Participatory mapping does not merely document spatial boundaries but also records temporal dimensions (open–closure cycles), access norms, prohibitions, and customary sanctions. Consequently, participation serves as a critical nexus linking customary governance systems with the restoration of sovereignty while transforming maps from static documents into dynamic instruments that reflect community socio-ecological realities (Redwood et al., 2020).

Without a deep understanding of the internal logic and sustainability principles underlying these rules, conservation or development efforts risk institutional misfit, where external policies actually erode local institutions that have adapted to local ecological conditions. Therefore, participatory mapping must also be actively conducted, revitalizing dormant TEK and designing new, legally recognized local wisdom-based conservation zones.

As good practices, three coastal management models in East Nusa Tenggara have demonstrated a participatory planning framework. *Papadak* in Rote involves the community from the outset through deliberation. *Lilifuk* in Kupang is reinforced by Perdes Kuanheum No. 1/2012 which formally regulates prohibitions and sanctions. Meanwhile, the Sawu Sea National Marine Park has a planning framework through a Ministerial Decree that mandates active participation of all stakeholders (Mujianto, 2018). These three models prove that good participatory planning practices can be realized through diverse pathways, ranging from formal (*Lilifuk* and Sawu Sea MPA) to semi formal deliberation based (*Papadak*).

On the other hand, *Letu Ai* in East Flores stands as an autonomous model that operates without external intervention yet remains effective. Models like this demonstrate that untouched TEK operating independently requires special protection in planning. Therefore, collective willingness is needed from village governments, customary institutions, indigenous

communities, religious leaders, and district governments to collaborate on an equal footing. This collaboration is not intended to intervene, but rather to recognize, strengthen, and protect the sustainability of such autonomous systems without diminishing their independence.

Thus, participation is both a prerequisite and a driver for achieving equitable conservation, which is the only effective pathway to preserving biodiversity in the long term. Policies must design governance transitions to institutionalize participation and justice into a sustainable system. Without progressive transition, participation will remain merely a pilot project, and equitable conservation will be nothing more than rhetoric (Dawson et al., 2021). These findings provide the basis for the imperative to involve traditional knowledge holders in decision-making processes at local, regional, and international levels (Caldeira et al., 2025).

Stage 3: Institutional Integration

To prevent jurisdictional overlap and the marginalization of customary law, both of which are primary triggers of tenure disputes and co-management failures, institutional integration must be carried out wisely and in alignment with the local historical context (Banikoi, 2024). Therefore, a knowledge integration framework is needed that goes beyond mere information exchange to reach the level of institutional integration (Cundill et al., 2015).

At this stage, TEK should be formally embedded within the institutional structure of the Ministry of Marine Affairs and Fisheries through customary management units, enabling local norms to engage on an equal footing with state knowledge while reducing the risk of marginalization (Huynh et al., 2020). Formal recognition grants customary management legal standing and institutional support, transforming Indigenous communities into legitimate partners in conservation while enabling the adoption of customary sanctions, prohibitions, and access rules that have proven effective in sustaining marine ecosystems.

The integration of *manaholo* into the Sawu Sea National Marine Park builds a bridge between customary and state systems through official recognition. *Lilifuk* stands as an exemplary practice because Perdes Kuanheum No. 1/2012 creates an integrative harmonization of customary and state laws. The Sawu Sea National Marine Park demonstrates the central

government's serious commitment to recognizing local wisdom through a ministerial decree. *Letu Ai* offers a lesson that compliance rooted in moral legitimacy and customary rituals is stronger than formal regulation alone.

However, the success of this integration depends on the state's willingness to delegate a portion of its regulatory authority and to build a joint monitoring system based on both scientific and local evidence, thereby avoiding merely symbolic recognition. The diversity of these models becomes Indonesia's strength, reflecting policy flexibility that adapts to local contexts, while also affirming that TEK recognition can proceed through various pathways-symbolic, substantive, autonomous, and top-down toward equitable and sustainable marine conservation governance.

Stage 4: Operationalization of Co-Management

This stage is a critical turning point that transforms normative recognition into an inclusive decision-making framework based on power sharing. Therefore, marine protected area governance must move beyond symbolic consultation by including customary authorities as full decision-makers within management bodies. This shift from consultation to decision-making is the essence of substantive collaborative governance, recognizing Indigenous Peoples not only as stakeholders but also as rights holders with legitimate authority over their territories (Ban et al., 2018; Butler et al., 2019). Without such redistribution of authority, community participation remains largely symbolic and risks reinforcing existing inequalities.

To ensure sustainability, co-management must be operationalized through the integration of customary and state systems, including customary access rules, prohibitions, and sanctions into MPAs governance. This integration creates hybrid institutions that combine state legal legitimacy with community-based social legitimacy, thereby strengthening compliance and governance effectiveness (Cohen et al., 2019). As a result, co-management moves beyond formal agreements to become an operational and context-sensitive governance system (Bennett et al., 2021).

In East Nusa Tenggara, best practices in coastal management reflect diverse approaches that are adaptive to local contexts. Papadak em-

phasizes early-stage deliberation with community involvement, *Lilifuk* is formalized through Village Regulation No. 1/2012, and the Sawu Sea Marine National Park mandates stakeholder participation through a ministerial decree. Implementation structures also vary: *Papadak* involves customary forums, *Manaholo*, and the community; *Lilifuk* involves customary leaders, religious leaders, village government, community, and external actors. Meanwhile, *Letu Ai* represents an autonomous model that operates effectively without external intervention.

The paradigm shift from objects of consultation to subjects of decision-making is the essence of substantive collaborative governance, recognizing Indigenous Peoples as rights holders with legitimate authority over their territories. This recognition underpins participatory planning and collaborative implementation as foundations for justice and sustainability in marine conservation governance. Participatory planning ensures equal involvement in decision-making, while collaborative implementation fosters equitable partnerships between customary and state systems. Together, they generate dual compliance, strengthen social legitimacy, and support both ecosystem sustainability and coastal community justice.

Stage 5: Harmonization of Legal Instruments

Legal harmonization is an operational stage for building a stable and sustainable hybrid legal system that prevents conflicts arising from the application of two legal systems (customary and state) in the field by creating a legal interface where both systems engage in dialogue and negotiation to find a new form that is legitimate and acceptable to both parties (Tias et al., 2026). The effectiveness of this harmonization depends heavily on the recognition of customary sanctions as an integral part of the management system, because sanctions such as fines, temporary access bans, or restoration rituals hold deep social and moral legitimacy rooted in social relations, identity, and community cosmology (Molnár & Babai, 2021).

Harmony between customary and state rules in East Nusa Tenggara is clearly reflected in Village Regulation No. 1/2012 in Kuanheun Village, which officially recognizes and legitimizes the local wisdom of *Lilifuk* into the state legal system. Customary rules such as the prohibition on catching fish before the designated

time and the prohibition on using destructive fishing gear, as well as the protection of coral reefs and turtles, no longer rely solely on social sanctions but also have formal legal force. This harmony is further strengthened by the integration of customary sanctions, such as fines for users of trawl nets, which maintain moral legitimacy while simultaneously having legal certainty.

Village Regulation proves to be a strategic entry point for legal harmonization, with prohibitions formulated specifically and measurably to create high legal certainty, as well as customary sanctions combining cash and rice fines that simultaneously enhance legitimacy and deterrence. Bottom-up participation born from community enthusiasm allows local particularities to be maintained as long as they do not conflict with state law, thereby creating a synergy where community social control complements formal state law enforcement.

In the end, the harmony of customary and state rules through the *Lilifuk* Village Regulation not only creates dual compliance (toward both customary law and state law) but also becomes an ideal model for institutional integration that can be replicated in other coastal areas. This model proves that substantive recognition of TEK does not always have to come from top-down national policy, but can instead begin at the village level through participatory legal harmonization rooted in local wisdom.

Stage 6: Adaptive Monitoring and Evaluation

This final stage is a vital instrument for ensuring long-term sustainability through a col-

laborative and adaptive monitoring and evaluation system. This is concretely realised in the practice of collaborative monitoring, which serves as a tangible example of how state and Indigenous community knowledge are combined to build a better and more relevant assessment system (Brondizio et al., 2021). This practice is not just about data collection but also a process of building trust and mutual learning that narrows the gap between state and indigenous knowledge.

Adaptive evaluation is implemented institutionally through periodic, action-oriented, customary state deliberation forums. This forum functions as a deliberative arena where data from joint monitoring is analysed to assess management effectiveness, diagnose new problems, and decide on policy adjustments such as revising zoning boundaries, modifying harvest rules, or refining sanction mechanisms (Schultz et al., 2015).

This mechanism makes conservation governance a dynamic system capable of adapting to climate change, economic pressures, and social dynamics, thus avoiding the rigidity that often causes top-down conservation policies to fail. Thus, the pinnacle of governance transformation is achieved when it successfully establishes institutions that are not only responsive and adaptive to change but also possess the resilience and capacity to evolve in confronting the complexities of future uncertainty.

As a visual synthesis of all the arguments that have been elaborated, this figure summarizes how the six stages of transformation are interconnected to achieve equitable and sustainable conservation.

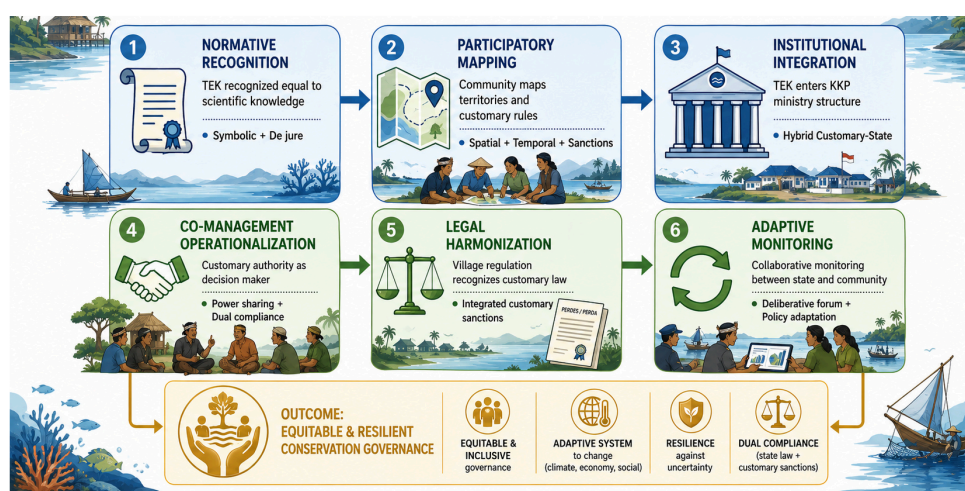


Figure 3. TEK-Based Co-Management Governance Model: Six Stages of Transformation

Source: Developed by the author

Referring to the synthesis of the six-stage transformation model above, this six-stage model yields four key points. First, normative recognition must be substantive by sharing power and space. Second, participatory mapping and institutional integration enable equal dialogue between local and state knowledge. Third, co-management operationalisation and legal harmonisation require shared authority, dual compliance, and recognition of customary sanctions. Fourth, adaptive monitoring is the key to sustainability. This model offers practical guidance for equitable, adaptive, and resilient conservation governance.

CONCLUSION

Overall, the integration of TEK, customary institutions, and customary law into marine conservation governance represents significant progress. Although the recognition of TEK remains limited, the harmonization of customary and state systems has created opportunities for more inclusive governance. With stronger customary institutions, enhanced local government capacity, and equitable national standards, this approach has the potential to serve as a national model for sustainable marine conservation governance.

This study concludes that the transformation toward co-management based on TEK requires six structured stages: normative recognition that moves beyond symbolism toward power redistribution and equitable spatial allocation; participatory mapping and institutional integration as prerequisites for equal dialogue between local and state knowledge; operationalization of co-management and legal harmonization built upon power sharing, dual compliance, and recognition of customary sanctions; and adaptive monitoring for long-term sustainability.

Theoretically, this study proposes an integrative model that synthesizes political ecology, TEK, and co-management by positioning power redistribution as a prerequisite for equitable conservation governance. The integration of TEK and co-management supports blue economy principles by strengthening community participation, local institutions, and sustainable marine resource management. Practically, collaboration between Indigenous communities and the state, supported by local regulations, provides a replicable model for strengthening marine conservation governance in coastal regions.

Nevertheless, the main limitation of this study is its treatment of indigenous peoples as a homogeneous entity that overlooks internal gender-based heterogeneity. Therefore, further research needs to critically investigate whether power redistribution in TEK-based co-management truly benefits indigenous women, or instead perpetuates male dominance in decision-making and reproduces inequality in new forms.

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