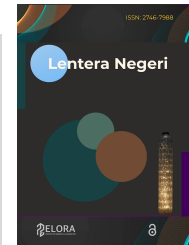




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Ecological citizenship through indigenous forest governance: operationalizing tena troikha principles

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ABSTRACT

Tena Troikha, a sacred forest of the Ormu Indigenous community in Nechebei, Papua, is proposed as a culturally grounded mechanism for forest protection. Indigenous ecological knowledge and customary institutions may contribute to local conservation, yet empirical evidence for their effectiveness and operational mechanisms remains limited. This study employed an ethnographic case study design conducted from October 2025 to March 2026, combining field observation, in-depth interviews with customary leaders 10, members of the Ormu Indigenous community 50, village officials 5, local stakeholders 5, relevant government representatives 5, and documentation review. Participants were selected using purposive and snowball sampling to ensure representation of key knowledge holders. Data were analyzed through iterative thematic coding, with triangulation across participant narratives, field notes, and documentary sources to strengthen credibility. Descriptive findings indicate that Tena Troikha is maintained through customary prohibitions, spiritual authority, and collective responsibility. Forest areas under Tena Troikha showed limited visible disturbance during field visits, and participants consistently linked ecological preservation to ancestral norms. Interpretively, these mechanisms support locally legitimate forest protection, though the study did not quantify deforestation rates or compare sacred versus non-sacred areas. Findings emphasize the role of Indigenous institutions and ecological knowledge in regulating sustainable resource use. Tena Troikha illustrates how Indigenous governance can contribute to forest conservation within culturally specific contexts. While findings are not statistically generalizable beyond the Ormu community, they highlight the potential of integrating customary authority, spiritual values, and participatory management into collaborative conservation strategies. Future research should combine qualitative insights with quantitative forest-cover monitoring to evaluate measurable ecological outcomes.



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Introduction

Forest and natural resource governance remains a central issue in environmental studies because each landscape contains distinct ecological, social, cultural, and political complexities. In many forested regions, conventional resource-management approaches have not fully addressed the degradation of ecosystems, the marginalization of local communities, and the weakening of customary institutions. This situation has encouraged scholars to reconsider Indigenous and community-based knowledge systems as alternative foundations for sustainable forest governance. In this context, traditional ecological knowledge is

increasingly recognized as a knowledge system that emerges from long-term interaction between communities, culture, and the natural environment, and it plays an important role in maintaining ecological continuity and human well-being (Berkes et al., 2000; Ibrahim, 2023; Molnár & Babai, 2021; Turner et al., 2022).

Indigenous communities are not only users of forest resources, but also custodians of cultural values, customary law, and ecological practices that regulate relationships between humans and nature. Previous studies have shown that traditional ecological knowledge enables communities to classify natural objects, regulate resource use, restore damaged ecosystems, and maintain social-ecological resilience (Agrawal, 2003; Allison, 2023; Manningtyas & Furuya, 2022; Zank et al., 2022). Customary forest governance also relies on social capital, local institutions, collective responsibility, and shared moral values that support environmental sustainability across generations (Aisharya et al., 2022; Brondizio et al., 2009; Yoshida et al., 2022). Therefore, returning forest management to locally grounded knowledge and customary institutions provides a promising pathway for conservation, particularly in areas where Indigenous communities still maintain strong cultural and spiritual ties to their territories (Asteria et al., 2024; Blesia et al., 2023; Hinz, 2022; Palar et al., 2018; Rai & Mishra, 2022).

Papua is one of Indonesia's most important forest regions, with forests that function not only as ecological systems but also as living spaces, sources of identity, and ancestral domains for Indigenous communities. For Papuan Indigenous peoples, forests are commonly understood as spaces that contain ecological, social, cultural, and spiritual meanings. The forest is not merely an economic asset, but a source of life, a symbol of ancestral continuity, and a foundation for communal existence (Marthen et al., 2024; Sumiati et al., 2025). However, forest sustainability in Papua is increasingly challenged by plantation expansion, infrastructure development, resource extraction, changes in land control, and the weakening of customary authority

The main research problem addressed in this study is how the Ormu Indigenous community in Nechebei Village maintains the existence and function of Tena Troikha as a sacred customary forest, and how this concept can contribute to the prevention of deforestation. The problem is significant because deforestation is commonly associated with permanent changes in forest cover caused by land conversion, agricultural expansion, plantation development, mining, infrastructure construction, and settlement growth (Durahman, 2024). A general solution to this problem is to strengthen Indigenous-based forest governance by recognizing customary land rights, revitalizing local ecological knowledge, empowering customary institutions, and integrating customary forest protection into collaborative conservation policy (Farina et al., 2024; Peluso, 1995; Siahaya et al., 2016). This can be achieved by establishing co-management arrangements between Indigenous communities, local governments, conservation agencies, and other stakeholders; integrating customary prohibitions and spatial classifications into regional land-use planning; providing legal protection against external land conversion, logging, and extractive activities; and creating community-based monitoring systems that combine customary surveillance with scientific tools such as forest-cover mapping, violation records, and ecological assessment.

Scientific literature indicates that community-based forest management can become an effective conservation strategy when local communities are recognized as legitimate actors in natural resource governance. Customary systems often contain rules regarding access, restriction, sanctions, spatial zoning, and intergenerational responsibility. These rules can support forest protection because they are socially accepted, culturally embedded, and morally binding within the community (Brondizio et al., 2009). In this regard, Indigenous forest governance should not be treated as an informal or secondary system, but as a living legal and ecological system that contributes to conservation and sustainable development (Haar, 2024)

The scientific literature also supports collaborative management as a solution for conservation areas where formal state governance intersects with Indigenous territories. In the Cycloop Mountains Nature Reserve, collaborative management is relevant because Indigenous communities possess local knowledge, customary institutions, territorial claims, and ecological experience that can strengthen formal conservation efforts (Marthen et al., 2024). This case study illustrates how incorporating Indigenous governance into protected-area management not only enhances the effectiveness of forest protection but also provides a practical model for integrating culturally grounded practices into broader conservation strategies. By examining Tena Troikha within this reserve, the study demonstrates the mechanisms through which customary authority and ecological knowledge can be formally recognized, thereby bridging local stewardship with state-led conservation initiatives. Legal and policy recognition of Indigenous peoples is also essential because marginalization of customary communities may increase forest vulnerability, while recognition of customary rights can improve conservation outcomes and reduce deforestation risks (Farina et al., 2024; Peluso, 1995).

Nevertheless, existing studies have not sufficiently examined the specific concept of Tena Troikha among the Ormu Indigenous community in Nechebei Village. Although research on Papua has discussed Indigenous forest relations, customary land rights, and conservation challenges in the Cycloop Mountains, limited attention has been given to how the Ormu people classify forest areas, protect sacred forest zones, and use customary prohibitions to prevent deforestation. This creates a research gap concerning the local mechanisms through which sacred forest concepts operate as practical conservation systems within Indigenous territories.

Another gap concerns the potential of Tena Troikha as a model for collaborative forest management in Papua. Previous studies have discussed community-based conservation, customary law, and Indigenous participation in forest governance, yet there remains limited analysis of how a specific Papuan customary concept can be developed as a co-management framework between Indigenous communities, conservation institutions, and local government. Therefore, this study addresses the need to analyse Tena Troikha not only as local wisdom, but also as a culturally grounded conservation model for preventing deforestation.

This study aims to examine in depth how the Ormu Indigenous community in Nechebei Village maintains the function and existence of Tena Troikha from the time of their ancestors to the present and future. It also aims to analyse the factors that may become challenges and threats to the sustainability of Tena Troikha, and to compare the concept as a potential collaborative forest-management model for other Indigenous communities in Papua in preventing deforestation.

The novelty of this study lies in its focus on Tena Troikha as a specific form of Papuan local wisdom that integrates ecological function, sacred value, customary law, and collective responsibility. Unlike studies that discuss Indigenous forest governance in general, this research positions Tena Troikha as a customary conservation institution that protects highland forests, water sources, biodiversity, and ancestral spaces through community-based restrictions and spiritual legitimacy.

The scope of the study is limited to the Ormu Indigenous community in Nechebei, Ravenirara District, Jayapura Regency, Papua Province. The study covers customary forest management, Indigenous land rights, traditional ecological knowledge, customary institutions, local rules for forest protection, threats to the sustainability of Tena Troikha, and the possibility of developing this concept as a collaborative forest-management model for deforestation prevention in Papua.

Method

This study employed a qualitative descriptive–analytical approach to examine the role of the Ormu Indigenous community in managing and protecting customary forests through the concept of Tena Troikha. This approach was selected because the research focused on understanding the meanings, values, norms, customary institutions, and ecological practices that shape the relationship between the Ormu people and their forest environment. The qualitative design enabled the study to interpret forest management not merely as an ecological activity, but also as a social, cultural, spiritual, and customary legal practice embedded in community life. The research was conducted in the Ormu Indigenous community, Ravenirara District, Jayapura Regency, Papua Province, from October 2025 to March 2026. To improve procedural transparency and replicability, the study was organized into three interrelated phases: instrument development and validation, field-based data collection, and thematic analysis with trustworthiness checks. The relationship between data sources, data-collection methods, and analytical phases is summarized in Figure 1.

Furthermore, informants were selected through purposive sampling because the study required participants who possessed direct knowledge and experience of customary forest governance, indigenous land rights, local ecological knowledge, customary sanctions, and deforestation prevention. The informant categories comprised customary leaders 10, members of the Ormu Indigenous community 50, village officials 5, local stakeholders 5, and relevant government representatives 5. The total number of informants was 75. These categories were included to capture both emic perspectives from customary actors and institutional perspectives from government and village-level stakeholders.

The sample size was justified by information richness and thematic saturation rather than statistical representativeness. Saturation was operationalized as the point at which at least two consecutive interviews or focus group discussions produced no new codes, themes, or contradictory explanations related to forest classification, customary norms, ecological values, customary sanctions, threats to forest sustainability, and Tena Troikha governance. A saturation log was maintained after each data-collection round to record newly emerging codes, repeated themes, and the decision to continue or stop recruitment.

Table 1. Informant categories, sample-size reporting, and data-collection methods.

Informant category	Sampling rationale	Number of informants	Main collection method(s)
Customary leaders	Authority over customary norms, forest classification, and sanctions	10	In-depth interviews; member checking
Ormu Indigenous community members	Daily experience of forest use, protection practices, and local ecological knowledge	50	FGDs; interviews; observation
Village officials	Village-level governance and coordination with customary institutions	5	Interviews; documentation
Local stakeholders	Knowledge of local development pressures, land-use change, and conservation initiatives	5	Interviews; FGDs
Government representatives	Formal policy, regulation, and institutional perspectives on indigenous forest protection	5	Interviews; documentation

The data used in this study consisted of primary and secondary data. Primary data were obtained through field observation, in-depth interviews, focus group discussions, and documentation of local practices. Secondary data were obtained from legal documents, policy documents, customary archives, institutional reports, and previous studies relevant to indigenous forest management, environmental conservation, and indigenous rights. The combination of primary and secondary data provided contextual evidence for interpreting customary practices in relation to formal conservation policies.

Field observation was used to examine the physical condition of customary forest areas, land-use patterns, forest-protection practices, and community activities in areas associated with Tena Troikha as a sacred and protected forest zone. In-depth interviews were conducted to explore individual perspectives on forest classification, customary rules, ecological values, sanctions, and threats to forest sustainability. Focus group discussions were used to clarify collective understandings, compare perspectives across informant groups, and validate emerging interpretations. Documentation studies were used to corroborate interview and observation findings with written records, policy materials, and institutional reports.

The observation checklist, interview guide, and focus group discussion guide were developed from the research objectives and reviewed before fieldwork for clarity, cultural appropriateness, and alignment with the study constructs. Instrument validation was conducted through expert review by 3 and consultation with 3. The instruments were revised based on comments concerning wording, cultural sensitivity, sequence of questions, and the ability of the questions to elicit information on customary forest governance.

Data analysis was conducted iteratively throughout the fieldwork period. Interview and focus group data were transcribed, field notes were organized chronologically, and documents were indexed according to source type and relevance to the research questions. The analysis followed six steps: familiarization with the data, open coding, development of an initial codebook, thematic classification, data display through matrices, and conclusion drawing. Codes were grouped into thematic categories related to customary forest classification, sacred forest protection, customary norms, sanctions, ecological values, institutional roles, and threats to sustainability.

No inferential statistical analysis was applied because the study aimed to interpret meanings, identify patterns, and explain customary governance practices rather than measure statistical relationships. The analytical emphasis was therefore placed on depth of interpretation, consistency of evidence across sources, and transparent documentation of coding and theme development.

The trustworthiness of the findings was established through credibility, transferability, dependability, and confirmability strategies. Credibility was strengthened through source triangulation across customary leaders, customary institution leaders, community members, village officials, local stakeholders, and government representatives, as well as method triangulation across observation, interviews, focus group discussions, and documentation. Preliminary themes were returned to 50 for member checking to confirm whether the interpretations accurately reflected community meanings and customary practices.

Transferability was supported by providing thick description of the study site, the role of Tena Troikha, informant characteristics, and the sociocultural context of customary forest governance. Dependability was supported through an audit trail consisting of the data-collection protocol, interview and focus group guides, observation notes, transcript records, coding memos, codebook revisions, and saturation logs. Confirmability was supported through reflexive memos and documentation of analytical decisions, allowing the interpretations to be traced back to the empirical data rather than researcher assumptions.

Figure 1 presents the visual research design, showing how the study linked informant categories and documentary sources to data-collection methods, analytical procedures, and trustworthiness checks.

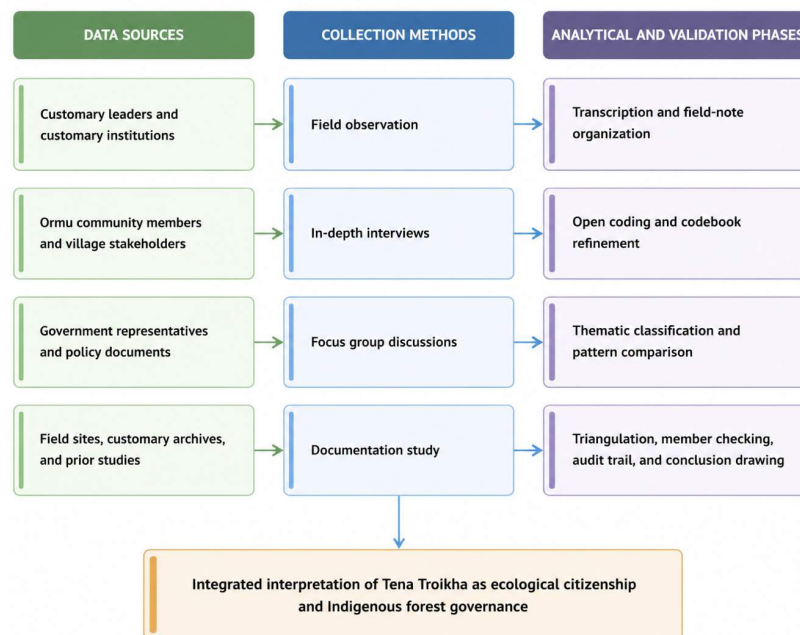


Figure 1. Research design flowchart linking data sources, collection methods, analytical phases, and trustworthiness procedures.

Results and Discussions

Tena Troikha as a sacred forest and conservation space

Field observations and participant accounts consistently identified Tena Troikha as a sacred customary forest rather than an ordinary resource area. Customary leaders described the forest as an ancestral space associated with spiritual authority, while community participants stated that it should not be opened for gardens, timber extraction, hunting, or settlement. Participants also reported that violations are understood to bring customary, social, ecological, or spiritual consequences, including social sanction, disturbance to community life, loss of water sources, crop failure, landslides, or drought. These statements constitute descriptive results from interviews and focus group discussions; by themselves, they do not establish a quantified causal effect on deforestation.

Field visits to accessible boundary areas and surrounding landscapes recorded dense vegetation, large trees, springs, waterfalls, and limited visible disturbance in areas identified by participants as related to Tena Troikha. Participants repeatedly linked these physical conditions to customary prohibitions and restricted access. Documentary materials and village-level information confirmed the presence of customary governance and conservation-oriented local recognition. However, the dataset did not contain satellite imagery, forest-cover time-series data, quantified violation records, or a comparative baseline between sacred and non-sacred forest areas. Consequently, the conservation claim is treated as a triangulated qualitative inference rather than a measured deforestation outcome.

Interpretively, the evidence suggests that the sacred status of Tena Troikha supports forest protection through three interrelated pathways: spatial separation between usable and prohibited areas, moral compliance grounded in ancestral authority, and social control through customary institutions. This

interpretation is consistent with studies showing that customary law and traditional ecological knowledge can support conservation when rules are culturally legitimate and practiced by local communities (Asteria et al., 2024; Hinz, 2022; Rai & Mishra, 2022). The evidence is strongest as an explanation of local governance mechanisms; therefore, this study refers to Tena Troikha as contributing to forest-protection and deforestation-prevention practices rather than as the sole or statistically demonstrated cause of deforestation prevention.

Table 2. Qualitative triangulation matrix separating raw findings from interpretation

Evidence source	Raw finding	Analytic contribution	Evidence boundary
Field observation	Dense vegetation, large trees, springs, waterfalls, and limited visible disturbance were recorded in accessible areas associated with Tena Troikha.	Supports the descriptive claim that the visited sacred forest areas showed low visible disturbance during fieldwork.	Does not quantify forest-cover change or compare sacred and non-sacred areas.
Participant narratives	Customary leaders and community members stated that Tena Troikha is sacred and that logging, hunting, land clearing, and settlement are restricted.	Explains the perceived compliance mechanism linking sacred status to avoidance of extractive activities.	Represents reported experience and belief, not independent measurement of deforestation rates.
Customary-governance information	Participants described customary authority, sanctions, ancestral obligation, and social consequences for violating forest rules.	Identifies local enforcement mechanisms that make conservation rules socially legitimate.	Formal violation records were not available in quantified form.
Documentation and local recognition	Documentary materials supported the existence of customary governance and local conservation-oriented recognition.	Provides contextual support for the institutional setting in which Tena Troikha is maintained.	Documentation does not substitute for spatial forest-cover analysis.
Triangulated conclusion	Observation, narratives, and customary-governance information converged around restricted access and low reported disturbance.	Supports a qualitative conclusion that sacred status contributes to forest-protection practices.	Future research should test the magnitude of this contribution using satellite imagery, forest-cover data, and longitudinal violation records.

Furthermore, the descriptive findings indicate that Tena Troikha is maintained through the convergence of sacred meaning, customary prohibition, and ancestral authority. The strongest contribution of this study is therefore an explanation of how an Indigenous sacred-forest institution creates locally legitimate restrictions on extraction and land conversion. The revised analysis does not claim that Tena Troikha alone has measurably prevented deforestation across the wider Cycloop landscape; rather, it shows that participants and field observations identify Tena Troikha as a protected customary zone in which forest disturbance is normatively restricted.

The ecological relevance of Tena Troikha is supported by field observations of highland forest, water sources, and relatively intact vegetation in the visited areas. These observations are important because the Cycloop landscape provides hydrological, ecological, and cultural functions for settlements below. Nevertheless, their interpretation must remain proportional to the evidence: they indicate local forest

condition at the time of fieldwork and support the plausibility of a protective customary mechanism, but they do not replace spatial analysis of forest-cover change. This evidence-calibrated interpretation strengthens, rather than weakens, the methodological transparency of the study.

These findings are consistent with wider literature showing that Indigenous environmental governance is often holistic and links forests, rivers, mountains, settlements, coastal areas, and sacred sites within a single moral and spatial order. In the Tepera community, for example, highland areas, rivers, springs, waterfalls, old settlements, coastal areas, and sacred places are classified according to ecological and cultural functions. Prohibitions against cutting trees in mountain areas, opening gardens near rivers, building houses near water sources, throwing waste into rivers or the sea, and disturbing sacred sites illustrate how customary regulation can integrate ecological and cultural rationales (Andriamarivololona & Jones, 2012; Maru et al., 2020; Nyangila, 2012; Onrizal & Mansor, 2020).

In the Ormu context, the Cycloop Mountains are perceived as ancestral land, sacred inheritance, a source of life, and a mother who provides sustenance. This worldview creates a moral responsibility to protect the forest from destructive use. Forest protection is therefore not only a technical land-management practice, but also a moral and spiritual obligation. This helps explain why unwritten customary rules may remain influential across generations even without written enforcement mechanisms.

The interpretation also corresponds with Brondizio et al., (2009) who emphasize the importance of social capital in governing social–ecological systems. Trust, shared values, kinship, customary authority, and collective responsibility enable community members to recognize restrictions as legitimate. The findings also support Blesia et al., (2023) who highlight the role of Indigenous institutions in managing community relations and protecting local interests. In this study, customary institutions function as local governance mechanisms that regulate access, reinforce restrictions, and support ecological balance, although the magnitude of ecological outcomes remains a task for future quantitative assessment.

Forest Use, Livelihoods, and Controlled Resource Extraction

The descriptive results indicate that forest use among the Ormu community remains closely linked to subsistence needs. Community members reported using forest areas to obtain vegetables, tubers, medicinal plants, fruits, materials for houses and boats, hunting tools, firewood, and customary decorations. Animal resources such as wild pigs, ground rats, maleo birds, bats, monitor lizards, and tree cuscus were also described as sources of protein. Participants stated that these activities are generally conducted in limited quantities for household consumption or small-scale sale to meet basic needs.

Participants distinguished between forest areas that may be used under customary regulation and areas such as Tena Troikha that must remain largely untouched. Wana, or former garden forest, was described as receiving greater use because it provides many resources, but it also forms part of a regenerative land-use cycle when gardens are abandoned and allowed to recover. This is a descriptive finding about livelihood practice and spatial differentiation, not a direct measurement of ecological recovery.

Interpretively, this pattern suggests a sufficiency-oriented form of resource use in which livelihood needs are balanced by customary norms and spatial restrictions. The finding supports Palar et al., (2018) who argue that traditional knowledge and cultural expressions can contribute to the protection of genetic resources and sustainable resource use. It is also consistent with Aisharya et al., (2022) who highlight the importance of interaction among local actors in community-based forest management. In the Ormu context, forest use is embedded in a system that combines livelihood needs, ecological restraint, and customary authority.

The evidence indicates that Tena Troikha contributes to deforestation-prevention practices by establishing a strict customary boundary between usable forest areas and sacred areas where extractive activities are prohibited. This boundary is physical, cultural, and spiritual. However, the claim is bounded by the qualitative design of the study: the data show how community members understand and practice restriction, but they do not quantify how much deforestation has been avoided.

The proposed protective mechanism is therefore interpreted as follows. First, the sacred status of Tena Troikha discourages destructive human activity. Second, customary norms regulate where people may farm, hunt, gather, or build settlements. Third, belief in ecological and spiritual consequences strengthens compliance with forest-protection rules. These mechanisms show how Indigenous forest protection can operate through shared belief, social control, and customary legitimacy, while also indicating the need for future spatial analysis to measure forest-cover outcomes.

This finding is relevant to wider discussions on deforestation in Papua. Previous studies indicate that deforestation in Papua is driven by plantation expansion, infrastructure development, resource exploitation,

and changes in land control systems. The expansion of oil palm plantations is a significant driver of deforestation in Papua. Many plantations are established in intact, biodiversity-rich forests, often disregarding indigenous land rights and sustainable development goals (Andrianto et al., 2019; Austin et al., 2017; Obidzinski et al., 2012; Runtuboi et al., 2020). Infrastructure projects, such as the Trans-Papua Highway, have facilitated deforestation by increasing accessibility to remote forests. These roads enable illegal logging, hunting, and resource extraction, while also altering indigenous livelihoods and land use patterns (Gaveau et al., 2021; Pattiselanno & Krockenberger, 2021; Sari & Rahman, 2021).

Poorly planned road development has been linked to environmental degradation and biodiversity loss (Pattiselanno & Krockenberger, 2021; Sari & Rahman, 2021). Against this broader context, the Ormu case suggests that areas under strong customary control may be more resistant to ecological disturbance, although this study cannot quantify that resistance. This interpretation supports Peluso, (1995) argument that the marginalization of Indigenous communities in forest governance can increase forest vulnerability, whereas recognition of Indigenous territorial control can strengthen forest protection. Marginalized Indigenous communities often face inequitable resource governance, elite capture of local forest management institutions, and exclusion of disadvantaged groups, which can lead to unsustainable practices and ecosystem vulnerability (Chomba et al., 2015; McDougall et al., 2013).

The Ormu concept of Tena Troikha has similarities with other indigenous conservation practices in Papua and Indonesia. For example, the Arfak community in the Arfak Mountains recognizes the principle of *igya ser hanjop*, which means standing to guard boundaries and reflects a normative system for protecting ecological and social life. The concept of *igya ser hanjop* is central to the Arfak people's approach to land management. It regulates agricultural practices by designating appropriate areas for farming while ensuring environmental sustainability and food security for families. This traditional ecological knowledge has been passed down through generations and remains integral to the community's farming practices (Krisnawati & Raya, 2025). Similarly, the Tepera community classifies highlands, rivers, settlements, coastal areas, and sacred places into zones with specific rules of use and prohibition. These examples show that indigenous communities often possess their own spatial planning systems that regulate ecological boundaries long before the introduction of formal conservation frameworks.

The main strength of Tena Troikha lies in its integration of ecological, spiritual, and customary dimensions. Unlike conservation systems that rely primarily on state enforcement, Tena Troikha is maintained through internal community belief and inherited customary authority. This gives the concept strong cultural legitimacy. The sacred character of the area provides an ethical foundation for conservation because forest protection is understood as respect for ancestors, protection of life sources, and responsibility toward future generations. The analysis should therefore be understood as a governance explanation rather than a quantified evaluation of forest-cover change.

This finding supports Marthen et al., (2024) who emphasize the need for collaborative management in the Cycloop Mountains Nature Reserve. Tena Troikha can serve as a basis for co-management between Indigenous communities, conservation authorities, and local government, especially if formal conservation policy recognizes and strengthens customary forest protection rather than replacing it with external management systems. Such collaboration should also incorporate spatial monitoring, participatory mapping, and transparent records of forest violations so that future studies can evaluate conservation outcomes more directly.

Table 3 shows that forest use among the Ormu community is closely linked to subsistence needs and controlled resource extraction. Forest resources are used to support daily life, including food, medicinal plants, building materials, firewood, and customary materials, but these uses are generally described as limited to household consumption and small-scale needs. This indicates that the Ormu community does not treat the forest primarily as a commercial commodity, but as a living resource that must be used carefully and responsibly. The role of Wana is particularly important because it functions as a former garden forest that continues to provide useful resources while also undergoing natural regeneration. The descriptive and interpretive findings on forest use, livelihoods, and controlled resource extraction are summarized in Table 3.

Table 3. Forest use, livelihoods, and controlled resource extraction.

Aspect	Findings/evidence	Interpretive implication
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Subsistence-based forest use	The Ormu community uses forest resources mainly for daily needs, including vegetables, tubers, medicinal plants, fruits, house and boat materials, hunting tools, firewood, customary decorations, and animal protein.	Forest use is oriented toward survival and household needs rather than commercial accumulation.
Controlled resource extraction	Resource extraction is generally limited in quantity and conducted for household consumption or small-scale sale.	This pattern reduces excessive pressure on forest ecosystems.
Role of <i>Wana</i>	<i>Wana</i> , or former garden forest, receives greater use because it provides many resources, but it remains part of a regenerative land-use system.	Shifting cultivation and forest recovery can coexist when regulated by customary norms.
Customary regulation	Forest use is governed by customary authority, spatial restrictions, and community rules that determine where farming, hunting, gathering, and settlement may occur.	Customary governance helps balance livelihood needs with ecological protection.
Function of <i>Tena Troikha</i>	<i>Tena Troikha</i> establishes a strict customary boundary between usable forest areas and sacred areas where access and extraction are restricted.	Its sacred status is associated with restricted access and low reported disturbance, but the magnitude of avoided deforestation was not quantified.
Conservation mechanism	Participants attributed avoidance of land clearing and extraction to spiritual belief, customary prohibition, social control, and fear of ecological or spiritual consequences.	Qualitative evidence supports a plausible protective mechanism; satellite imagery, forest-cover data, and longitudinal violation records are needed to measure conservation outcomes.
Cultural legitimacy	<i>Tena Troikha</i> is protected through ancestral authority, spiritual meaning, and collective community belief.	Conservation gains strong legitimacy because it is embedded in local values and inherited traditions.
Comparison with other Indigenous systems	The Ormu and Tepera communities both classify ecological spaces such as forests, rivers, settlements, coastal areas, and sacred sites according to rules of use and prohibition.	Indigenous communities possess spatial planning systems that predate formal conservation frameworks.
Co-management potential	<i>Tena Troikha</i> can support collaboration between Indigenous communities, conservation authorities, and local government.	Formal conservation policy should recognize customary protection systems and combine them with participatory mapping and spatial monitoring.

The table also clarifies the evidence boundary for claims about *Tena Troikha*. The data support the conclusion that *Tena Troikha* is a sacred conservation zone associated with restricted access, customary prohibition, and low reported disturbance. The data do not support a quantified claim about the amount of deforestation prevented. Thus, *Tena Troikha* is best interpreted as a culturally grounded protective mechanism that can contribute to forest conservation, particularly when combined with legal recognition, participatory mapping, spatial monitoring, and collaborative management.

Challenges to the Sustainability of *Tena Troikha*

Although *Tena Troikha* remains a strong customary conservation concept, the study also indicates that its sustainability may face several challenges. Social change, population growth, economic needs, external land-use pressure, weak recognition of customary authority, and modernization may gradually reduce community compliance with traditional forest rules. The document notes that the concept of *Tena Troikha* may become degraded over time due to changing human needs and civilizational development.

Another challenge concerns the interaction between customary governance and formal state regulation. Although Ormu Indigenous community has been recognized as a customary village and has received



attention through conservation programs, customary systems still require stronger legal and institutional support. Without formal recognition and policy integration, customary protection may remain vulnerable to external intervention, land-use conflict, or development projects that do not fully consider indigenous rights.

These challenges reflect broader problems in Indonesian forest governance, where customary forest management is often undervalued in comparison to state-led or market-oriented approaches. Farina et al., (2024) and Durahman, (2024) emphasize that recognition and legal protection of customary forests are crucial for realizing indigenous rights and controlling deforestation. Therefore, the sustainability of Tena Troikha depends not only on internal community commitment but also on the extent to which government policy recognizes customary authority and integrates it into environmental governance.

The findings suggest that Tena Troikha has important implications for indigenous-based forest governance and deforestation prevention. First, the concept demonstrates that customary ecological knowledge can function as an effective conservation mechanism. Second, it shows that sacred forest areas can protect biodiversity, water sources, and ecological stability. Third, it confirms that customary institutions and local norms can regulate forest use in ways that are socially legitimate and environmentally sustainable. This concept is illustrated in the following figure 2.

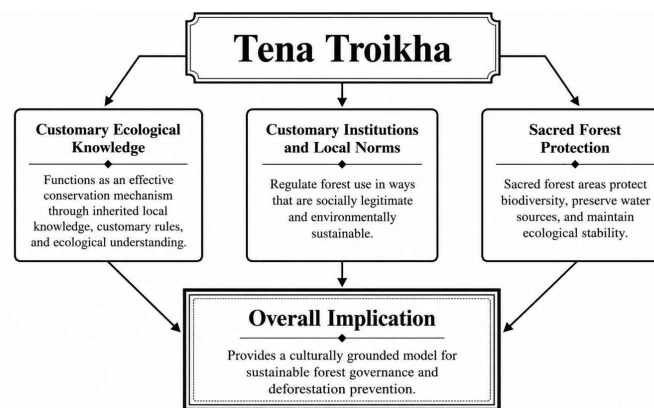


Figure 2. Implications of tena troikha for indigenous-based forest governance and deforestation prevention

The findings also indicate that Tena Troikha may be developed as a model for collaborative forest management in other indigenous communities in Papua. However, such development should not reduce Tena Troikha to a technical conservation instrument. Its cultural, spiritual, and customary meanings must remain central. Any policy adoption should be based on respect for indigenous knowledge, protection of customary land rights, and participation of customary institutions in decision-making. Indigenous knowledge systems, which include spiritual and cultural practices, are essential for sustainable resource management and community well-being. These systems are holistic, adaptive, and deeply rooted in the relationship between people and their environment (Mistry et al., 2020; von der Porten et al., 2016; Withanage et al., 2024).

Ormu Indigenous community possesses a sophisticated system of forest classification, utilization, and protection. The concept of Tena Troikha represents a form of ecological citizenship rooted in Papuan local wisdom, where forest protection is practiced through customary responsibility, spiritual belief, and collective obligation. The integration of customary knowledge, community participation, and formal conservation policy can strengthen efforts to prevent deforestation in the Cycloop Mountains and provide a culturally grounded model for sustainable forest governance in Papua.

Conclusions

Tena Troikha represents a culturally and ecologically significant customary forest-protection system among the Ormu Indigenous community in Nechebei, Papua. This study demonstrates that Tena Troikha functions as a sacred ancestral landscape where ecological, spiritual, and customary practices converge to guide local forest management. Descriptive and interpretive findings show that community norms, spiritual beliefs, and ancestral authority restrict logging, hunting, and land clearing within Tena Troikha, contributing to the maintenance of local forest cover, water sources, biodiversity, and ecological stability. These findings,

however, are based on a single-case ethnographic study and rely on qualitative participant narratives, field observations, and document analysis; no satellite imagery, longitudinal forest-cover data, or comparative baseline analysis were employed to quantify deforestation outcomes. The study's methodological boundaries constrain generalizability. Findings reflect the practices and perspectives of the Ormu community and may not automatically extend to other Indigenous groups or ecological contexts. Factors such as community cohesion, customary authority, environmental conditions, and exposure to external pressures can influence the effectiveness of sacred-forest governance elsewhere. Therefore, the Tena Troikha model should be viewed as a context-specific example of Indigenous ecological citizenship rather than a universally transferrable solution. Future studies could strengthen external validity by incorporating multiple case sites, systematic forest-cover monitoring, and comparative analysis across communities. Despite these limitations, the study highlights the potential of Indigenous knowledge systems and customary governance in supporting locally legitimate forest protection. Integrating customary authority with formal conservation policy and collaborative management between Indigenous communities, government institutions, and conservation actors may enhance both the sustainability of Tena Troikha and its applicability as a culturally grounded reference for forest governance in Papua.

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