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Exploring the role of ritual communication in forest Conservation: A case study of the Pa'totiboyongan ritual among the Mappurondo community

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Abstract

This research aims to examine the role of traditional communication of the Mappurondo indigenous community in Mamasa Regency, West Sulawesi in forest conservation. For the Mappurondo, forests have deep spiritual and cultural significance, not only as a natural resource, but as an important part of their identity. With increasing pressure on forests due to land expansion and other activities, customary-based environmental communication becomes very relevant to preserve. This research uses a qualitative method with etnography communication approach. Data were obtained through in-depth interviews, observation and analysis of documentation related to Mappurondo traditional rituals. The research results show that traditional communication carried out through traditional rituals such as Pa'totiboyang and Andian plays an important role in conveying the message of forest conservation. The Pa'totiboyang ritual, for example, contains a message to maintain harmony with nature as a source of life, while Andian emphasizes the importance of renewing commitment to the environment through offerings to ancestors. Through these rituals, the values of environmental conservation are conveyed to the community and passed on to the younger generation. The role of traditional leaders is very central in conveying these messages because they are considered to have strong spiritual authority. Traditional leaders act as enforcers of customary rules that prevent forest destruction and strengthen community awareness of the importance of preserving nature. This research concludes that traditional communication through traditional rituals and the authority of traditional leaders is effective in preserving forests in Mamasa.

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Introduction

Forests play a crucial role in maintaining environmental balance and supporting life on Earth. Beyond being vast expanses of trees, forests are complex ecosystems that function as the "lungs of the world" by absorbing carbon dioxide and releasing oxygen (Brockerhoff et al., 2017). According to Global Forest Watch, ongoing deforestation leads to significant carbon emissions, escalates global warming, and accelerates climate change (Olman & Schneider, 2024). Tropical forests in Indonesia, including those in West Sulawesi, are among the world's most biodiverse ecosystems and serve as critical carbon sinks that mitigate climate change impacts (Asgaf et al., 2023). However, deforestation in Sulawesi, driven by agricultural expansion, mining, and illegal logging, threatens these vital ecosystems, with rates reaching approximately 27,000 hectares per year (Kementerian Lingkungan Hidup dan Kehutanan, 2022)

In Mamasa Regency, the situation is particularly concerning. Economic pressures are increasingly shifting forest use from traditional subsistence activities toward commercial exploitation. Indigenous communities, such as the Mappurondo, rely heavily on forests not only for economic sustenance but also for preserving their cultural and spiritual identity (Kamakaula et al., 2024). Loss of forest resources impacts them profoundly, disrupting traditional ways of life, increasing social vulnerability, and elevating risks of environmental disasters such as floods and landslides (Bang, 2024).

Amid these challenges, understanding indigenous approaches to environmental stewardship becomes essential. Indigenous knowledge systems offer longstanding models for sustainable forest management (Datta et al., 2024; Yanou et al., 2023). Among these, the Mappurondo community in Mamasa employs rich traditional communication practices, deeply rooted in ritual and cultural symbolism, to promote forest conservation.

Previous studies have recognized the potential of traditional and ritual-based communication in fostering environmental awareness (Milstein et al., 2017). However, most research has focused on formal environmental communication frameworks, often overlooking the critical role of indigenous ritual communication and the authority of traditional leaders in sustaining conservation practices. Specifically, there is a lack of empirical studies examining how ritual communication in communities like the Mappurondo serves as a mechanism for transmitting ecological values across generations.

This research aims to address that gap by investigating how the traditional communication practices of the Mappurondo Indigenous People—especially through rituals such as *Pa'totiboyang*—contribute to forest conservation in Mamasa, West Sulawesi. Through an ethnographic communication approach, this study explores the ways rituals, symbols, and the authority of traditional leaders function as ecological communication strategies that strengthen environmental stewardship within the community.

Research Questions

1. How does ritual communication among the Mappurondo community convey messages about forest conservation?
2. What role do traditional leaders play in maintaining and transmitting conservation values through customary practices?
3. How are these environmental values preserved and passed down to younger generations within the Mappurondo society?

Literature Review

Traditional and Customary Communication

Traditional communication among indigenous peoples encompasses oral storytelling, rituals, myths, and symbolic practices that sustain ecological knowledge and social cohesion (Lasino et al., 2023). These communication forms not only preserve cultural identity but also serve as tools for environmental conservation (Kinch et al., 2022). Research highlights those traditional narratives, embedded with ecological values, fostering an early understanding of environmental stewardship among younger generations (Magallanes-Blanco, 2022).

Traditional ecological knowledge (TEK) is a cumulative body of knowledge, practices, and beliefs developed through generations of close interaction with the environment (Chakraborty, 2024). TEK encompasses sustainable resource management practices, such as controlled burning techniques and agroforestry systems, often transmitted through non-formal means like rituals and folklore (Sandha et al., 2024; Slikkerveer & Gellaerts, 2024). Combining TEK with scientific conservation strategies has been shown to enhance the effectiveness of ecosystem management (Akalibey et al., 2024).

In the context of the Mappurondo community, traditional rituals act as mediums for transferring ecological wisdom, reflecting an intricate understanding of the forest as both a physical and spiritual entity essential for community survival.

Ritual Communication Theory

Ritual communication theory, as developed by Liao et al. (2023), emphasizes communication not merely as information transmission but as a cultural process that sustains community values, beliefs, and identities. Ritual communication focuses on symbolic participation, collective identity formation, and the reinforcement of social cohesion through repeated ceremonial practices (Gushiken, 2020).

In indigenous contexts, rituals often integrate environmental symbols such as sacred trees, rivers, or mountains, reinforcing the sacredness of the environment (Jumalia et al., 2024). Repetition of symbolic acts during rituals fosters a shared understanding of environmental responsibility among community members and strengthens social solidarity (Chaoran, 2024).

Applied to the Mappurondo community, ritual communication theory explains how ceremonies such as *Pa'totiboyang* not only transmit ecological messages but also shape collective identity centered around forest stewardship (Wang, 2023).

Symbolism and Ecological Communication in Rituals

Symbolism plays a central role in traditional rituals, serving as a powerful medium for conveying complex environmental values. Studies of African and Southeast Asian societies demonstrate that symbolic objects, such as plants, animals, and ceremonial artifacts, embody ecological and spiritual significance (Noortyani et al., 2023; Udechukwu, 2019).

Rituals such as harvest festivals and planting ceremonies often use natural symbols to emphasize interdependence between humans and nature (Lang & Kundt, 2023). In the Mappurondo tradition, natural elements like rice, water, and forest animals are integral to rituals, serving as tangible reminders of ecological ethics. Through symbolism, rituals ensure that environmental knowledge is internalized at a deep cultural level, making conservation not merely a practice but a shared moral obligation.

Integrating Traditional Knowledge into Contemporary Conservation

Recent scholarship advocates for integrating indigenous ecological knowledge into modern conservation efforts (Postero et al., 2022). Indigenous practices offer sustainable models for natural resource management, often overlooked by conventional conservation policies (Moloise et al., 2023).

By recognizing the epistemological validity of traditional knowledge systems, policymakers and conservationists can foster more inclusive, culturally sensitive, and effective environmental strategies. The Mappurondo case highlights the potential of ritual-based communication as a complementary approach to formal environmental education and advocacy (Jakes, 2024).

Methodology

Research Design

This study employed a qualitative research design using an ethnographic communication approach to explore how traditional communication practices support forest conservation among the Mappurondo Indigenous People in Mamasa, West Sulawesi.

Rationale for Ethnographic Communication Method

The ethnographic communication approach was chosen for its ability to provide an in-depth understanding of the community's traditional communication practices and their role in forest conservation. This approach allows for:

1. Contextual understanding: Ethnography enables researchers to study communication patterns within their natural cultural context.

2. Nuanced insights: Participant observation and in-depth interviews provide rich, detailed data on the community's practices and values.

3. Cultural sensitivity: This approach acknowledges the importance of cultural context and allows for a more nuanced understanding of the community's perspectives.

A qualitative design was chosen to allow an in-depth exploration of the cultural meanings embedded in rituals, symbols, and oral traditions (Varsonova, 2022).

The ethnographic communication approach was specifically selected because it emphasizes understanding communication patterns within their natural cultural contexts (Hymes, 1974). This approach is appropriate for capturing the nuanced ways in which the Mappurondo people convey ecological values through rituals and traditional leadership structures.

Research Process Flow

The research process involved several sequential steps, summarized in the diagram below:

Research Planning
↓
Participant Selection (Purposive Sampling)
↓
Data Collection
→ In-depth Interviews (20 participants)
→ Participant Observation (Participation in rituals)
→ Document Analysis (Customary laws, community records)
↓
Data Transcription and Translation
↓
Thematic Data Analysis
↓
Triangulation and Validation
↓
Interpretation and Report Writing

Participants

Participants were purposefully selected to ensure rich and diverse perspectives related to traditional communication and forest conservation. They included:

1. 5 Traditional leaders (holding spiritual authority),
2. 10 Active community members (participants in rituals),
3. 5 Young generation members (cultural learners).

All participants provided informed consent before participating in the study.

Data Collection

Data collection was conducted over a period of three months, from June to August 2023, in Mamasa Regency, West Sulawesi. The specific locations included various villages within the regency where the Mappurondo community actively practices their traditional rituals. The data collection methods included:

1. In-depth Interviews: Semi-structured interviews were conducted with 20 participants, including traditional leaders and community members. These interviews aimed to explore their views on ritual communication, its significance, and its impact on forest conservation. Each interview lasted approximately 60 to 90 minutes and was conducted in the local language to ensure clarity and comfort for the participants.

2. Participant Observation: The researcher participated in several traditional rituals, including the Pa'totiboyongan and Andian ceremonies. This method allowed for direct observation of communication patterns, rituals, and the social dynamics within the community. The researcher took detailed field notes during these events to capture the nuances of the rituals and the interactions among participants.

3. Document Studies: The researcher analyzed customary records, local regulations, and other written documents related to forest conservation practices within the Mappurondo community. This included reviewing historical texts and community guidelines that outline traditional practices and beliefs regarding environmental stewardship.

The data collection process was designed to be flexible, allowing for the emergence of new themes and insights as the research progressed. The researcher maintained a reflexive journal throughout the data collection period to document personal reflections and observations, which contributed to the analysis.

Sampling and Sample Size

The sample size for this study consisted of 20 participants, selected through purposive sampling. This approach was chosen to ensure that the participants had relevant knowledge and experience related to the research focus. The sample included a diverse range of individuals, including:

- Five traditional leaders who hold significant authority in the community.
- Ten active community members who regularly participate in traditional rituals.
- Five younger individuals who are involved in learning and passing on traditional values.

This sample size is deemed sufficient for qualitative research, as it allows for the collection of rich, detailed data while ensuring that the perspectives of various community members are represented.

Data Analysis and Procedure

Data analysis was conducted using thematic analysis, a qualitative method that facilitates the identification and interpretation of patterns within the collected data. The analysis process began with transcription, where all interviews were audio-recorded with participants' consent and then transcribed verbatim. These transcripts were subsequently translated into English for further analysis. Following transcription, the researcher engaged in initial coding, identifying key themes

and concepts related to traditional communication and forest conservation. This involved highlighting significant quotes and passages that reflected the participants' views and experiences. After the initial coding, the researcher grouped the codes into broader themes, focusing on areas such as the role of rituals in communication, the significance of traditional leaders, and the transmission of values to younger generations. To enhance the validity of the findings, data triangulation was employed, comparing insights from interviews, participant observations, and document studies, which ensured a comprehensive understanding of the communication practices within the Mapp rondo community. The final step of the analysis involved interpreting the findings in relation to existing literature on ritual communication and environmental conservation, linking the identified themes to theoretical frameworks, such as Carey's concept of ritual communication as a participatory process that fosters shared meaning. Throughout the analysis, the researcher adhered to ethical principles, including maintaining participant confidentiality and ensuring that the findings accurately represented the voices of the Mappurondo community. This systematic approach to data analysis aimed to provide a nuanced understanding of how traditional communication practices contribute to forest conservation and the preservation of cultural values within the Mapp rondo community.

Ethical Approval

This study did not require or receive ethical approval from an institutional review board or ethics committee.

Results

This section presents the key research findings derived from the analysis of traditional communication practices of the Mappurondo Indigenous People in Mamasa, West Sulawesi, particularly in relation to forest conservation. The findings are organized into thematic areas, supported by relevant evidence, including tables, figures, and graphs, to enhance clarity and understanding.

Key Research Findings

1. Role of Traditional Rituals in Communication: The analysis revealed that traditional rituals, particularly the Pa'totiboyongan, serve as vital communication mediums for conveying messages about forest conservation. The ritual emphasizes the importance of maintaining harmony with nature and includes specific taboos that reinforce ecological awareness (Chistyakov & Chistyakova, 2020).

Table 1 presents the key elements of the Pa'totiboyongan ritual, including its timing, ecological messages, and community participation. These components illustrate how the ritual functions as a mechanism for transmitting environmental values across generations.

Table 1 Key Elements of the Pa'totiboyongan Ritual

Element	Description
Timing	Conducted annually in August
Key Messages	Harmony with nature, sustainability of resources
Taboos	Prohibition of marriage ceremonies during the ritual
Community Involvement	Participation of all community members

Table 1 summarizes the essential components of the Pa'totiboyongan ritual, highlighting its significance in promoting environmental values.

2. Significance of Traditional Leaders: Traditional leaders play a crucial role in the transmission of conservation messages. They are viewed as custodians of cultural values and possess the spiritual authority to enforce customary rules that prevent forest destruction.

Figure 1 illustrates the hierarchical structure of influence within the Mappurondo community, showcasing how traditional leaders impact community practices related to forest conservation.



Figure 1 Influence of Traditional Leaders on Community Practices

3. Transmission of Values to Younger Generations: The research found that traditional communication practices effectively transmit environmental values to younger generations. This is achieved through storytelling and

participation in rituals, which instill a sense of responsibility towards nature.

Figure 2 depicts the percentage of younger community members actively participating in traditional rituals over the past five years, indicating a positive trend in engagement.

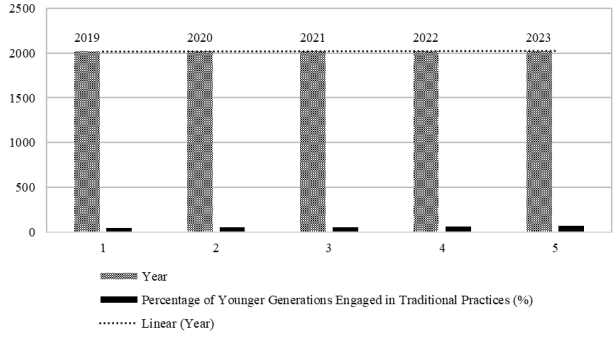


Figure 2 Engagement of Younger Generations in Traditional Practices

4. Data Triangulation and Validation: The use of data triangulation enhanced the validity of the findings. Insights from interviews, participant observations, and document studies were compared to provide a comprehensive understanding of the communication practices (Table 2).

Table 2 Sources of Data for Triangulation

Source	Type of Data	Key Insights
Interviews	Qualitative narratives	Personal experiences and beliefs
Participant Observations	Behavioral patterns	Real-time engagement in rituals
Document Studies	Historical records	Cultural significance of rituals

This Table 2 outlines the various sources of data used in the research, emphasizing the richness of information obtained through multiple methods.

Implications of Results

The findings of this research have several implications for both the Mappurondo community and broader environmental conservation efforts:

1. Strengthening Cultural Identity: The integration of traditional communication practices in forest conservation reinforces the cultural identity of the Mappurondo people. By valuing their rituals and customs, the community fosters a deeper connection to their environment, which is essential for sustainable resource management.

2. Policy Recommendations: The insights gained from this research can inform policymakers about the importance of incorporating indigenous knowledge and practices into formal conservation strategies. Recognizing the role of traditional leaders and rituals can enhance community engagement in conservation efforts.

3. Educational Initiatives: The findings suggest the need for educational programs that emphasize the significance of traditional ecological knowledge. By incorporating these values into formal education, younger generations can be better equipped to advocate for environmental sustainability.

4. Community Empowerment: Empowering traditional leaders and community members to take an active role in conservation initiatives can lead to more effective management of natural resources. This approach not only respects indigenous practices but also promotes collaborative efforts in addressing environmental challenges.

5. Future Research Directions: The study opens avenues for further research on the impact of modernization on traditional practices and the potential for integrating indigenous knowledge with contemporary conservation methods. Longitudinal studies could provide deeper insights into the evolving dynamics of traditional communication in environmental stewardship.

The research highlights the critical role of traditional communication practices among the Mappurondo Indigenous People in forest conservation. Through rituals, the authority of traditional leaders, and the transmission of values to younger generations, the community effectively conveys messages of ecological awareness and sustainability. The findings underscore the importance of integrating indigenous knowledge into broader conservation strategies, ultimately contributing to the preservation of both cultural heritage and natural resources (VijayKumar, 2019).

Discussion

The findings from the study on the traditional communication practices of the Mappurondo Indigenous People in Mamasa, West Sulawesi, reveal a profound connection between cultural rituals, environmental conservation, and the engagement of younger generations (Nurkidam & Mahyudin, 2023). This section interprets the results, discusses their implications, and provides actionable insights for practice, policy, and future research.

Interpretation of Results

The data indicate that traditional rituals, particularly the Pa'totiboyongan, serve as essential conduits for transmitting ecological knowledge and cultural values. These rituals are not merely ceremonial; they embody a participatory process that fosters community cohesion and reinforces the importance of environmental stewardship. The hierarchical communication structure, where traditional leaders disseminate knowledge to community members, highlights the role of authority and respect in maintaining ecological balance (Saiti & Stefou, 2018). This structure ensures that the wisdom of elders is preserved and passed down, creating a sense of continuity and responsibility among younger generations.

Moreover, the increasing engagement of younger generations in traditional practices, as evidenced by the rising percentages over the years, suggests a revitalization of cultural identity and environmental awareness. This trend is significant as it indicates that younger individuals are not only recognizing the value of their heritage but are also actively participating in its preservation. The integration of oral storytelling and participation in rituals serves as a powerful educational tool, instilling values of conservation and respect for nature in the youth (Prasetyo, 2023).

Comparison with Existing Literature

The findings of this study align with previous research emphasizing the significance of traditional knowledge systems in environmental conservation (Datta et al., 2024; Yanou et al., 2023). Similar to Carey's concept of ritual communication as a participatory process, the Pa'totiboyongan ritual among the Mappurondo community fosters shared meaning and reinforces environmental stewardship. However, this study diverges from some existing literature by highlighting the critical role of traditional leaders in maintaining ecological balance and transmitting conservation values. The study's results also support the idea that indigenous practices can offer valuable insights into sustainable resource management, echoing the findings of Brockerhoff et al. (2017). Overall, this research contributes to the growing body of literature on the importance of indigenous knowledge in environmental conservation, while also providing new insights into the specific role of traditional communication practices in this context.

Implications

The findings of this study carry several implications for practice, policy, and future research.

1. Significance of Findings: The results underscore the importance of traditional knowledge systems in contemporary environmental conservation efforts. The Mappurondo community's reliance on rituals and oral traditions for ecological education demonstrates that indigenous practices can offer valuable insights into sustainable resource management. This recognition of traditional knowledge as a legitimate and effective means of conservation can enhance the effectiveness of environmental initiatives.

2. Implications for Practice: For practitioners working in the field of environmental conservation, the study highlights the need to incorporate indigenous knowledge into conservation strategies. Engaging with local communities and respecting their cultural practices can lead to more effective and sustainable outcomes. Practitioners should facilitate platforms for dialogue between traditional leaders and conservationists, allowing for the exchange of knowledge and collaborative decision-making. Additionally, educational programs that emphasize the significance of traditional practices can empower younger generations to take an active role in conservation efforts.

3. Policy Implications: Policymakers should recognize the value of integrating indigenous knowledge into formal conservation policies. This can be achieved by creating frameworks that support the participation of indigenous communities in environmental governance. Policies that protect traditional practices and promote cultural heritage can enhance community resilience and foster a sense of ownership over natural resources. Furthermore, funding initiatives that support traditional ecological knowledge projects can facilitate the documentation and dissemination of these practices, ensuring their survival in the face of modernization.

4. Future Research: The study opens avenues for future research to explore the impact of modernization on traditional practices and the potential for integrating indigenous knowledge with contemporary conservation methods. Longitudinal studies could provide insights into how engagement levels among younger generations evolve over time and the factors influencing their participation. Additionally, comparative studies between different indigenous communities could reveal diverse approaches to environmental conservation and the role of cultural practices in fostering sustainability.

Conclusion

The research on the traditional communication practices of the Mappurondo Indigenous People in Mamasa, West Sulawesi, has illuminated the vital role that cultural rituals and oral traditions play in forest conservation. The findings reveal that these practices are not merely remnants of the past but are dynamic tools for fostering ecological awareness and community engagement, particularly among younger generations. The Pa'totiboyongan ritual and other traditional ceremonies serve as essential mediums for transmitting environmental values, reinforcing the community's connection to nature, and ensuring the sustainability of their natural resources.

The study highlights the significance of traditional leaders in this process, as they act as custodians of knowledge and cultural practices. Their authority and respect within the community facilitate the effective communication of conservation messages, ensuring that the wisdom of elders is preserved and passed down. The increasing participation of younger generations in these rituals indicates a positive trend towards revitalizing cultural identity and environmental stewardship, suggesting that traditional practices can coexist with modern influences.

Reflecting on the research findings, it is clear that the integration of indigenous knowledge into contemporary conservation efforts is not only beneficial but necessary. The Mappurondo community's approach to forest conservation, rooted in their cultural practices, offers valuable insights that can enhance the effectiveness of environmental initiatives. As the pressures on natural resources continue to grow, recognizing and supporting traditional ecological knowledge becomes imperative for sustainable development.

This study demonstrates the vital role of traditional communication practices in forest conservation among the Mappurondo Indigenous People. The findings highlight the significance of cultural rituals, oral traditions, and traditional leaders in transmitting environmental values and promoting community engagement. These results have important implications for policy-making at both local and national levels.

Policy Implications

1. Integrating indigenous knowledge: Incorporating traditional ecological knowledge into formal conservation strategies.

2. Supporting community engagement: Fostering greater engagement among younger generations in traditional practices.

3. Promoting collaborative conservation: Partnering with indigenous communities to leverage traditional knowledge in environmental management.

Future Research Directions

1. Explore comparative analyses: Investigating diverse approaches to environmental stewardship among different indigenous communities.

2. Conduct longitudinal studies: Examining the impact of modernization on traditional practices and conservation outcomes.

Recommendations

Based on the research findings, several recommendations can be made to enhance the role of traditional communication in forest conservation and to support the Mappurondo Indigenous People in their efforts:

1. Strengthening Community Engagement: It is essential to foster greater engagement among younger generations in traditional practices. Community leaders and organizations should create opportunities for youth to participate in rituals and ceremonies, ensuring that they understand the cultural significance and ecological messages embedded within these practices. Workshops, cultural festivals, and mentorship programs can be effective in bridging the gap between generations.

2. Integrating Traditional Knowledge into Education: Educational institutions should incorporate traditional ecological knowledge into their curricula. This can be achieved by collaborating with local elders and traditional leaders to develop programs that highlight the importance of cultural practices in environmental conservation. By instilling respect for indigenous knowledge in students, future generations will be better equipped to advocate for sustainable practices.

3. Promoting Collaborative Conservation Initiatives: Conservation organizations should actively seek partnerships with indigenous communities to leverage traditional knowledge in environmental management. Collaborative projects that combine scientific approaches with indigenous practices can lead to more effective conservation outcomes. Engaging the Mappurondo community in decision-making processes will ensure that their voices are heard and their rights are respected.

4. Advocating for Policy Recognition: Policymakers must recognize the value of traditional ecological knowledge in environmental governance. This can be achieved by developing policies that protect indigenous rights and promote the

integration of traditional practices into formal conservation strategies. Advocacy efforts should focus on highlighting successful case studies where indigenous knowledge has contributed to sustainable resource management.

5. Documenting and Preserving Traditional Practices: Efforts should be made to document and preserve the traditional ecological knowledge of the Mappurondo community. This can involve creating digital archives, recording oral histories, and publishing materials that showcase their cultural practices and environmental wisdom. Such documentation will not only serve as a resource for future generations but also raise awareness of the importance of indigenous knowledge in broader conservation discussions.

6. Encouraging Research and Knowledge Exchange: Future research should continue to explore the intersection of traditional knowledge and modern conservation practices. Comparative studies between different indigenous communities can provide insights into diverse approaches to environmental stewardship. Additionally, facilitating knowledge exchange platforms where communities can share their experiences and practices can foster collaboration and innovation in conservation efforts.

The research highlights the vital connection between the Mappurondo community and their forest environment, underscoring the significance of indigenous knowledge and practices in conservation efforts. The community's traditional practices and rituals are essential components of environmental stewardship and play a crucial role in forest preservation. Incorporating indigenous knowledge into conservation strategies can enhance their effectiveness and promote sustainability. Furthermore, empowering local communities to actively participate in conservation initiatives fosters a sense of ownership and responsibility, strengthening their role as guardians of their natural resources. Future studies could benefit from including specific examples or case studies that illustrate how these traditional practices are applied in practice, providing a deeper understanding of the practical benefits and real-world applications of indigenous knowledge in forest conservation efforts. By recognizing and supporting these practices, we can enhance the sustainability of natural resources while empowering indigenous communities to preserve their cultural identity. The recommendations provided aim to strengthen the integration of traditional knowledge into contemporary conservation efforts, ensuring that the voices of indigenous peoples remain central to the discourse on environmental sustainability. As we move forward, it is crucial to embrace a holistic approach that values both scientific and indigenous knowledge in our quest for a sustainable future.

Conflict of Interest

The authors declare no conflict of interest

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