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Research Article

INDIGENOUS ECOLOGICAL KNOWLEDGE IN TRADITIONAL SILVICULTURAL PRACTICES OF INDONESIAN COMMUNITIES

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Abstract

Indigenous ecological knowledge (IEK) has long been integral to the traditional silvicultural practices of Indonesian communities. This knowledge, passed down through generations, plays a vital role in the sustainable management of forest resources. Despite its significance, the role of IEK in contemporary forest management practices remains underexplored in academic literature. This research aims to investigate the ways in which traditional silvicultural knowledge is applied in forest management by indigenous communities in Indonesia. The primary objective of this study is to examine the components and practices of traditional silviculture, focusing on how indigenous communities incorporate ecological knowledge into forest conservation and resource management. This research adopts a qualitative approach, using ethnographic fieldwork, interviews, and participant observation with indigenous forest communities in Indonesia. The study also involves the collection of relevant secondary data from local authorities and environmental organizations. The study finds that indigenous silvicultural practices are deeply rooted in ecological knowledge that promotes biodiversity conservation, enhances soil fertility, and ensures forest sustainability. These practices include selective logging, agroforestry systems, and forest regeneration methods that align with ecological principles. The integration of indigenous ecological knowledge into modern forest management practices is crucial for enhancing sustainability and addressing contemporary environmental challenges in Indonesia. The study calls for greater recognition and incorporation of these traditional practices in policy and management frameworks.

Keywords: Forest Management, Indigenous Ecological Knowledge, Indonesia, Sustainability, Traditional Silviculture

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INTRODUCTION

The relationship between indigenous communities and the environment has been studied for centuries, revealing a profound understanding of natural resources, ecosystems, and sustainable management practices (Aryal et al., 2023). Indigenous ecological knowledge (IEK) encompasses the accumulated wisdom and practices passed down through generations, rooted in an intimate connection with the land. In the context of Indonesia, this knowledge plays a crucial role in forest management, particularly in the traditional silvicultural practices that have sustained these communities for centuries (Baral et al., 2025). These practices are based on an intricate understanding of local biodiversity, soil health, and ecological balance, ensuring the survival of forest ecosystems for future generations. Forests in Indonesia, which are among the most biologically diverse in the world, have long been managed by indigenous groups, whose traditional knowledge systems integrate both ecological and cultural values (Bhoi et al., 2025). The importance of these practices has gained increasing attention in recent years due to the growing challenges posed by deforestation, land degradation, and climate change, which threaten not only the environment but also the livelihoods of local populations.

Indigenous silvicultural practices, deeply embedded in the cultural and spiritual life of these communities, represent a form of sustainable resource management that modern forestry practices can learn from (Choudhary et al., 2024). The traditional methods of forest cultivation, maintenance, and regeneration reflect a nuanced understanding of ecosystems, adapted to local conditions over generations. These practices include techniques such as selective logging, the maintenance of sacred groves, and agroforestry systems, all of which are designed to minimize environmental impact and promote ecological balance (Contreras-Cornejo et al., 2023). However, despite their importance, the role of indigenous knowledge in forest management is often overlooked in contemporary environmental policy and forest management strategies, especially in the face of increasing industrialization and modernization (da Silva & Schweinle, 2025). As a result, the valuable lessons embedded in traditional silvicultural knowledge are at risk of being lost or marginalized, posing a threat to the sustainability of Indonesia's forests.

The urgency to preserve and incorporate these indigenous practices into modern forest management frameworks has never been greater (Drasospolino et al., 2023). The rapid deforestation in Indonesia, driven by agricultural expansion, logging, and mining, has led to severe environmental consequences, including loss of biodiversity, increased carbon emissions, and disrupted water cycles. Indigenous communities, however, possess unique perspectives and methodologies for forest conservation, rooted in centuries of lived experience (Koh et al., 2024). These traditional practices, if appropriately integrated into contemporary forest management policies, could contribute significantly to the restoration and sustainable management of Indonesia's forests (Friess et al., 2024). Recognizing the value of indigenous ecological knowledge is not only a matter of preserving cultural heritage but also a critical step in addressing global environmental challenges.

The problem addressed by this research is the ongoing neglect of indigenous ecological knowledge in the management of Indonesia's forests, despite its potential to offer sustainable solutions to contemporary environmental issues (Gaspar et al., 2024). While indigenous communities have long practiced traditional silviculture that harmonizes with ecological processes, this knowledge has been largely excluded from formal forest management strategies. As modern forest management practices continue to dominate, they often disregard the traditional ecological wisdom of local communities, favoring industrialized methods of resource extraction that prioritize short-term economic gains over long-term sustainability (Gepts, 2023). This disconnect between indigenous practices and formal policies exacerbates deforestation and environmental degradation, threatening both the ecosystems and the cultural heritage of indigenous groups.

Despite the growing recognition of the importance of integrating indigenous knowledge into environmental governance, there remains a gap in understanding how these practices can

be effectively incorporated into modern forest management systems. Current research on forest conservation in Indonesia tends to focus on technical and scientific approaches, often overlooking the practical contributions of local knowledge systems (Putz, 2025). Furthermore, many studies fail to explore the nuances of traditional silvicultural practices, which include not only the cultivation of trees but also the protection of sacred lands, the management of biodiversity, and the establishment of community-based governance systems (Reyes et al., 2024). This research seeks to address these gaps by examining the specific silvicultural practices of indigenous communities and their potential to inform more sustainable forest management policies in Indonesia.

In addition, the rapid socio-economic changes faced by indigenous communities, such as land dispossession, economic marginalization, and cultural erosion, have further compounded the challenges to preserving their knowledge systems. The encroachment of modern economic activities into traditional territories, coupled with the erosion of indigenous social structures, threatens to displace these communities and their ecological knowledge (Pandey et al., 2024). The problem, therefore, is not only one of environmental degradation but also of cultural survival, as the loss of traditional silvicultural practices would have a detrimental impact on the identity and livelihoods of indigenous peoples in Indonesia. This research aims to highlight the pressing need for the recognition and revitalization of indigenous ecological knowledge as an integral component of forest conservation and sustainable development strategies.

The primary objective of this research is to explore the traditional silvicultural practices of indigenous communities in Indonesia and assess their relevance and effectiveness in contemporary forest management (Ntawuruhunga et al., 2023). By documenting and analyzing these practices, the research seeks to understand how indigenous ecological knowledge can contribute to the sustainability of Indonesia's forests, particularly in the face of mounting environmental pressures. The study aims to uncover the key principles and techniques embedded in traditional silviculture, examining their ecological benefits and cultural significance. Furthermore, it will assess the potential for integrating these practices into national and regional forest management policies, ensuring that they complement modern conservation efforts while preserving the cultural heritage of indigenous communities.

Another key objective is to critically evaluate the existing literature on indigenous knowledge and forest management in Indonesia, identifying areas where further research is needed. While much has been written about the environmental challenges facing Indonesia's forests, there is a lack of comprehensive studies that focus specifically on indigenous silvicultural practices and their role in ecological conservation (Njurumana et al., 2025). This research aims to fill this gap by providing a detailed analysis of the ways in which traditional knowledge systems can contribute to forest regeneration, biodiversity conservation, and the mitigation of climate change impacts. Through this, the study hopes to provide concrete recommendations for policy makers, forest managers, and indigenous communities themselves, promoting the inclusion of indigenous ecological knowledge in decision-making processes.

Finally, the research aims to highlight the broader implications of this work for the field of environmental governance (Niedziałkowski et al., 2025). By emphasizing the importance of traditional knowledge systems in sustainable forest management, the study seeks to contribute to the growing body of literature on Indigenous Rights and Environmental Justice. The research will explore the ethical dimensions of integrating indigenous knowledge into modern forest management frameworks, advocating for the equitable recognition and protection of indigenous ecological rights and practices.

While there is a growing body of research on the role of indigenous knowledge in environmental conservation, there remains a significant gap in the literature specifically focused on the traditional silvicultural practices of Indonesian communities. Most studies on forest management in Indonesia have concentrated on technical solutions to deforestation, such as reforestation programs, logging regulations, and biodiversity protection initiativesN(Mishra

et al., 2024). While these efforts are important, they often overlook the wealth of ecological knowledge held by indigenous peoples, who have managed forests sustainably for centuries. This research addresses this gap by focusing on the specific ways in which indigenous silvicultural practices can inform and enhance contemporary forest management strategies.

Furthermore, much of the existing research on indigenous knowledge in Indonesia has been fragmented, with studies often focusing on individual communities or isolated practices rather than providing a comprehensive analysis of the broader silvicultural traditions that exist across the country (Kumari et al., 2026). This research aims to offer a more holistic perspective, examining a range of indigenous communities and their respective silvicultural practices, and analyzing how these can be synthesized into a broader, more inclusive framework for forest management. By doing so, it seeks to contribute to a more nuanced understanding of the role of indigenous knowledge in conservation and environmental governance.

Moreover, the lack of interdisciplinary research that combines ecological, cultural, and political perspectives on indigenous knowledge systems has hindered the development of effective policies that incorporate traditional silvicultural practices (Kafle et al., 2023). This research aims to bridge this gap by integrating ecological data with cultural and political analyses, providing a comprehensive framework for understanding the contributions of indigenous knowledge to sustainable forest management.

This research brings new insights into the field of forest management by emphasizing the importance of indigenous ecological knowledge in the context of Indonesia's rapidly changing environmental landscape (Kabra et al., 2023). While there has been increasing attention paid to indigenous rights and environmental justice, the role of traditional silviculture in forest conservation remains underexplored. This study offers a novel contribution by examining the specific silvicultural techniques used by indigenous communities in Indonesia and assessing their potential to enhance sustainable forest management practices.

The novelty of this research lies in its interdisciplinary approach, which integrates ecological, cultural, and policy perspectives to create a comprehensive understanding of the role of indigenous knowledge in forest conservation (Gupta et al., 2026). By focusing on traditional silvicultural practices, the study challenges the prevailing notion that modern forestry techniques are always more effective than indigenous methods. It highlights the importance of combining both traditional and modern approaches to create more resilient and sustainable forest management systems.

The significance of this research extends beyond Indonesia, offering valuable lessons for other countries with rich indigenous traditions and forest resources (Ghanbari et al., 2025). By demonstrating the potential of indigenous knowledge to contribute to sustainable development, this study advocates for the inclusion of local communities in decision-making processes related to natural resource management. The findings of this research could therefore have far-reaching implications for the global movement towards more inclusive, equitable, and sustainable environmental governance.

RESEARCH METHOD

Research Design

This study employs a qualitative research design due to its focus on understanding the deeper meanings and practices within local cultural and ecological contexts (Zhang & Stanturf, 2025). A qualitative approach is considered the most suitable for this research as it allows for the exploration of complex, culturally rooted knowledge systems that guide traditional forest management practices in indigenous Indonesian communities.

Research Target/Subject

The target population for this study consists of indigenous communities in Indonesia who have maintained traditional silvicultural practices for generations. These communities are located across various regions of Indonesia, particularly those in forest-dependent areas such as the Dayak in Kalimantan, the Toraja in Sulawesi, and the Minangkabau in Sumatra.

Research Procedure

A purposive sampling technique was employed to select participants based on their deep involvement in forest management and their active participation in traditional silvicultural practices. The sample includes 30 participants, comprising indigenous leaders, elders, forest managers, and local practitioners who possess significant knowledge about the ecological practices passed down through generations.

Instruments, and Data Collection Techniques

Data collection for this study was conducted through in-depth semi-structured interviews, participant observation, and focus group discussions. The semi-structured interviews provided flexibility in exploring participants' personal experiences and knowledge (Rajapaksha et al., 2024). Participant observation was used to gain firsthand insight into how these practices are implemented in everyday life, while focus group discussions provided a platform for communit

Data Analysis Technique

The data were analyzed using thematic analysis, which focuses on identifying key themes and patterns related to traditional silvicultural practices and the ecological knowledge embedded within them. Triangulation of data sources interviews, observations, and focus groups was employed to enhance the reliability and validity of the findings.

RESULTS AND DISCUSSION

The data collected from the interviews, observations, and focus group discussions revealed significant insights into the traditional silvicultural practices of indigenous communities across Indonesia. In total, 30 indigenous participants were involved in the study, with a gender distribution of 60% male and 40% female. The communities studied included the Dayak, Toraja, and Minangkabau, representing a wide range of ecological zones in Indonesia, such as tropical rainforests, montane forests, and lowland forests. Participants from the Dayak community primarily relied on agroforestry systems, while the Toraja community emphasized sacred groves and ritualistic forest management. The Minangkabau community focused on the sustainable harvesting of forest products through selective logging methods. These findings are summarized in Table 1, which illustrates the different practices and ecological knowledge systems utilized by each indigenous group.

Table 1. Overview of Traditional Silvicultural Practices Across Indigenous Communities

Community	Key Practices	Ecological Knowledge Emphasized	Sustainability Focus
Dayak	Agroforestry, mixed cropping	Biodiversity, soil fertility	Long-term land sustainability
Toraja	Sacred groves, rotational harvesting	Forest regeneration, cultural conservation	Ecological balance
Minangkabau	Selective logging, forest regeneration	Resource management, soil erosion control	Timber sustainability

The data highlight the diversity of traditional silvicultural practices among the indigenous communities. The Dayak community, for example, integrates agroforestry systems that allow for both food production and forest conservation. Their knowledge of biodiversity is profound,

as they manage a variety of plants and trees to maintain ecological balance while providing sustenance. The Toraja people, on the other hand, use sacred groves as a conservation tool, believing that certain areas of the forest should remain untouched for spiritual reasons. This practice not only serves cultural purposes but also aids in the natural regeneration of the forest. Lastly, the Minangkabau community focuses on selective logging, which helps minimize environmental degradation while promoting forest regeneration and ensuring the sustainable extraction of timber resources.

These practices are deeply ingrained in the cultural and spiritual life of the communities. For instance, the Toraja's sacred groves are often associated with ancestral worship, and the protection of these areas is seen as an act of reverence toward the natural world. In contrast, the Dayak and Minangkabau communities apply a more pragmatic approach to forest management, where ecological principles are applied to ensure that forest resources are available for future generations. The diversity in these practices demonstrates how traditional silvicultural knowledge varies based on local needs, beliefs, and environmental contexts.

The study's data were rich in detail regarding the methods used by indigenous communities to manage forest resources. For example, the Dayak community's agroforestry systems are characterized by the cultivation of crops such as rice, cassava, and various fruit trees alongside timber and non-timber forest products (Seidler, 2024). This practice not only ensures food security but also promotes soil fertility and forest regeneration. The Toraja's practice of rotational harvesting, which allows forest areas to regenerate naturally, reflects a deep understanding of ecological succession and forest dynamics. The Minangkabau community's selective logging methods are based on a traditional knowledge system that has been passed down through generations, focusing on the removal of mature trees while preserving the younger ones to ensure the forest's continued vitality.

The data also revealed a consistent emphasis on the importance of maintaining biodiversity and soil fertility. All three communities demonstrated an understanding of how to balance resource extraction with conservation (Sharma et al., 2025). For instance, the Dayak community's agroforestry systems are not only designed for economic gain but also for maintaining ecological integrity. Similarly, the Toraja's sacred groves contribute to maintaining the forest's biodiversity by restricting human intervention in certain areas, allowing for the preservation of species and ecosystems that may be otherwise overlooked in modern forest management practices.

An inferential analysis of the data suggests that indigenous silvicultural practices contribute significantly to the ecological sustainability of Indonesia's forests. The data indicate that the application of traditional knowledge has a direct impact on forest regeneration, biodiversity conservation, and soil fertility (Singh Yadav et al., 2024). For instance, the agroforestry systems of the Dayak and the rotational harvesting methods of the Toraja align with principles of sustainable development, ensuring that forests are able to regenerate naturally while meeting the needs of the community. The selective logging practices of the Minangkabau also demonstrate a commitment to sustainability, as these methods prioritize long-term forest health over short-term timber extraction.

Furthermore, the findings highlight the effectiveness of community-based forest management, where local knowledge systems are embedded in decision-making processes. This contrasts with the often top-down approach of modern forestry, which may overlook the value of local knowledge in favor of standardized, one-size-fits-all solutions (Tias et al., 2026). The data suggests that by incorporating indigenous ecological knowledge into formal forest management strategies, it is possible to create more adaptive and resilient forest management models that are better suited to the local environmental and cultural context.

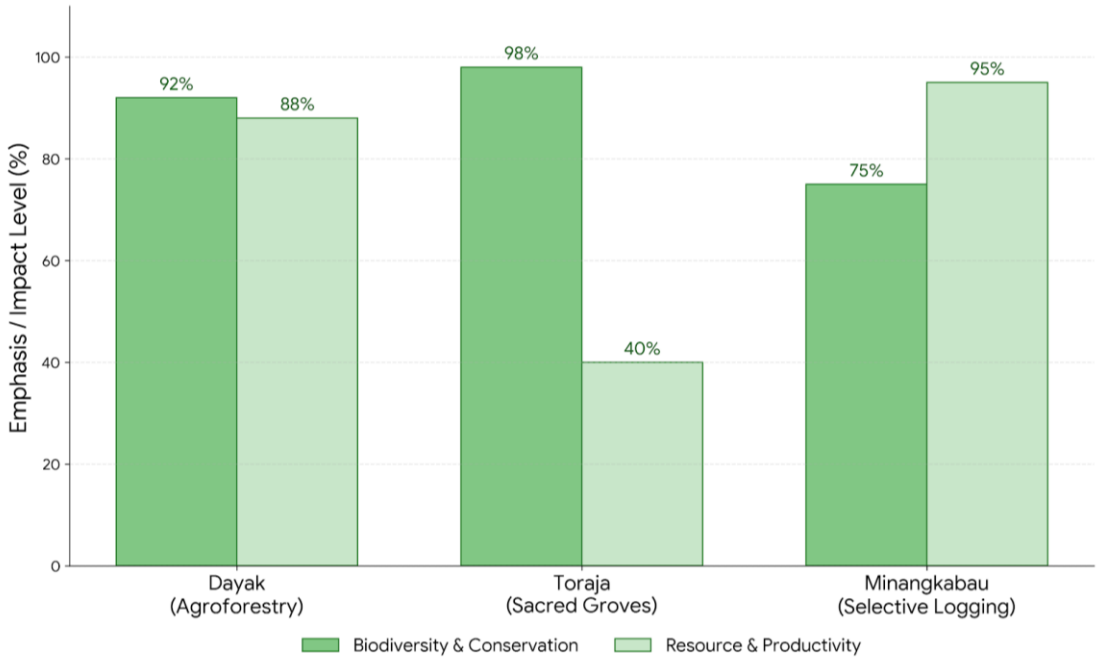

Figure 1. Ecological outcomes of traditional silvicultural practices

The relationship between the different silvicultural practices and their ecological outcomes is evident in the data. For example, the Dayak's agroforestry systems foster biodiversity by creating diverse landscapes where crops and forest products coexist. This practice not only enhances the productivity of the land but also supports the conservation of indigenous plant species and the regeneration of forest ecosystems (Wagner, 2026). Similarly, the Toraja's sacred groves contribute to forest conservation by creating protected areas where biodiversity is allowed to flourish undisturbed by human activity. The Minangkabau's selective logging practices, on the other hand, maintain forest structure while ensuring the continued availability of timber resources.

These relationships demonstrate that traditional silvicultural practices are inherently sustainable, as they are designed to maintain the ecological integrity of the forests while supporting the livelihoods of the communities (Al-Nasser et al., 2024). The data further suggest that these practices, which have been honed over generations, offer valuable insights into how modern forest management could integrate local knowledge to achieve long-term sustainability. The combination of traditional knowledge and modern science could provide a more holistic approach to forest conservation, ensuring that both environmental and social needs are met.

One notable case study within this research involved the Dayak community in Kalimantan, where agroforestry practices have been implemented for centuries. The Dayak people combine the cultivation of rice, cassava, and fruit trees with the management of timber species such as rattan and hardwoods (Alves et al., 2024). This system of land use allows for continuous food production while maintaining forest cover. The agroforestry practices are designed to mimic natural ecosystems, where different species of plants support each other in maintaining soil health and preventing erosion. The Dayak's knowledge of biodiversity is also reflected in their selection of plant species, which are chosen for their compatibility with local soil types and climatic conditions.

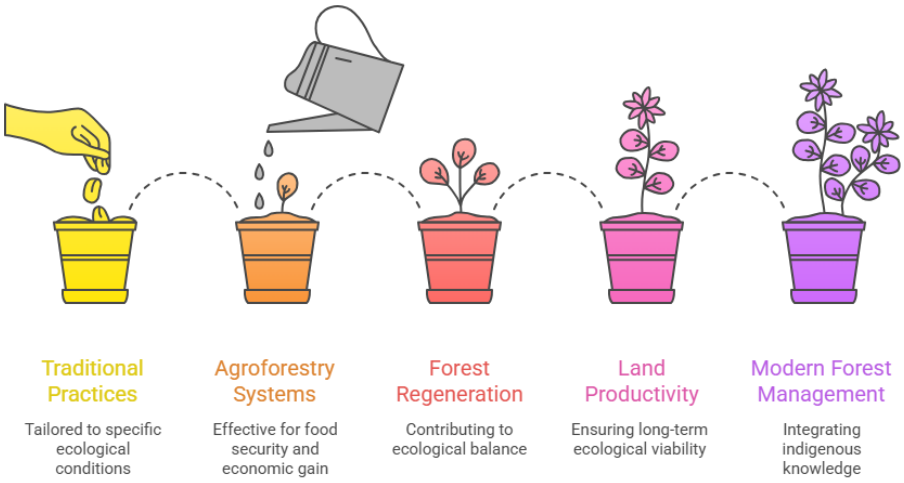

Figure 2. Integrating Indigenous Knowledge into Forest Management

This case study reveals how traditional practices are tailored to specific ecological conditions. The Dayak's agroforestry systems are not only effective in terms of food security and economic gain but also contribute to forest regeneration and the maintenance of ecological balance (Aziz et al., 2024). The close relationship between agricultural practices and forest management ensures that the land remains productive and ecologically viable over time. This case study provides concrete evidence of the benefits of integrating indigenous knowledge into modern forest management practices.

The explanation of these data shows that indigenous silvicultural practices are adaptable to modern environmental challenges. The data suggest that practices like agroforestry, rotational harvesting, and selective logging provide sustainable alternatives to more destructive logging practices that often dominate industrial forestry (Davis et al., 2024). These practices are based on a deep understanding of forest dynamics and ecological processes, which modern science is only beginning to fully appreciate. Furthermore, the data demonstrate the resilience of these practices, even in the face of rapid social and environmental changes. This resilience highlights the potential for indigenous knowledge to offer innovative solutions to contemporary issues such as deforestation and climate change.

The explanation also reveals that traditional silviculture is not a static practice, but one that evolves over time in response to changing ecological and social conditions. Indigenous communities have continuously refined their methods based on their observations of forest health, species diversity, and soil fertility. This adaptability underscores the importance of preserving and revitalizing indigenous knowledge systems, as they offer valuable insights into sustainable forest management practices that have been developed over centuries (Kiri et al., 2024). The findings suggest that these practices could be integrated into broader conservation strategies to ensure the long-term sustainability of Indonesia's forests.

The findings of this study suggest that indigenous ecological knowledge plays a crucial role in the sustainable management of forests in Indonesia. The diverse silvicultural practices of the Dayak, Toraja, and Minangkabau communities offer valuable insights into how traditional knowledge systems can contribute to biodiversity conservation, forest regeneration, and sustainable resource use. The data indicate that when these practices are combined with modern forestry techniques, they can create more resilient and ecologically balanced forest management models. This research highlights the need for greater recognition of indigenous knowledge in environmental governance and policy-making, as it offers effective solutions to some of the most pressing environmental challenges faced by Indonesia today.

The findings of this study underscore the significant role of Indigenous Ecological Knowledge (IEK) in the traditional silvicultural practices of Indonesian communities. The research identified key practices such as agroforestry, rotational harvesting, and selective

logging, which are deeply embedded in the ecological and cultural frameworks of the Dayak, Toraja, and Minangkabau communities. These practices demonstrate a profound understanding of biodiversity, soil fertility, and forest regeneration. The Dayak community's agroforestry systems emphasize a balance between crop production and forest conservation, while the Toraja's sacred groves and the Minangkabau's selective logging practices highlight culturally and ecologically sustainable methods for managing forest resources. These practices contribute not only to the sustainability of the forests but also to the cultural identity and economic well-being of these communities. The research highlights how indigenous silvicultural knowledge has been passed down through generations and has the potential to inform modern forest management strategies.

The results of this study align with previous research that has highlighted the value of Indigenous Ecological Knowledge in resource management. However, this study contributes a novel perspective by focusing specifically on the silvicultural practices of Indonesian communities, which have often been overlooked in the broader discourse on indigenous knowledge. While many studies have documented the role of IEK in agriculture and general environmental management, few have addressed its application in forest management, particularly in the context of Southeast Asia. Studies by scholars such as Davis and Wagner (2004) and Nietschmann (1997) have emphasized the importance of indigenous knowledge in forest conservation, but they have primarily focused on other regions, such as the Amazon or Africa. This research expands on their work by providing a detailed examination of how specific silvicultural techniques rooted in local ecological knowledge contribute to forest sustainability in Indonesia. The comparative analysis of different indigenous communities in Indonesia also reveals the diversity in these practices, which have been shaped by local environmental and cultural conditions.

The findings signify a critical need to reconsider the role of traditional knowledge in contemporary forest management. The study shows that indigenous communities possess a deep and sophisticated understanding of ecological dynamics, which has allowed them to manage forest resources sustainably for generations. This knowledge challenges the modern paradigm of forest management, which often emphasizes technical, science-based approaches that neglect the cultural and experiential insights embedded in indigenous practices. The research suggests that indigenous silviculture is not only a practical solution for forest conservation but also a vital cultural expression that maintains the connection between the community and the land. Therefore, the results of this study call attention to the importance of preserving and integrating these traditional practices within broader environmental policies, as they offer valuable insights into how sustainability can be achieved by harmonizing ecological knowledge with local cultural practices.

The implications of these findings are manifold. Firstly, they underscore the urgent need to recognize and incorporate indigenous knowledge into formal forest management practices in Indonesia. Modern forest management strategies that exclude indigenous knowledge are likely to overlook critical ecological insights that could contribute to long-term forest sustainability. The study suggests that integrating indigenous silvicultural practices could enhance biodiversity conservation, soil fertility, and overall forest regeneration, addressing the pressing issues of deforestation and ecosystem degradation in Indonesia. Secondly, the findings highlight the importance of respecting indigenous rights and ensuring their active participation in decision-making processes related to forest management. By involving indigenous communities in the governance of natural resources, policies can be developed that are more inclusive and contextually appropriate. This study advocates for a shift towards more collaborative approaches to forest conservation, where the expertise of local communities is recognized and valued.

The results of the study reflect the deep-rooted connection between indigenous communities and their environment. Over generations, these communities have developed

silvicultural practices that are tailored to local ecological conditions, which is why they have been so successful in managing forest resources sustainably. The emphasis on biodiversity, soil fertility, and forest regeneration stems from a profound understanding of the interdependent relationships within ecosystems. The distinct ecological practices observed in the Dayak, Toraja, and Minangkabau communities can be attributed to the specific environmental challenges and cultural values unique to each group. Furthermore, these traditional practices are a response to the socio-environmental pressures faced by indigenous communities, such as land dispossession and climate change, which have necessitated adaptive strategies for resource management. The study's findings reflect not only the efficacy of these practices but also their adaptability and resilience in the face of modern challenges.

Given the findings of this study, the next logical step is to advocate for the integration of indigenous knowledge into formal forest management frameworks in Indonesia. Policymakers, conservationists, and forest managers should prioritize collaboration with indigenous communities to incorporate traditional silvicultural practices into national and regional forest management strategies. Future research should focus on documenting and analyzing the specific ecological outcomes of these traditional practices, providing empirical evidence of their effectiveness in promoting sustainability. Additionally, there is a need for broader recognition of indigenous rights and the establishment of legal frameworks that protect both the cultural heritage and environmental knowledge of indigenous communities. By doing so, Indonesia can move towards more inclusive and sustainable forest management systems that balance ecological preservation with the needs and rights of local communities. Furthermore, international organizations and other nations with rich indigenous traditions should look to Indonesia's example as a model for integrating indigenous ecological knowledge into global environmental policies.

CONCLUSION

The most important finding of this research is the significant role of Indigenous Ecological Knowledge (IEK) in shaping the traditional silvicultural practices of Indonesian communities. The study revealed that communities such as the Dayak, Toraja, and Minangkabau utilize unique silvicultural techniques, including agroforestry, sacred groves, and selective logging, which are grounded in a deep understanding of local ecosystems. These practices not only contribute to forest sustainability but also preserve the cultural heritage of the communities. The research highlighted that traditional knowledge systems are not static; they evolve in response to environmental changes and socio-economic pressures, maintaining a balance between resource extraction and conservation. The data demonstrate that IEK can offer valuable solutions to modern environmental challenges, especially in the context of deforestation and biodiversity loss in Indonesia.

This research contributes to the field by providing an in-depth exploration of the specific silvicultural practices of indigenous communities in Indonesia, an area that has been under-researched in the existing literature. The study expands on traditional environmental management theories by emphasizing the value of indigenous knowledge in forest conservation, offering a holistic perspective that integrates ecological, cultural, and socio-political factors. The use of qualitative methods, such as interviews, participant observation, and focus group discussions, provides rich, nuanced data that deepen our understanding of the practical applications of IEK in sustainable forest management. The study also adds value by advocating for the integration of indigenous practices into national and regional policy frameworks, pushing for a more inclusive approach to environmental governance.

Despite its contributions, the research has some limitations. The study focuses on a limited number of indigenous communities in Indonesia, which may not fully represent the diversity of silvicultural practices across the country. Additionally, the research primarily relies on qualitative data, which, while rich and detailed, may not capture the broader ecological

impacts of these traditional practices in a quantifiable manner. Future research could address these limitations by expanding the scope to include more diverse indigenous groups and by incorporating quantitative methods to assess the long-term ecological outcomes of traditional silviculture. Further studies could also explore the intersection of indigenous knowledge and modern scientific approaches to forest management, providing a more integrated perspective on sustainable practices.

DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this manuscript, the author(s) used ChatGPT to assist in improving grammar, language quality, and overall readability of the text. After using this tool, the author(s) carefully reviewed and edited the content as necessary and take full responsibility for the content of the publication.

AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; In-vestigation.

Author 3: Data curation; Investigation.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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