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Indigenous knowledge and ecotourism for sustainable livelihoods in Arakan, Cotabato, Philippines

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Abstract. *Baguio Jr. RP, Kahar YH, Nacionales JM, Mantawil BA, Habibun JF, Ramos RMM, Matucan GM, Casis AP. 2026. Indigenous knowledge and ecotourism for sustainable livelihoods in Arakan, Cotabato, Philippines. Asian J Ethnobiol 9 (1): y090118. https://doi.org/10.13057/asianjethnobiol/y090118.* This study examines how Indigenous Knowledge Systems (IKS) support environmental conservation and sustainable livelihoods through ecotourism among the Manobo communities in Arakan, North Cotabato, Philippines. Using a convergent mixed-methods design, data were gathered through surveys, interviews, focus group discussions, and participant observation across three ecotourism areas: Matigol, Gambodes, and Aguas Falls. Within the sample of 60 respondents, more than half reported practicing rotational farming, sacred grove protection, and ritual-based water governance, describing these as supportive of soil fertility, biodiversity conservation, and freshwater sustainability. These knowledge-based land and resource practices remain primary livelihood sources, providing up to one-third of household income, while ecotourism activities add supplementary earnings through guiding, handicrafts, and cultural presentations. Community perceptions indicate strong recognition of ecotourism benefits, especially income opportunities and cultural preservation, cited by over 70% of respondents, though concerns persist regarding cultural commodification and ecological disturbances in sensitive areas. Correlation analysis also suggests that tourism growth is closely linked with increased household income but may heighten environmental pressure without proper safeguards. The study demonstrates that IKS provides crucial ecological and cultural assets for resilient livelihoods but requires institutional recognition, inclusive governance, and environmental safeguards to ensure that ecotourism reinforces, rather than undermines, both cultural identity and ecological integrity.

Keywords: Indigenous ecological knowledge, biocultural conservation, community-based tourism, Manobo, Philippines

INTRODUCTION

Indigenous Knowledge Systems (IKS) embody generations of ecological insight, cultural practice, and resource-use strategies shaped through sustained interaction with nature. In the Philippines, these include rotational farming, sacred grove protection, ritual-based water governance, agroforestry, and seasonal planting calendars. Far from being relics, such practices remain central to biodiversity conservation and cultural identity by linking ecological stewardship with community resilience (Camacho et al. 2015; Garnett et al. 2018; Reyes-García et al. 2019; Hill et al. 2020). Globally, IKS is increasingly recognized as a foundation for sustainability science. Berkes (2018) describes Traditional Ecological Knowledge (TEK) as an adaptive, cumulative body of understanding enabling communities to manage ecosystems across generations, while Maffi (2005) emphasizes biocultural diversity, the interdependence of cultural and ecological systems. As indigenous practices erode, ecological resilience often declines in parallel. In recent years, international frameworks such as the Convention on Biological Diversity (CBD) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) have acknowledged the critical role of indigenous peoples in achieving conservation and sustainability goals, further validating the relevance of IKS in contemporary environmental discourse (Painemilla et al. 2010).

Across Southeast Asia, culturally embedded ecological governance systems serve similar purposes. In eastern Indonesia, the sasi system regulates harvesting seasons to ensure resource regeneration and equitable access (Adhuri 2013). In Bali, the subak irrigation system integrates ritual and cooperative management to sustain productive rice terraces (Lansing 2006). Similar sacred forest governance exists in Mindanao, where taboos protect biodiversity and reinforce communal responsibility (Calderon et al. 2017). These cases illustrate that Indigenous Knowledge Systems (IKS) across the region represent complex frameworks rooted in both ecological understanding and cultural governance (Thompson et al. 2020). Despite their value, indigenous practices frequently remain marginalized in formal conservation and tourism policies, which can lead to cultural misrepresentation and ecological degradation.

While the ecological contributions of IKS are well documented, several critical gaps remain. First, research often isolates conservation or tourism impacts rather than examining how indigenous practices simultaneously sustain ecosystems and livelihoods through ecotourism. Second, Southeast Asian cases are seldom synthesized to identify shared sustainability principles that could inform

policy and development models. Third, Indigenous Peoples are too often portrayed as passive beneficiaries instead of decision-makers in conservation and tourism governance (Lasco et al. 2020; Nguyen et al. 2022). These gaps limit the academic and policy relevance of existing scholarship and obscure community agency.

This study addresses these concerns through the case of the Manobo communities in Arakan, North Cotabato, where indigenous ecological practices intersect with emerging ecotourism initiatives. Arakan is characterized by forests, waterfalls, and sacred sites, making it both a conservation landscape and a growing tourism destination. Understanding how Manobo practices contribute to biodiversity protection, cultural continuity, and livelihood diversification provides empirical insight into the integration of IKS with ecotourism.

Building on this context, the study makes three key contributions: (i) documenting how Manobo ecological practices, including rotational farming, sacred site stewardship, ritual-based water governance, and agroforestry, serve as conservation strategies and livelihood supports; (ii) evaluating intersections between IKS and ecotourism, highlighting opportunities and risks; and (iii) situating these findings within a broader Southeast Asian perspective to inform sustainability models. The study pursues six objectives aligned with the integration of IKS in ecotourism planning, socio-economic development, and environmental governance.

Based on these gaps and objectives, the study hypothesizes that stronger adherence to Indigenous Knowledge Systems is associated with enhanced ecological stewardship and improved livelihood outcomes through community-led ecotourism. This hypothesis reflects the assumption that indigenous knowledge not only supports environmental sustainability but also creates economic opportunities when appropriately integrated into development initiatives. By outlining a conceptual pathway for this integration, the research advances both theoretical understanding and practical approaches to inclusive, culturally grounded development. Furthermore, the findings are expected to inform policymakers, practitioners, and local stakeholders on how to effectively incorporate IKS into sustainable tourism and conservation strategies (Bennett et al. 2016; Dawson et al. 2021).

MATERIALS AND METHODS

Research location and population

The study was conducted in Arakan, North Cotabato, Philippines, particular around the ecotourism spots, namely Matigol Falls (C632+M4R, Arakan, Cotabato), Gambodes Falls (F64C+38R, Arakan, Cotabato), and Aguas Falls (9567+43W, Arakan, Cotabato) (Figures 1 and 2), focusing on its indigenous people who are known for their traditional, environmentally friendly practices. The local ecotourism operators, and other stakeholder groups, including relevant local government officials, and the NGOs concerned with sustainable tourism, were included in the target population.

Theoretical framework

This study is anchored on two complementary frameworks: Traditional Ecological Knowledge (TEK) (Berkes 2018) and socio-ecological resilience theory (Folke et al. 2010). TEK frames Indigenous Knowledge Systems (IKS) as culturally embedded practices that regulate resource use through accumulated ecological understanding, ritual, and social norms. Resilience theory extends this perspective by explaining how such practices enhance a community's ability to absorb shocks, adapt to environmental and economic pressures, and maintain core functions (Figure 3).

Taken together, these frameworks allow the study to analyze not only the existence of IKS but also their transformative potential. Specifically, IKS practices in Arakan are interpreted as ecological and cultural assets that strengthen resilience by sustaining biodiversity, regulating land and water systems, and reinforcing collective governance. Resilience, in turn, becomes the mechanism through which these practices support adaptive livelihood strategies, including ecotourism (Sterling et al. 2017; Sato et al. 2018).

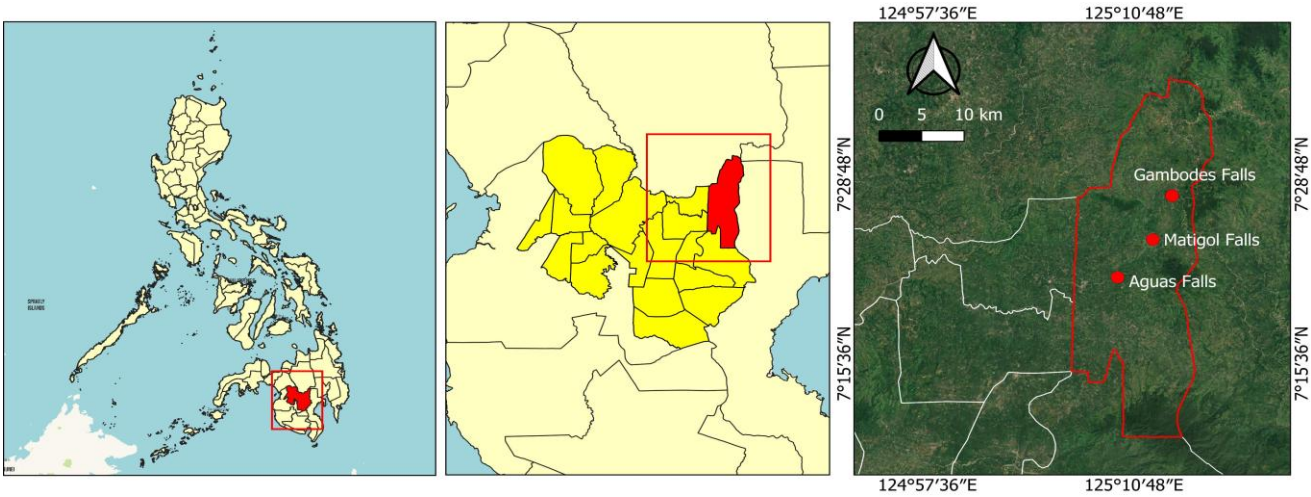

Figure 1. Location of the study sites in Arakan, North Cotabato, Philippines: Matigol Falls, Gambodes Falls, and Aguas Falls

Figure 2. The three ecotourism falls in Arakan, Philippines: A. Matigol Falls; B. Gambodes Falls; C. Aguas Falls

Figure 3. Conceptual diagram of the study. Indigenous Knowledge Systems (IKS) are conceptualized as ecological and cultural practices that contribute to resilience through adaptive capacity, ecological stewardship, and cultural continuity. Strengthened resilience, in turn, supports ecotourism outcomes, including sustainable livelihoods, cultural preservation, and environmental sustainability. The framework anchors the study on Traditional Ecological Knowledge (Berkes 2018) and socio-ecological resilience theory (Folke et al. 2010)

Research design

This study adopted a convergent parallel mixed-methods design (Creswell and Clark 2018) to examine the role of Indigenous Knowledge Systems (IKS) in environmental conservation and sustainable livelihoods through ecotourism. In this design, quantitative and qualitative strands are implemented concurrently, analyzed separately, and then integrated to provide a comprehensive interpretation.

This approach was selected because it enables the study to move beyond description toward explanation: quantitative findings establish the extent of practices and their perceived impacts, while qualitative evidence clarifies *how* and *why* these practices influence ecological stewardship and livelihood strategies. The integration of both strands strengthens the validity of interpretations and situates indigenous knowledge within broader discussions on sustainability science and ecotourism.

Sampling

The study utilized purposive sampling in selecting information-rich respondents from indigenous communities surrounding Matigol Falls, Gambodes Falls, and Aguas Falls in Arakan, North Cotabato. Participants were chosen based on their direct involvement in traditional ecological practices and local ecotourism activities. These included community elders, cultural knowledge holders, local tour guides, environmental stewards, as well as women and youth engaged in tourism-related roles. Coordination with the Municipal Tourism Office and the Indigenous Peoples Mandatory Representative (IPMR) helped identify appropriate respondents, and tribal leaders validated the final selections to ensure cultural appropriateness and community acceptance. Efforts were made to ensure balanced representation across the three sites and various community roles. All participants were briefed on the study's purpose, and informed consent was obtained, with strict adherence to cultural protocols throughout the data collection process.

Data collection

Data were collected through a combination of qualitative and quantitative techniques. A structured survey was administered to 60 purposively selected Manobo community members who actively engage in indigenous ecological practices and ecotourism-related activities. The survey instrument included items measuring key constructs such as the extent of indigenous ecological practices, perceptions of environmental conservation, and the perceived livelihood benefits of ecotourism, with responses rated using a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). To enrich the data, three Focus Group Discussions (FGDs) were conducted with five participants each, representing elders, women, and youth,

to capture diverse generational and gendered perspectives. In addition, ten key informant interviews were carried out with tribal elders, local tourism officers, and environmental stewards using semi-structured guides to explore nuanced insights into ritual practices, land-use governance, and tourism perceptions. Participant observation was employed during community visits and cultural rituals to contextualize responses and validate behaviors. Transect walks were conducted alongside community guides to document sacred sites, ecological zones, and culturally significant landscape features.

Data analysis

Quantitative data were encoded and processed using SPSS software and analyzed using descriptive statistical tools such as frequency counts, percentages, and cross-tabulations to determine the extent of practice adoption and its economic impacts. Pearson's correlation coefficient was also applied to examine relationships between tourism-related activities and their socio-economic or environmental effects. Qualitative data collected from FGDs and interviews were analyzed through thematic coding to ensure the validity and reliability of the data, the study employed data triangulation by comparing and corroborating results across surveys, FGDs, and observations. Survey instruments were pre-tested with a small group of respondents to ensure clarity, consistency, and reliability before full deployment. Internal consistency was verified by cross-checking related variables, and descriptive statistics were reviewed to identify potential outliers or inconsistencies. The accuracy and representativeness of the findings were further validated through participant feedback sessions, wherein selected respondents and FGD participants reviewed and confirmed the interpretation of results.

Ethical considerations

The study obtained informed consent ethical protocols, including obtaining informed consent from participants, ensuring confidentiality, and respecting indigenous cultural practices. Efforts will be made to involve local communities collaboratively, ensuring that their perspectives are respected and valued throughout the research process.

RESULTS AND DISCUSSION

This section presents the key findings of the study based on survey results, focus group discussions, and field observations conducted across the three ecotourism sites in Arakan, North Cotabato. The analysis is structured around five thematic areas aligned with the research objectives: (i) indigenous knowledge systems in environmental conservation; (ii) the role of indigenous practices in supporting sustainable livelihoods; (iii) community perceptions on the potential of ecotourism; (iv) the socio-economic and environmental impacts of ecotourism, and (v) implications for integrating indigenous knowledge into ecotourism planning. The results are presented in tabular form with supporting narrative analysis, highlighting both quantitative trends and qualitative insights. Each section discusses how indigenous practices contribute to biodiversity conservation, income generation, cultural preservation, and environmental awareness, while also addressing emerging concerns such as cultural commodification and ecological degradation. These findings underscore the critical role of indigenous knowledge in shaping inclusive, sustainable, and resilient tourism frameworks rooted in local contexts.

Indigenous knowledge systems in environmental conservation

Table 1 presents the documented indigenous practices for environmental conservation observed among the respondents in Arakan, North Cotabato. The most commonly reported practice is rotational farming, cited by 65% of participants. This method involves cyclically shifting agricultural activities between plots to allow natural regeneration of the soil, maintaining its fertility, and minimizing pest buildup. Sacred grove conservation, reported by 55% of respondents, reflects the community's deep spiritual and cultural connection to specific forest areas, which are preserved out of respect for ancestral beliefs and traditional taboos. Meanwhile, water management rituals, practiced by 50% of participants, consist of ceremonial offerings and seasonal observances near springs, rivers, and other water bodies to promote collective responsibility and sustainable use of freshwater resources. In addition, 45% of respondents reported practicing traditional agroforestry, which involves the integration of native trees or fruit-bearing species within agricultural plots. This practice contributes to soil stabilization, biodiversity enhancement, and the creation of microclimates beneficial for crop growth. Lastly, indigenous soil conservation techniques were noted by 40% of participants, who use natural materials such as bamboo, stones, and native grasses to construct physical barriers against soil erosion, particularly in upland and sloped areas. These diverse practices highlight the ecological sophistication and cultural depth of indigenous environmental management systems in Arakan.

These results are consistent with participant narratives. A male elder expressed a deep cultural and ecological value in these practices, often linking them not only to environmental benefits but also to their sense of identity, ancestry, and moral responsibility to the land. One elder shared with quiet conviction:

"The soil, like a person, needs time to rest. When we let it rest, it gives back more the next time." - Male elder

For many, the protection of sacred groves is about more than biodiversity; it's about honoring ancestral spirits and preserving the community's spiritual balance. A community leader explained:

"That forest is sacred. Protecting it is not something we debate; it is our obligation." - Female community leader

Water rituals also remain a vital part of community life, especially during planting and harvest seasons. A young participant, when asked about these rituals, shared:

"Before we take water from the spring, we give thanks through prayer or offerings." - Youth FGD participant

These narratives position conservation not merely as resource management, but as a profound responsibility rooted in relationships with the land, community, and ancestry.

Economic contribution of indigenous knowledge to livelihoods

Table 2 illustrates the diverse economic contributions of indigenous knowledge-based activities to household incomes in Arakan, North Cotabato. The findings reveal that indigenous practices are deeply embedded in local livelihood strategies and are essential to both income generation and sustainable resource management. Rotational farming remains the most significant contributor to household income, accounting for 30% of total earnings. Sixty households reported monthly incomes ranging between PHP 5,000 and PHP 7,000 from this activity. This practice is grounded in indigenous knowledge related to soil fertility management and native crop selection.

Fishing and aquatic resource management contribute 20% of household income and are practiced by 35 households. These activities are supported by traditional ecological knowledge, particularly regarding seasonal fishing cycles and the use of sustainable gear. The collection of forest products, such as medicinal plants and wild fruits, adds another 25% to household income, with 40 households engaged. The average monthly contribution from this practice ranges from PHP 4,000 to PHP 6,000, made possible by the application of indigenous knowledge in sustainable harvesting techniques.

Agroforestry and tree planting contribute 15% of income, involving 45 households. These practices utilize indigenous techniques such as intercropping, strategic tree placement, and traditional planting calendars to enhance ecological balance and food security. Finally, ecotourism-related activities account for 10% of household income. This includes cultural performances, guiding, and handicraft production, with 25 households engaged. These activities represent a blend of livelihood generation and cultural expression, supported by traditional ecological and cultural knowledge.

Table 1. Documented indigenous practices for environmental conservation

Indigenous practice	Description	Environmental benefit	Cultural significance	Frequency of use (%) (n=60)
Rotational Farming	Shifting cultivation on different plots to allow soil recovery.	Maintains soil fertility, reduces soil erosion, and prevents nutrient depletion.	Preserves crop diversity and indigenous knowledge of soil management.	65%
Sacred Groves	Protection of certain forest patches due to spiritual beliefs.	Biodiversity hotspots, conservation of rare species, and protection from logging.	Reflects spiritual connection to land and ancestral reverence.	55%
Water Management Rituals	Traditional ceremonies aimed at protecting springs and rivers.	Reduces contamination of water sources and supports sustainable water use.	Symbolizes respect for natural water bodies as life sources.	50%
Traditional Agroforestry	Planting fruit trees and native tree species alongside crops.	Provides habitat for diverse species, enriches the soil, and prevents erosion.	Integrates forest resources into agricultural practices.	45%
Indigenous Soil Conservation	Building natural barriers using stones and native grass to prevent soil runoff.	Reduces surface runoff and soil erosion, conserves soil moisture.	Demonstrates traditional land management skills.	40%

Table 2. Economic contribution of indigenous knowledge to livelihoods

Activity	Contribution to household income (PHP/month)	Percentage of total income	Number of households engaged	Use of indigenous knowledge
Rotational Farming	PHP 5,000 - PHP 7,000	30%	60	Soil fertility maintenance, native crop selection
Fishing and Aquatic Resource Management	PHP 3,500 - PHP 5,000	20%	35	Knowledge of sustainable fishing seasons, gear use
Collection of Forest Products	PHP 4,000 - PHP 6,000	25%	40	Identification of medicinal plants, wild fruits
Agroforestry and Tree Planting	PHP 2,500 - PHP 4,000	15%	45	Management of multi-species planting
Ecotourism-related Activities	PHP 1,000 - PHP 2,000	10%	25	Cultural performances, guiding, handicrafts

Note: 1 USD = PHP 56

Table 3. Community perceptions on ecotourism potential

Perceived benefit	% of respondents (n=60)	Description	Ranking
Income generation	85%	Participants emphasized additional earnings from guiding services, sales of local products, and cultural performances.	1
Cultural preservation	75%	Community members valued the opportunity to showcase and preserve their cultural traditions.	2
Environmental awareness	70%	Participants highlighted the role of ecotourism in promoting conservation awareness among tourists.	3
Community empowerment	60%	Greater involvement in ecotourism planning was seen as a means to enhance community self-determination.	4
Risks of cultural commodification	40%	Concerns were raised about the potential dilution of cultural practices for tourist consumption.	5

Table 4. Perceived socio-economic and environmental impacts of ecotourism

Impact category	Positive impact (%)	Negative impact (%)	Description	Correlation with tourism activities	p-value
Income and employment	70%	15%	New job opportunities in guiding and handicraft production.	Strong (0.75)	0.01
Cultural preservation	65%	25%	Revival of traditional dances and rituals for tourists.	Moderate (0.60)	0.05
Environmental awareness	60%	20%	Increased community engagement in conservation programs.	Moderate (0.55)	0.05
Environmental degradation	20%	50%	Reports of increased waste and habitat disturbance in sensitive areas.	Strong (0.70)	0.01
Cultural commodification	10%	40%	Concerns about the authenticity of performances and practices.	Weak (0.45)	0.05

Note: If p-value is < 0.05 = significance. ±0.81 to ±0.99 = Very Strong Correlation; ±0.61 to ±0.80 = Strong Correlation; ±0.41 to ±0.60 = Moderate Correlation; ±0.21 to ±0.40 = Weak Correlation; ±0.01 to ±0.20 = Very Weak Correlation

Perceived socio-economic and environmental impacts of ecotourism

Tables 3 and 4 collectively show that community members recognize both opportunities and challenges associated with ecotourism in Arakan, North Cotabato. As indicated in Table 3, the most widely known benefit of ecotourism is income generation, cited by 85% of the respondents. This finding is reinforced by Table 4, where 70% of respondents reported increased income and employment opportunities-particularly in guiding and handicraft production-with a strong correlation of 0.75 to tourism activities. These positive outcomes suggest that community-led ecotourism can significantly contribute to sustainable livelihood diversification.

Ecotourism also fosters cultural pride and environmental awareness, as respondents highlighted its role in strengthening local identity and encouraging participation in conservation efforts. These benefits reflect the community's recognition that tourism can reinforce both cultural and environmental values.

However, concerns about cultural commodification and ecological pressures were likewise evident. As shown in Table 3, 40% of respondents expressed worry that cultural traditions might be diluted for tourist entertainment. A similar finding in Table 4 shows 10% of respondents identifying cultural commodification as a negative outcome of ecotourism, indicating that this issue, while not yet widespread, is emerging and should not be overlooked. Additionally, community members noted ecological concerns such as waste accumulation and habitat disturbance, risks that increase with higher tourist presence near sensitive areas.

Pearson's correlation analysis examined the relationship between the level of tourism activities (measured by frequency of tourist visits and household engagement in tourism services) and selected socio-economic and environmental indicators. A strong positive correlation was found between tourism activity and household income/employment ($r = 0.75$, $p < 0.01$), indicating that increased tourism is significantly associated with improved economic outcomes. Moderate positive correlations were observed between tourism activity and cultural preservation ($r = 0.60$, $p < 0.05$) and environmental awareness ($r = 0.55$, $p < 0.05$). However, tourism activity was also strongly associated with environmental degradation ($r = 0.70$, $p < 0.01$), suggesting increased ecological pressure in high-traffic areas. A weaker but significant correlation was found between tourism and cultural commodification ($r = 0.45$, $p < 0.05$). These results indicate that while tourism enhances livelihoods and cultural visibility, it simultaneously introduces measurable environmental and cultural risks.

Taken together, the results reveal a dual dynamic: ecotourism supports income and cultural continuity, yet it can also introduce potential risks to cultural authenticity and environmental integrity when not carefully managed.

These insights emphasize the need for robust governance mechanisms that ensure ecotourism development respects indigenous values, avoids cultural distortion, and is implemented with strong environmental safeguards.

Discussion

The findings of this study demonstrate that Indigenous Knowledge Systems (IKS) in Arakan function not merely as a collection of traditional practices but as an integrated socio-ecological system that shapes environmental governance, cultural identity, and livelihood strategies. Practices such as rotational farming, sacred grove protection, ritual-based water management, agroforestry, and soil conservation illustrate how environmental stewardship is embedded within cultural norms and ancestral obligations. Rather than being technical resource management strategies alone, these practices reflect what Traditional Ecological Knowledge (TEK) scholars describe as knowledge-practice-belief complexes, where ecological management is inseparable from cultural meaning and spiritual responsibility (Berkes 2018). In this sense, conservation in Arakan is not an external environmental agenda but a culturally embedded system of stewardship transmitted across generations.

The ecological practices observed in Arakan also align with patterns documented in other Southeast Asian indigenous communities, suggesting that culturally embedded environmental governance is a regional phenomenon. Rotational farming, which allows land to recover through fallow periods, resembles shifting cultivation systems practiced by the Tagbanua and Pala'wan in Palawan that have been shown to maintain biodiversity when external pressures are minimal (Novellino and Dressler 2010). Similarly, sacred grove protection mirrors conservation systems such as the sasi tradition in Maluku and customary forest zoning among Dayak communities in Kalimantan, where spiritual sanctions regulate resource use and discourage overexploitation (Njau et al.2019). Ritual-based water management in Arakan also parallels Bali's subak irrigation system, in which religious ritual's structure collective water governance. These parallels reinforce the argument that indigenous environmental practices across the region operate as culturally legitimized conservation institutions rather than informal or primitive systems. The findings therefore support the TEK perspective that indigenous knowledge contributes to biodiversity conservation through culturally embedded governance structures.

Beyond environmental stewardship, the study reveals that IKS also serves as the economic backbone of local livelihoods. Rotational farming and forest product gathering remain the primary contributors to household subsistence, while fishing, agroforestry, and ecotourism provide supplementary income. This pattern suggests that ecotourism in Arakan functions primarily as a diversification strategy rather than a livelihood replacement. From a resilience theory perspective, such diversification may strengthen the community's adaptive capacity by spreading economic risk across multiple livelihood sources. Resilience theory emphasizes that socio-ecological systems become more stable when communities maintain diverse resource-use strategies capable of responding to environmental or economic shocks. In Arakan, the coexistence of farming, forest resource use, and emerging tourism activities indicates a form of livelihood hybridity that potentially enhances resilience. However, the findings also suggest that tourism remains financially modest compared to traditional activities, reinforcing the continued importance of indigenous production systems in maintaining community stability.

Despite these positive contributions, the results highlight important social and governance complexities that challenge optimistic assumptions about community-based ecotourism. Women and youth play visible roles in handicraft production, cultural performances, and tourism-related activities, yet leadership and decision-making remain largely male-dominated or externally mediated. This pattern both supports and complicates existing scholarship on gender and tourism. Scheyvens and Biddulph (2018) argue that tourism can create economic opportunities for women while simultaneously reproducing structural inequalities when control over resources and decision-making remains limited. The situation in Arakan reflects this duality: women benefit from additional income opportunities but are not proportionately represented in governance or revenue distribution processes. The findings therefore reinforce critiques that community-based tourism does not automatically produce empowerment unless institutional mechanisms actively promote equitable participation.

Another significant theme emerging from the study is the ambivalence of community perceptions toward ecotourism. Respondents recognize the potential benefits of tourism, including increased income, cultural revitalization, and environmental awareness. At the same time, they express concern that tourism may commodify sacred traditions or place additional pressure on fragile ecosystems. This tension reflects broader debates in tourism studies regarding the cultural impacts of heritage-based tourism. Cole (2007) observed similar dynamics in Bali and Batak communities, where rituals gradually transformed into staged performances designed for visitors. Recent scholarship also suggests that commodification risks are heightened when tourism development prioritizes market demand over cultural meaning (Bai and Weng 2023). In Arakan, the concern that rituals might lose their sacred value if performed solely for tourists indicates that cultural authenticity remains a central issue in the integration of IKS and tourism.

Environmental impacts further complicate this picture. While respondents acknowledged that ecotourism increases awareness of environmental protection, they also identified ecological disturbances associated with visitor activities, such as waste accumulation and habitat disruption. This contradiction underscores a critical challenge for ecotourism development: the industry's success depends on natural landscapes, yet unmanaged tourism can degrade those very ecosystems. Similar outcomes have been

documented in ecotourism destinations such as Puerto Princesa and Tangkoko, where rapid tourism growth exceeded local environmental management capacity (Beudels-Jamar et al. 2016). The findings therefore suggest that ecological sustainability in Arakan cannot rely solely on cultural conservation practices but must also incorporate institutional regulations for visitor management and environmental protection.

Governance structures appear to be a decisive factor shaping these outcomes. Although many respondents associate ecotourism with empowerment, interviews reveal that decision-making authority often remains concentrated among local government units and external development organizations rather than within the indigenous community itself. This reflects what Dressler et al. (2016) describe as tokenistic participation, where communities are consulted but lack real authority over resource governance. The limited legal recognition of ancestral domains in Arakan further constrains indigenous communities' ability to enforce customary conservation rules. Such conditions weaken the institutional foundations of indigenous stewardship, echoing similar conflicts in Kalimantan (Indonesia) where industrial land concessions have undermined customary tenure systems (Myers et al. 2017). These findings highlight that the long-term viability of IKS depends not only on cultural continuity but also on formal recognition of indigenous governance rights.

Taken together, these findings reveal that the relationship between IKS and ecotourism in Arakan is characterized by dynamic tension rather than straightforward synergy. On one hand, tourism can create opportunities for cultural revitalization, income diversification, and environmental awareness. On the other hand, it can introduce pressures that risk cultural commodification, ecological degradation, and unequal benefit distribution. This ambivalence should not be interpreted as a failure of community-based ecotourism but rather as evidence of the complex realities that communities face when integrating traditional systems with modern economic activities.

From a theoretical perspective, the results demonstrate how TEK and resilience theory intersect in shaping community responses to tourism development. TEK provides the cultural knowledge base that guides environmental stewardship, while resilience theory helps explain how communities adapt to changing economic opportunities. The emergence of ecotourism in Arakan can therefore be understood as an adaptive strategy within a broader socio-ecological system, where traditional practices continue to anchor environmental management while new livelihood opportunities are cautiously incorporated. The community's mixed perceptions of tourism illustrate an ongoing process of adaptation in which cultural values, economic needs, and environmental constraints are constantly negotiated.

Based on these insights, this study proposes a refined conceptual model for integrating Indigenous Knowledge Systems and ecotourism. While the initial framework (Figure 3) conceptualized IKS as a foundation for environmental conservation and livelihood development, the findings suggest that three additional mediating factors must be incorporated: governance structures, equity in participation, and ecological risk management. In this refined model, IKS remains the core knowledge system supporting conservation and livelihoods, but the success of ecotourism depends on inclusive governance arrangements, equitable distribution of benefits, and institutional mechanisms to regulate environmental impacts. Without these mediating factors, tourism development may weaken rather than strengthen indigenous socio-ecological resilience.

This study demonstrates that Indigenous Knowledge Systems (IKS) play a central role in biodiversity conservation, cultural revitalization, and livelihood enhancement among the Manobo communities of Arakan, North Cotabato. Traditional practices such as rotational farming, sacred grove protection, ritual-based water management, and agroforestry continue to function as culturally grounded mechanisms for environmental stewardship while simultaneously supporting household subsistence and local identity. The emergence of ecotourism has created additional opportunities for income generation and cultural visibility, indicating that tourism can complement traditional livelihoods when carefully aligned with indigenous knowledge systems. However, the findings also reveal important challenges. While ecotourism contributes to economic diversification and cultural awareness, it simultaneously introduces risks of cultural commodification, environmental pressure, and unequal participation in decision-making. These tensions underscore that ecotourism is not inherently sustainable; rather, its outcomes depend on governance arrangements that respect indigenous authority and ecological limits.

To address these challenges, the integration of IKS into ecotourism development should move beyond symbolic recognition toward institutionalized community leadership. Based on the findings of this study, a practical approach would involve the establishment of community-based co-management structures, such as a local ecotourism management committee composed of tribal elders, women's representatives, youth leaders, and local government officials. Within this structure, elders could hold advisory or veto authority on matters related to sacred sites, rituals, and cultural performances to prevent inappropriate commercialization of traditions. In addition, tourism guidelines grounded in customary norms-such as codes of conduct for visitors based on traditional rules governing forests, water sources, and sacred spaces-could help regulate tourist behavior and protect culturally significant landscapes. Environmental safeguards, including visitor limits, waste management systems, and community monitoring of ecological impacts, would further ensure that tourism activities remain compatible with conservation goals.

Ultimately, strengthening the role of indigenous institutions in tourism governance is essential for maintaining the balance between cultural preservation, ecological sustainability, and economic opportunity. When supported by inclusive governance frameworks and recognition of customary authority, Indigenous Knowledge

Systems can serve not only as a foundation for conservation but also as a guiding framework for responsible and culturally respectful ecotourism development.

While the study provides valuable community-based insights, it is important to note, however, that these findings are subject to several limitations. The research focuses on three ecotourism areas and relies largely on self-reported perceptions, which may not capture long-term or indirect impacts. Additionally, the cross-sectional design provides a current snapshot, but trends may shift as tourism grows. Future research should incorporate longitudinal monitoring and include external stakeholders such as local government units and tourism operators for deeper socio-political analysis.

To support culturally grounded and environmentally sound ecotourism, the following policy recommendations are proposed: (i) Strengthen community ownership and leadership in ecotourism planning, management, and benefit-sharing by establishing participatory decision-making bodies where Indigenous leaders, elders, women, and youth have meaningful representation and authority; (ii) Develop and enforce cultural safeguarding guidelines that protect sacred rituals, sites, and traditions from distortion or inappropriate commercialization, ensuring that tourism activities respect Indigenous cultural values and authenticity; (iii) Implement and adequately fund visitor management systems, including visitor limits, zoning of sensitive ecological areas, and community-led environmental monitoring to prevent ecological degradation in ecotourism destinations; (iv) Provide targeted skills training and capacity-building programs that support Indigenous entrepreneurship, community-based tourism enterprises, and sustainable tourism management practices; (v) Institutionalize partnerships among Indigenous leaders, local governments, tourism offices, and non-governmental organizations to align tourism policies and development programs with Indigenous Knowledge Systems (IKS) and customary governance structures.

Supporting the integration of Indigenous Knowledge Systems in ecotourism planning can advance a biocultural model of development in which environmental protection, cultural integrity, and community well-being reinforce one another, ensuring that tourism development strengthens rather than undermines Indigenous socio-ecological resilience.

In conclusion, this study demonstrates that Indigenous Knowledge Systems (IKS) play a central and measurable role in biodiversity conservation, cultural continuity, and livelihood enhancement among the Manobo communities in Arakan, North Cotabato. Furthermore, the study confirms that stronger adherence to IKS supports ecological resilience and livelihood diversification, but underscores that sustainable outcomes depend on inclusive governance, equitable participation, and the institutional integration of indigenous knowledge into ecotourism planning to ensure that development reinforces rather than undermines both cultural integrity and environmental sustainability.

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