

ICCAs as a Bio-Geo-Cultural Foundation for Strengthening the Aspiring Sangkulirang–Mangkalihat Geopark

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ABSTRACT

The Sangkulirang–Mangkalihat karst landscape in East Kalimantan possesses exceptional bio-geocultural value and has historically been safeguarded by the Dayak Basap Indigenous community. While Indigenous and Community Conserved Areas (ICCAs) and Geoparks both aim to promote sustainable land management, the synergistic integration of Indigenous spiritual-ecological practices within formal Geopark frameworks remains underexplored, particularly in tropical karst environments. To address this research gap, this study examined the integration of ICCAs within the Geopark framework to promote participatory conservation and responsible tourism. Employing a qualitative methodology comprising ethnographic fieldwork, in-depth interviews with Indigenous stakeholders, and field observations, this research evaluated traditional conservation mechanisms. The findings revealed that the traditional governance systems and cultural rituals of the Dayak Basap community maintained ecological and spiritual balance, reflecting the core principles of ICCAs. The study identified three specific ICCAs—Mengkuris Cave, Mount Kepang, and Kiamplasan—that uniquely integrated heritage, ecological, and community values. The integration of these frameworks demonstrated a strong complementary relationship; ICCAs provided social, cultural, and spiritual foundations, while Geoparks offered institutional recognition, technical support, and international networks to support sustainable geotourism. These findings provided important policy implications, suggesting that regional and national governments should formally incorporate ICCA recognition into Geopark zoning regulations to strengthen the legal protection of Indigenous governance systems. Ultimately, this synergy established a replicable model for responsible tourism that balances biodiversity conservation, cultural resilience, and equitable development, providing a critical framework for advancing global socio-ecological sustainability efforts.

INTRODUCTION

Indonesia possesses exceptional geological resources, reflected in various sites that preserve evidence of the Earth's long history (Septian et al., 2019). These sites have increasingly been designated as Geoparks, which are managed based on three main pillars: conservation, education, and local economic development (UNESCO, 2015). Although these frameworks are designed to protect geoheritage and support sustainable tourism (Rahmasari &

Parameswari, 2020), current management approaches often prioritize physical geoscientific aspects over local governance systems (Bassi, 2012; Stoffelen, 2020). Consequently, Geopark management frequently lacks meaningful community involvement, resulting in perceptions among local residents that Geoparks provide limited benefits to their welfare (Ibrahim et al., 2021). This situation reflects a persistent gap between participatory governance principles and their practical implementation, despite the widely recognized importance of active local community participation in ensuring the long-term sustainability of Geoparks (Mammadova et al., 2022; Worboys, 2015).

To address this gap, the integration of Indigenous and Community Conserved Areas (ICCAs) into the Geopark framework offers a highly complementary approach by combining geoheritage protection with community-based natural resource management (Berkes, 2009; Stevens et al., 2024). Recognized by the Convention on Biological Diversity (CBD) and the International Union for Conservation of Nature (IUCN), ICCAs utilize existing customary governance systems and local ecological knowledge to support environmental protection (Borrini-Feyerabend et al., 2014; Wali et al., 2017). International case studies, including overlapping conservation areas in Italy, sacred natural sites in Nepal, and conservation initiatives on Qeshm Island, demonstrate that the application of ICCA principles can effectively bridge the gap between formal conservation objectives and local socio-cultural benefits (Arjjumend et al., 2017; Dominguez & Benessaiah, 2017; Ghayoumi, 2014; Jana & Paudel, 2010). This integration is consistent with the IUCN paradigm that promotes rights-based and collaborative governance while respecting Indigenous territories (Stevens, 2010).

Despite this global potential, a significant research gap remains regarding the role of ICCAs within Geopark governance systems in Southeast Asia. Previous studies in the region, such as research on the Langkawi Geopark in Malaysia (Ibrahim et al., 2021) and the Kinabalu UNESCO Global Geopark (Dousin et al., 2024), have frequently emphasized community participation but have primarily positioned Indigenous communities as tourism actors or cultural components rather than as central governance entities. Furthermore, implementing collaborative governance in Indonesia presents distinct challenges. Formal recognition of Indigenous-managed areas remains limited (Pradhani, 2019), while national Geopark management systems often continue to adopt top-down approaches with uneven levels of community engagement (Rahmatin & Nawangsari, 2025).

A critical case that illustrates this governance gap and faces increasing environmental pressures is the Aspiring Sangkulirang–Mangkalihat Geopark (Sunkar et al., 2022). This area, renowned for its unique 51,800-year-old handprint cave site (Aubert et al., 2018; Sunkar et al., 2022), represents the living territory of the Dayak Basap Indigenous community, whose local wisdom-based management practices align with ICCA principles. The urgency of investigating this site is driven by ongoing threats from extractive activities, including mining and industrial timber plantations, which may endanger both geoheritage sites and local livelihoods. Currently, the customary areas managed by the Dayak Basap community possess significant cultural and ecological value but have not yet been explicitly integrated into the formal Geopark management system. Unlike previous studies that have overlooked the governance capacity of Indigenous communities, the novelty of this research lies in conceptualizing ICCAs not merely as cultural attractions but as existing governance systems that function as a bio-geocultural foundation for participatory Geopark management (Denis et al., 2022).

To address these challenges and reduce fragmentation in management practices, this study aims to: (1) identify the characteristics of ICCAs within the Dayak Basap region, and (2) examine the potential integration of these ICCAs into the management framework of the Aspiring Sangkulirang–Mangkalihat Geopark. By achieving these objectives, this research provides two major contributions. Theoretically, it expands the literature on sustainable geotourism by integrating Indigenous governance perspectives with Geopark conservation frameworks. Practically, it provides important policy implications for regional governments and Geopark management authorities by proposing a strategic framework for incorporating customary laws into Geopark Master Plans and regional spatial planning (Rencana Tata Ruang Wilayah / RTRW). This approach aims to establish a balance between ecological conservation, UNESCO Global Geopark recognition, and the protection of Indigenous rights.

METHOD

Study Area and Research Design

This research was conducted in January 2025 in Batu Lepoq Village, East Kutai Regency, East Kalimantan, focusing on the Dayak Basap Indigenous community within the Aspiring Sangkulirang–Mangkalihat karst landscape. A mixed-method approach was employed, combining qualitative ethnographic research to examine socio-cultural aspects and participatory spatial analysis to identify customary territories.

Sampling Strategy and Participant Profile

To ensure a comprehensive and representative community consensus, a purposive sampling strategy was utilized. Informants were selected based on specific criteria: deep knowledge of customary law, active involvement in land management, historical understanding of the landscape, and representation of marginalized voices within the community. A total of 21 key participants were selected. The detailed profile of the participants is presented in Table 1.

Table 1. Profile of Research Participants

Participant Category	Quantity	Selection Criteria
Customary Leaders	1	Hold authority over customary laws and have deep knowledge of traditional area management.
Community Elders	3	Serve as historical knowledge keepers with a deep understanding of culturally significant areas.
Village Officials	1	Act as the link between formal village administration and traditional customary governance.
Women/Housewife Figures	5	Provide perspectives on domestic land use, medicinal plants, and women's roles in conservation.
Youth Figures	11	Represent the next generation, offering insights into cultural continuity and future community development.
Total Participants	21	

Ethical Procedures

Strict ethical guidelines were followed throughout the research. Prior to any data collection, Free, Prior, and Informed Consent (FPIC) was obtained from all traditional authorities and individual participants. The research objectives, data usage, and the participatory mapping process were clearly explained in a culturally appropriate manner. Participants were explicitly informed of their voluntary participation, their right to withdraw from the study at any time without consequence, and the guarantee of anonymity regarding sensitive cultural information unless explicit permission was granted for publication.

Data Collection and Validation Process

Primary qualitative data were gathered through in-depth interviews with traditional leaders and Focus Group Discussions (FGDs) with the broader participant groups to explore traditional conservation values and collectively manage culturally significant areas. Spatial data, including the boundaries of customary utilization zones and sacred sites, were mapped through participatory community tracking and digitized using ArcMap.

To ensure the rigor and credibility of the findings, a two-tiered data validation process was implemented:

1. **Qualitative Validation**

Data rigor was established through source triangulation (cross-verifying information across interviews, FGDs, and field observations) and member checking, where preliminary interpretations were presented back to the customary leaders to confirm accuracy and prevent misinterpretation of Dayak Basap cultural values.

2. **Spatial Validation**

The digitized spatial features were validated through rigorous community-led ground-truthing to ensure the mapped boundaries accurately reflected the community's lived realities and traditional spatial knowledge.

Data Analysis

Data analysis followed an ethnographic interpretation approach (Fiantika et al., 2022) to decode the meanings behind indigenous practices. Furthermore, the analysis adapted the High Conservation Value (HCV) 6 framework (Brown et al., 2013) which focuses on areas critical to local communities' traditional cultural identity alongside ICCA guidelines (UNEP-WCMC & ICCA Consortium, 2021). This integrated analytical framework assesses cultural significance and community-based conservation potential, emphasizing traditional governance and cultural continuity as integral elements for sustainable landscape management within the Geopark context.

RESULT AND DISCUSSION

Empirical Findings : Traditional Governance and ICCAs Identification

The Dayak Basap indigenous community originates from Batu Lepoq Village, Batu Lepoq Hamlet, which since 1934 has had a customary structure under the recognition of the Kutai Kartanegara Kingdom through the appointment of Loekahan as the customary chief. To this day, the Dayak Basap community still preserves various traditional rituals such as *Erau*, *Pelas tanah*, and *Belian*, which reflect their spiritual connection with nature and their ancestors. The *Erau* ritual is an expression of gratitude for the harvest, featuring dances, traditional games, and a procession of offerings to the river spirits. *Pelas tanah* (Figure 1) is performed to honor the guardians of the forest and maintain the balance of the ecosystem through animal sacrifices, accompanied by taboos such as a three-day ban on activities in the forest. Meanwhile, *Belian* serves as a ritual of healing and protection from spirit disturbances, while maintaining harmony between humans and nature.



Figure 1: *Pelas tanah*

The presence of these various cultural practices shows that the Dayak Basap local knowledge system plays an important role in managing their living space. Traditional values that emphasize ecological and spiritual balance form the basis for the establishment of ICCAs, which are areas that reflect the principles of culture-based conservation and community independence in maintaining the sustainability of natural resources in the Sangkulirang–Mangkalihat karst region. There are three ICCAs in the Dayak Basap indigenous community, namely Mengkuris Cave, Mount Kepang, and Kiamplasan.

A. Mengkuris Cave

Mengkuris Cave is a historical site with handprint paintings estimated to date back 51,800 years (Aubert *et al.* 2018; Sunkar *et al.* 2022). This site was designated a Cultural Heritage Site by the government in 2016 based on the Sangkulirang–Mangkalihat Karst Area Book published by the Ministry of Education and Culture. For the Dayak Basap community, Mengkuris Cave has sacred historical and cultural value, so they continue to preserve it. This cave has a close relationship with the local community in three main aspects: (1) dependence on livelihood and welfare, (2) local culture, and (3) social identity. Since being designated as a Cultural Heritage Site, Mengkuris Cave has been used as a speleological tourist attraction that supports the economy of the surrounding community. In addition to ecotourism, the community also utilizes the natural resources around the cave while adhering to customary rules. In Dayak culture, the forest is the main source of life, providing food, water, traditional medicines, and building materials. This makes forest conservation highly influential to the community's welfare (Romario *et al.* 2024). The initiation of ICCA protection in the area is based on social relations with the community as outlined in customary rules as an effort to protect the area. The rules in Mengkuris Cave include:

1. No immoral or indecent acts are allowed in the Mengkuris Cave area.
2. It is not permitted to place your palm on the palm paintings in Mengkuris Cave,
3. It is prohibited to work or carry out activities for 3 days after the traditional pelas tanah ritual, and
4. It is prohibited to cut down mangris or bangeris trees (*Koompassia excelsa*) because they are bee hives and a source of honey for the livelihoods of the local community.



Figure 2: Historical relics in the form of paintings in Mengkuris Cave

The protection of Gua Mengkuris by the Dayak Basap community demonstrates that customary conservation practices may indirectly contribute to geoheritage protection within the Aspiring Sangkulirang–Mangkalihat Geopark. These customary mechanisms may complement formal geopark governance by regulating visitor behavior, controlling resource extraction, and maintaining the cultural legitimacy of conservation practices at the local level. Although these practices were not originally established under formal geopark frameworks, customary restrictions on forest clearing, resource extraction, and damage to cave paintings have functioned as community-based conservation mechanisms that support the preservation of geological and archaeological values. The customary rules function as informal governance mechanisms that regulate human interaction with geoheritage sites and natural resources.

B. Mount Kepang

The second ICCA, Mount Kepang, is an area protected by the Dayak Basap indigenous community because of its significant historical and cultural value. The name Mount Kepang comes from the Dayak word *kebang*, which means overlapping. This refers to a tradition in the past where corpses were not buried, but placed in piles on the mountain. This tradition is the background for the naming of Gunung Kepang by the local community. The Dayak Basap indigenous community utilizes Gunung Kepang as a resource to meet their daily needs, especially through the utilization of forest products. This area is planted with various types of trees and medicinal plants that are used according to the needs of the community. The utilization of forest products in Gunung Kepang is limited to the needs of the community, such as the use of medicinal plants for traditional medicine.

The utilization of natural resources on Mount Kepang for medicinal plants shows the community's dependence on their livelihood. The relationship between humans and medicinal plants is realized because humans utilize plants that have properties to prevent, alleviate, or cure diseases (Indah 2024). The community rarely conducts activities on Mount Kepang due to the sacred status of the area for them. In addition, the beliefs of the surrounding community state that seeding and preservation can be done by nature itself with the help of the environment, climate, and existing wildlife. The beliefs of a community form the basis of their relationship with nature, especially the forest, which is an integral part of their lives. The close relationship between the Dayak people and nature reflects their view of balance and harmony (Kwirinus and Saeng 2023). Environmental sustainability practiced by the Dayak Basap community in Mount Kepang is manifested through norms and rules governing the extraction of natural resources. The rules in Mount Kepang include:

1. The community is allowed to cut down trees on the condition that they are used for local purposes and not for sale, for example, to build houses.
2. The community can only harvest old rattan, while young rattan must be left for regeneration on Mount Kepang
3. It is prohibited to cut down mangris or bangeris trees (*Koompassia excelsa*) because they are bee hives and a vital source of honey for the livelihoods of the local community.

C. Kiamplasan

Similar to Mengkuris Cave, Mount Kepang illustrates how sacred values and customary restrictions contribute to long-term ecological stewardship within the customary landscape. The third ICCA is Kiamplasan. Kiamplasan is a garden-like area located near the Batu Lepoq River. This land was formerly a plantation managed by the Bahari community or the previous community in 1974 and is now used by the local community as a source of fruit. They are often referred to as sailors, fishermen, or communities that depend on marine and coastal resources for their livelihood. The Bahari people usually move around in search of more abundant marine resources, such as fish, sea cucumbers, or other marine products. Batu Lepoq Village is located in East Kutai Regency, bordering Berau Regency, which according to Risfiana *et al.* (2021) was a coastal community during the pre-colonial era, so there is a high potential for the Bahari people to enter Batu Lepoq Village via the Batu Lepoq River. Over decades of socio-cultural interaction, these coastal migrants gradually transitioned to a sedentary riverine lifestyle, socio-economically assimilating and intermarrying with the indigenous Dayak Basap.

Kiamplasan can be categorized as ICCAS because it includes three characteristics of ICCAs according to UNEP-WCMC and ICCA Consortium (2021), namely having unique and sustainable land management with shifting cultivation that contributes positively to the ecology, being a source of livelihood and food for the community, indirectly relating to humans, and contributing to the welfare of the local community through gardening. Kiamplasan is not used entirely for gardening by the community. Only 1/3 of the area is used for gardening with a shifting land system. The cleared land is used by the community for gardening to meet their daily needs, such as vegetables, onions, and so on, to ensure their survival. Other land that is not cleared as fields is used as a source of fruit and rattan for the Dayak Basap community. Plant growth in this area is done naturally with the help of animals in the forest.

The shifting cultivation system is a local wisdom and a unique farming method of the Dayak people in Kalimantan. Shifting cultivation is carried out by clearing and burning the land, which may sound like forest destruction, but based on customs and culture, shifting cultivation is a method that is in harmony with nature. This is because within 1-3 years, the field will return to forest (Wardana 2022). The shifting cultivation system among the Dayak Basap community is based on the lunar calendar.

Table 2. The shifting cultivation schedule of the Dayak Basap tribe

No	Month	Activity
1	June	Clearing land

2	July	Felling trees
3	August	Waiting for the felled tree to be left to dry
4	September	Burning land that will be planted as natural fertilizer
5	Oktober	Planting
6	February – March	Harvest

Unlike the sacred-oriented conservation practices found in Mengkuris Cave and Mount Kepang, Kiamplasan reflects a livelihood-based conservation system where shifting cultivation and agroforestry practices contribute to ecological sustainability and community resilience. The traditional practices of the Dayak Basap community, particularly the strict prohibition on felling mangris trees and the systematic fallow periods in shifting cultivation, carry profound hydro-geological implications for the Sangkulirang–Mangkalihat karst landscape. Karst ecosystems are structurally fragile, characterized by thin, highly permeable soil layers over soluble carbonate rocks (epikarst) that are exceptionally vulnerable to soil erosion and hydrological disruptions. By maintaining dense tree canopies through customary taboos, the community indirectly protects this sensitive epikarst layer from severe degradation. If extensive deforestation occurred on these steep karst hills, the landscape would rapidly lose its capacity to retain rainwater, accelerating soil loss and threatening the stability of underground aquifers. Consequently, this local ecological governance plays a critical role in sustaining the microclimate and preventing the drying up of subterranean rivers, such as the water systems interconnected with the Mengkuris Cave.

Complementary Governance: ICCAs and the Geopark Framework

Collectively, these three ICCAs demonstrate that conservation within the Dayak Basap customary territory is not limited to ecological protection alone, but also encompasses spiritual values, livelihood systems, social identity, and customary governance. Although each ICCA has different functions and characteristics, all of them reflect community-based stewardship practices that contribute to the preservation of cultural and ecological landscapes within the Aspiring Sangkulirang–Mangkalihat Geopark. ICCAs and Geoparks should not be understood as overlapping conservation systems, but rather as complementary approaches with different governance mechanisms. ICCAs are rooted in customary institutions and community-based practices, while Geoparks operate within formal multi-stakeholder governance frameworks. Their integration therefore provides opportunities for more participatory, inclusive, and sustainable landscape management. (Borrini-Feyerabend *et al.* 2014; Stevens *et al.* 2024). The case of Mengkuris Cave illustrates how customary conservation practices may complement formal geopark governance through community-based management systems.

The Bio-Geo-Cultural Approach in Practice

The integration of ICCAs within the Geopark framework, as demonstrated in the case of Mengkuris Cave, offers a viable path towards participatory conservation that connects geological, ecological, and cultural values. The customary practices of the Dayak Basap community, rooted in spiritual rituals, resource management, and ecological balance, demonstrate the principles of ICCAs. When integrated into Geopark management, these values transform the perspective of local communities from passive beneficiaries into guardians of cultural heritage and ecosystems. This alignment is in line with the new conservation paradigm promoted by the IUCN and CBD, which emphasizes the recognition of local rights, traditional

knowledge, and collective governance as essential components of sustainable area management (Stevens 2013).

The application of ICCAs principles in Geopark management further strengthens its social legitimacy and the long-term effectiveness of conservation initiatives. This integration supports the development of culturally-rooted geotourism, placing local traditions, rituals, and spiritual landscapes as interpretive assets for responsible tourism. It is important to note that effective co-management is necessary to mitigate potential risks such as cultural commodification and unfair distribution of benefits. Through collaborative governance between local communities, government agencies, and conservation organizations, Mengkuris is an example of a bio-geo-cultural approach that harmonizes nature conservation, cultural preservation, and community well-being (Denis *et al.* 2022).

The bio-geo-cultural approach is particularly relevant in the Sangkulirang–Mangkalihat karst landscape because biodiversity, geological heritage, and cultural values have developed through long-term interactions between indigenous communities and their environment (Knudson *et al.* 2018). In the Dayak Basap context, customary practices related to sacred landscapes, forest protection, and resource management demonstrate how ecological sustainability is closely embedded within cultural and spiritual systems.

The relevance of community participation within geopark governance has also been demonstrated in other UNESCO Global Geoparks. A study in the Kinabalu UNESCO Global Geopark, Sabah (Malaysia) found that the economic and socio-cultural benefits of the Geopark had a positive impact on community welfare, and that community support for the development of the Geopark mediated this relationship (Dousin *et al.* 2024). ICCAs may function as local governance infrastructures that strengthen participatory management within aspiring geoparks, particularly in areas where formal institutional arrangements are still developing.

Critical Reflections: Risks, Co-Management, and Strategic Contributions

Despite providing significant contributions, these ICCAs are still informally acknowledged and lack structural integration within the existing geopark governance framework. Without stronger institutional recognition, there is a risk that indigenous conservation practices may become marginalized within tourism-oriented development agendas. This reflects international trends where community-conserved areas are often undervalued or inadequately incorporated into established conservation frameworks (Bassi 2012, Stoffelen 2020). The findings suggest that integrating Dayak Basap ICCAs into geopark management may provide several strategic contributions, including:

1. Enhanced geosite protection via established customary regulations governing resource utilization and visitor access.
2. The maintenance of cultural continuity aligns with UNESCO's criteria for intangible heritage.
3. Promotion of sustainable livelihoods through ecotourism, non-timber forest products, and agroforestry systems.
4. Co-governance opportunities exist to mitigate top-down management gaps and align with rights-based conservation approaches advocated by the CBD and IUCN (Tauli-Corpuz *et al.* 2020).

The findings indicate that Dayak Basap ICCAs serve as a strong bio-geo-cultural foundation that may enhance the long-term sustainability and UNESCO eligibility of the

Sangkulirang–Mangkalihat Geopark. The formal acknowledgment and incorporation of these ICCAs into geopark governance serve as a vital approach to fostering inclusive, community-based landscape management.

Implications for Sustainable Geotourism and UNESCO Eligibility

The existence of ICCAs within the Aspiring Sangkulirang–Mangkalihat Geopark serves as a strong bio-geo-cultural foundation and a vital enabling condition for strengthening community involvement before formal geopark governance becomes fully established. The application of ICCA principles supports the development of culturally-rooted geotourism, positioning local traditions, rituals, and spiritual landscapes as interpretive assets for responsible tourism. This synergy aligns perfectly with the sustainable tourism framework (Goodwin, 2011), which emphasizes balancing environmental, socio-cultural, and economic integrity by placing the Dayak Basap as key actors in site interpretation and decision-making.

The experience at Mengkuris Cave illustrates how responsible tourism can serve as a powerful mechanism for both local empowerment and effective conservation. This model is in strict accordance with the principles of UNESCO Global Geoparks, which advocate for community-based geotourism where local participation and equitable benefit sharing are central to the sustainability of heritage and livelihoods (Worboys, 2015). The findings ultimately indicate that the long-term sustainability and UNESCO eligibility of aspiring geoparks depend not only on geological conservation and tourism development, but critically on the formal acknowledgment and integration of existing indigenous governance systems that have long maintained the socio-ecological integrity of the landscape.

CONCLUSION

This study identified three ICCAs within the Dayak Basap customary territory—Mengkuris Cave, Mount Kepang, and Kiamplasan—which represent different forms of community-based conservation embedded in spiritual values, customary governance systems, and livelihood practices. The findings indicated that conservation practices within the Sangkulirang–Mangkalihat karst landscape were not solely ecological but were also closely connected to cultural identity, traditional knowledge, and community stewardship.

This study further argued that ICCAs should not be understood merely as cultural supporting elements within Geopark frameworks but as existing territorial governance systems that contribute directly to participatory conservation, social legitimacy, and long-term sustainability in aspiring Geopark management. The integration of ICCAs and Geoparks therefore represented a bio-geocultural conservation approach that recognized the interconnected relationships among geological heritage, biodiversity, and Indigenous cultural values.

The findings highlighted the critical need to strengthen institutional recognition of Indigenous governance within Geopark management frameworks. Rather than being positioned solely as tourism beneficiaries, the Dayak Basap community should be recognized as active rights-holders and governance actors. From a policy perspective, the Aspiring Sangkulirang–Mangkalihat Geopark should strategically incorporate these customary conservation systems into its long-term management strategies. The implementation of a collaborative management model involving Indigenous communities, local governments, and conservation organizations is essential to address limitations of top-down governance while ensuring equitable participation, cultural protection, and socio-ecological resilience across the landscape.

Although this research established a qualitative foundation for ICCA–Geopark

integration, several areas require further investigation. Future studies should quantitatively assess the ecological and hydrological impacts of Dayak Basap customary practices on fragile karst ecosystems. In addition, comparative research across other aspiring and established Geoparks in Southeast Asia is recommended to evaluate the applicability and transferability of this bio-geocultural model. Longitudinal studies examining the socio-cultural impacts of formal tourism development and external extractive pressures on Indigenous governance systems are also important for supporting adaptive management.

Ultimately, this study demonstrated that the sustainability of aspiring Geoparks depends not only on geological conservation and tourism development but also on the recognition of existing Indigenous governance systems that have long maintained the socio-ecological integrity of the landscape.

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