The role of conservation education in the Dayak indigenous community of Ensaid Panjang village, Sintang Regency, West Kalimantan Province

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Abstract. The Dayak indigenous community of Ensaid Panjang village in Sintang Regency, West Kalimantan Province, plays a crucial role in conservation education and forest management. This study identifies stakeholders and assesses their collaborative roles in conserving Customary Forest using a matrix of alliances and conflicts (MACTOR) analysis. The results reveal power imbalances among stakeholders, with government entities dominating decision-making while indigenous communities remain marginalised. However, there is strong support for integrating indigenous knowledge into conservation education. The analysis indicates a promising coalition framework supporting culturally grounded biodiversity education and customary forest recognition, although there are doubts and it can trigger conflicts related to policies and agribusiness interests carried out by key actors. Strategies for effective conservation education include fostering cultural coalitions, negotiating with the government and private sectors, empowering the community through social capital initiatives, and promoting inclusive governance that respects local wisdom. The findings provide a basis for designing multilevel collaborative governance, where Dayak communities drive conservation, and the state and private sectors are invited to form alliances based on shared goals. This study contributes to the literature on community-based conservation in Indonesia and offers a framework for more equitable Indigenous Forest conservation strategies.

1 Introduction

West Kalimantan is ranked among the top ten Indonesian provinces contributing to deforestation in 2023, underscoring the critical environmental challenges faced by the

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region. According to data from the Indonesian Land Cover and Permit Information System [1]. Kalimantan Island recorded the highest total deforestation in 2024, with a loss of 129, 896 ha. Specifically, West Kalimantan led deforestation rates in 2023 with 35,162 ha, rising to second place in 2024 with an increased area of 39,598 ha (Fig. 1).

Fig. 1. Results of Simontini deforestation data from 2001 to 2024.

This deforestation primarily occurred within concession areas designated for timber and industrial plantations and through the large-scale expansion of oil palm plantations. [1] data (Fig. 2) revealed that in 2024, 3% of deforestation occurred within conservation zones, 49% within production forests, and 43% outside forest areas (non-forest land or APL). Deforestation connected to oil palm expansion has been pervasive throughout West Kalimantan and is predominantly driven by large corporate investors rather than smallholder plantations [2].

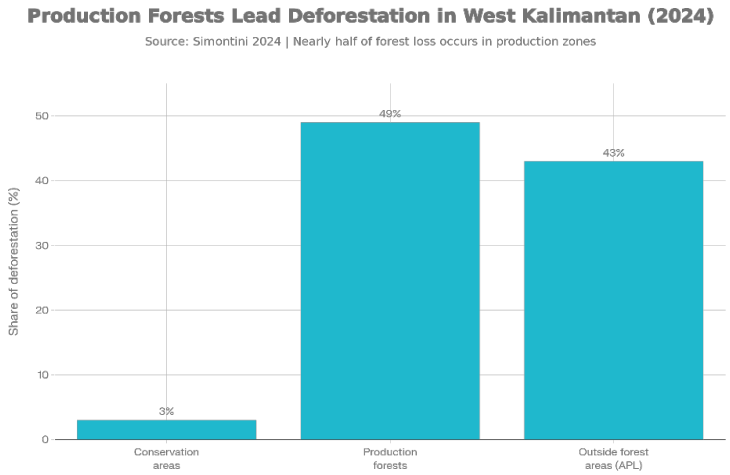

Fig. 2. Distribution of deforestation in West Kalimantan (2024)

Addressing this deforestation crisis calls for robust frameworks that empower local communities in alignment with the United Nations Sustainable Development Goal (SDG) 17 on partnerships. Indonesia's social forestry regulatory framework, principally Permen LHK No. 83/2016 and its refinement in Permen LHK No. 9/2021, formally recognises forest-adjacent communities as primary rights holders and managers under schemes such as

Community Forests, Village Forests, Forestry Partnerships, and Customary Forests. Empirical studies have demonstrated that when social forestry schemes are implemented through multi-stakeholder partnerships, they effectively enhance forest conservation, while simultaneously improving local livelihoods and food security. These outcomes underpin national commitments to multiple SDGs, including poverty alleviation, climate action, and sustaining terrestrial ecosystems (SDG 15) [3, 4].

The Dayak indigenous community of Ensaid Panjang exemplifies the operationalization of cooperative governance. Their customary forest, legally recognized under Sintang Regency Regulation No. 12/2015, has been highlighted as a successful social forestry initiative that protects over 150 hectares of forest. Beyond conservation, this initiative supports traditional livelihoods, such as women's weaving, natural dye production, and ecotourism. Forest stewardship is governed by adat (customary) rules emphasizing the rotational management of tawang forests and strict bans on destructive practices, thereby maintaining biodiversity while enabling the sustainable use of non-timber forest products. These integrative practices contribute to sustainable natural resource management and fulfill SDG 15, while the inclusive legal and permit frameworks embody SDG 17's principles of shared governance among customary authorities, local governments, and NGOs [5].

Despite persistent pressures from economic forces and land conversion, Indigenous communities, such as those in Ensaid Panjang, have exhibited resilience grounded in local wisdom, culturally embedded values, practices, and belief systems that harmonize human-nature relationships and sustain communal food systems. This local wisdom serves not only as an environmental safeguard but also as a fundamental component of traditional heritage and identity [5]. Conservation education within the Dayak community reinforces this connection. The intergenerational transfer of ecological knowledge, preservation of the Betang Ensaid Panjang longhouse, agroforestry and natural dye plant training, and youth involvement in ecotourism and digital marketing constitute a "living curriculum" that integrates cultural heritage with sustainable land management. Such community-driven educational initiatives enhance the collective agency to resist destructive land-use changes, positioning local wisdom as a practical mechanism for forest protection rather than merely a symbolic attribute [6].

By incorporating social forestry permits, customary governance, and conservation education, the Ensaid Panjang case exemplifies a transformative model through which indigenous territories transition from deforestation frontiers to resilient nodes of sustainable landscape governance in Indonesia. This partnership-based approach not only advances local and national deforestation control strategies but also simultaneously promotes multiple interrelated Sustainable Development Goal (SDG) targets. This study aims to identify critical stakeholders and assess their collaborative roles in conserving the Customary Forest with the Dayak community of Ensaid Panjang Village, Sintang Regency, West Kalimantan Province, thereby contributing evidence to the growing body of scholarship demonstrating the value of indigenous stewardship and cross-sectoral partnerships in combating deforestation [3-5].

Taken together, the complex dynamics of deforestation in West Kalimantan necessitate holistic solutions that leverage Indigenous knowledge, inclusive governance, and multi-stakeholder partnerships. The Ensaid Panjang experience reveals the powerful convergence of customary law, social forestry, and community-led education in fostering sustainable forest management frameworks that are aligned with international sustainable development agendas.

2 Methods

This study was conducted in Ensaid Panjang Village, Sintang Regency, West Kalimantan Province, focusing on the customary forest management system of the Dayak indigenous community. The location was selected based on the existence of a local wisdom system in forest management maintained by the local customary community and the dynamic interactions between various stakeholders in conservation education efforts. Primary data were collected from the interviews, and secondary data were processed using a prospective analysis approach.

Improve transparency and reproducibility in methodology, the MACTOR framework's selection of informants, assessment methods, and analytical tools are thoroughly detailed. Twelve key informants were intentionally chosen to represent each stakeholder group identified in the research, including traditional leaders, representatives from indigenous communities, local government officials, educators, NGOs, academics, business figures, youth and women's groups, and media personnel. The selection criteria for informants included: (1) active involvement in conservation education or traditional forest management, (2) decision-making power or institutional representation, (3) understanding of local governance dynamics, and (4) willingness to engage in comprehensive interviews. This targeted sampling ensured the inclusion of individuals with strategic influence and pertinent experiential knowledge.

The MACTOR analysis adhered to a structured process adapted from Godet (2007). Initially, actors and strategic goals were identified through literature review and preliminary interviews. Subsequently, respondents evaluated the Matrix of Direct Influences (MDI) using a standardized ordinal scale from 0 to 4, where 0 signifies no influence, 1 weak influence, 2 moderate influence, 3 strong influence, and 4 very strong influence among actors. Then, actor positions on each objective were assessed using a convergence–divergence scale from –4 (strong opposition) to +4 (strong support). These scores were validated through iterative discussions and cross-checking among informants to minimize subjective bias. The matrices were then processed to produce the Direct and Indirect Influence Matrix (MDII), influence–dependence maps, and convergence/divergence analysis among actors.

Data processing and visualization were carried out using the MACTOR module developed by LIPSOR, with spreadsheet-based data tabulation (Microsoft Excel) supporting matrix preparation and verification. The software facilitated the calculation of influence indices, actor mobilization scores (3MAO), and graphical mapping of stakeholder relationships. Employing standardized procedures and analytical software enhances methodological rigor and allows for the replication of the analytical workflow in similar socio-ecological governance studies.

The primary analytical tool used was the Matrix of Alliances and Conflicts: Tactics, Objectives, and Recommendations (MACTOR). This method was chosen for its ability to measure the balance of power between actors and analyze the potential for convergence (alliances) and divergence (conflicts) among them in relation to a series of strategic objectives. The use of MACTOR was relevant to answer the research question regarding forms of collaboration and objective agreements, as well as to achieve the research objectives of identifying key actors and formulating collaborative strategies for customary forest conservation in the Ensaid Panjang Village.

The research implementation stages included: first, identifying actors (key informants); second, filling in the direct influence matrix between actors (MDI matrix); third, conducting an analysis of the MACTOR application system; and fourth, the Direct and Indirect Influence Matrix (MDII). Finally, the Map of Influence and Dependence between

actors [7].

Table 1. The role of actors in the conservation education of Ensaid Panjang Village

No	Code	Actors
1.	Actor 01	Traditional Leaders and Dayak Customary Institutions
2.	Actor 02	Dayak Sub-tribe Indigenous Communities
3.	Actor 03	Sintang District Government
4.	Actor 04	Village Government/Village Consultative Body & Village Forest/Village-Owned Enterprise
5.	Actor 05	Schools (Elementary-Senior High) & Local Non-formal Education Units
6.	Actor 06	Teachers, Customary Facilitators, and Environmental Extension Officers
7.	Actor 07	Universities
8.	Actor 08	Non-governmental/Conservation Organizations
9.	Actor 09	Technical Units of the Ministry of Environment and Forestry
10.	Actor 10	Business Actors
11.	Actor 11	Youth/Community Groups, Village Youth Organizations. And Women's Groups
12.	Actor 12	Local Media and Community Content Creators

Table 2. The main objective is to measure the position and interests of each actor, namely:

No.	Code	Goals
1.	Obj01	to conserve biodiversity through practices based on local wisdom.
2.	Obj02	to integrate Dayak local wisdom into pocket books as a reference for conservation education practices.
3.	Obj03	to strengthen the recognition and protection of customary territories/forests as a basis for conservation.
4.	Obj04	to improve community welfare through fair and sustainable conservation-based economic activities (non-timber forest products and ecotourism).

The MACTOR methodology, as outlined by Godet (2007) [8], provides a robust framework for analyzing power dynamics and interactions among multiple actors based on their strategic objectives, thus enabling a nuanced understanding of both collaboration and conflict within complex social-ecological systems. This theoretical lens is particularly appropriate given the multifaceted nature of customary forest conservation, which involves Indigenous knowledge, local government regulations, non-governmental organizations (NGOs), and other stakeholders whose interests and influences often intersect.

Data collection was conducted using a mixed approach, beginning with the purposeful selection of Ensaid Panjang Village for its unique maintenance of indigenous wisdom systems governing forest management, coupled with the presence of varied actors engaging in conservation education activities. Primary data were collected through in-depth interviews with key informants representing Indigenous community leaders, government officials, NGOs, and other directly involved parties, allowing for an in-depth exploration of actor perspectives, roles, and objectives. Complementing these insights, secondary data were sourced from policy documents, conservation program reports, and archival research to provide a contextual foundation grounded in historical and institutional frameworks.

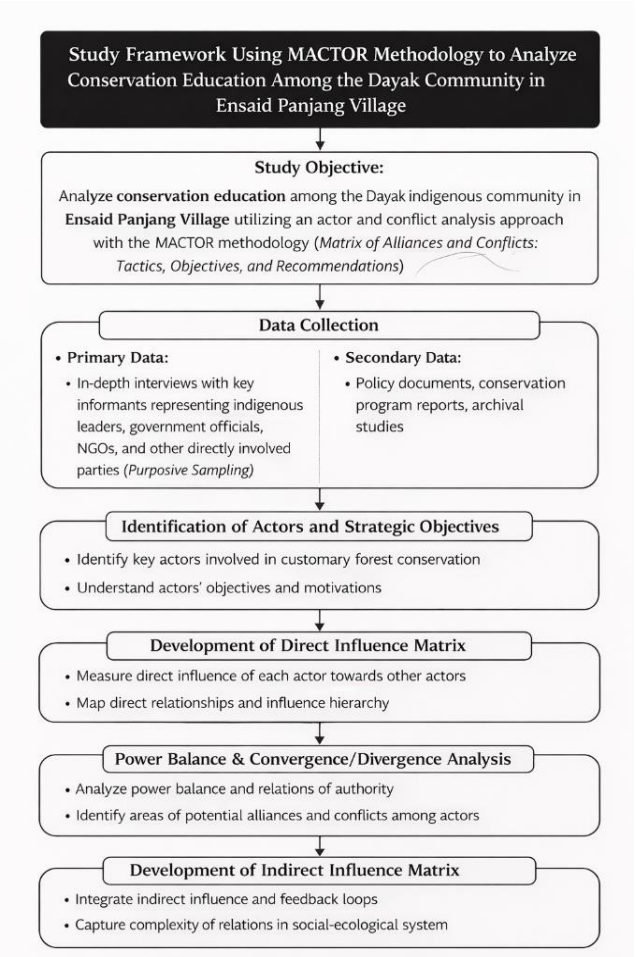

Fig. 3. Research method framework

3 Results and discussion

3.1 Map of influences and dependences between actors

The MACTOR analysis generated a comprehensive influence and dependence map (Fig. 1) We constructed a chart comprising 12 significant groups delineated by two axes: influence (vertical) and dependence (horizontal). This chart elucidates the power dynamics of imparting conservation education to the Dayak Sintang community. Using the MACTOR method, we assessed the role of each group. Data derived from the Matrix of Direct Influences (MDI) categorized the groups into four primary types (Table I). The Ministry of Environment and Forestry and Sintang District Government exhibit substantial influence while demonstrating minimal dependence on other entities, thereby underscoring their significance. This observation aligns with other studies in Indonesia, where governmental bodies continue to dominate policy and resource allocation, even amid efforts to decentralize power [9].

Educational institutions, including schools, universities, teachers, and local educational

groups, wield considerable influence but require substantial governmental support to effectively impart indigenous knowledge. This finding is consistent with research on Dayak Paramasan, where local educators require formal backing to achieve success. The chart further highlights the power disparities. Traditional Leaders and Dayak Customary Institutions possess some influence but are heavily reliant on government support, rendering them vulnerable [6]. This mirrors previous studies, indicating that Indigenous communities are frequently marginalized in decision-making processes [10]. Business groups and local media exhibit moderate influence and dependence, suggesting limited involvement in the matter. However, they could potentially pose challenges if conservation initiatives conflict with their interests, akin to the findings from the Cipari Archaeological Park, where business interests have the potential to disrupt conservation efforts [11].

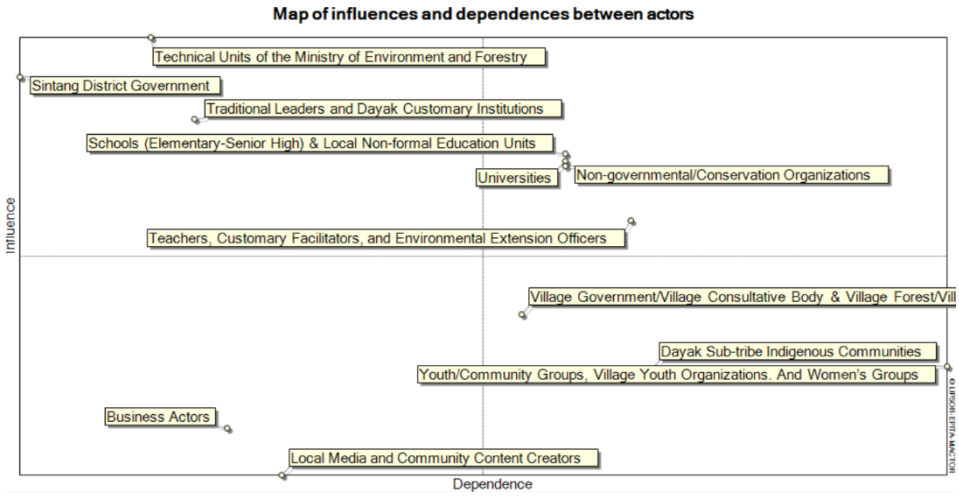

Fig. 4. Map of influences and dependencies among actors.

Table 3. Distribution of influence and dependency categories between actors

Kuadran I (Dominant Actors)	Kuadran II (Relay Actors)	Kuadran III (Dependent Actors)	Kuadran IV (Autonomous Actors)
Technical Units of the Ministry of Environment and Forestry	Schools (Elementary-Senior High) & Local Non-formal Education Units	Dayak Sub-tribe Indigenous Communities	Village Government/Village Consultative Body & Village Forest/Village-Owned Enterprise
Sintang District Government	Non-governmental/Conservation Organizations	Youth/Community Groups, Village Youth Organizations. And Women's Groups	Business Actors
Traditional Leaders and Dayak Customary Institutions	Universities		Local Media and Community Content Creators
	Teachers, Customary Facilitators, and Environmental Extension Officers		

The MACTOR map depicts the dynamics of influence and dependency among various stakeholders within the Dayak conservation education network in Sintang, West Kalimantan. In Quadrant I, the Technical Units of the Ministry of Environment and Forestry, along with the Sintang District Government, hold a prominent position marked by considerable influence and minimal reliance on others. These bodies possess substantial decision-making power and control over policies, representing the state's dominant role in forest governance and formal education, signifying deeply rooted centralized control over environmental resources and educational institutions. This scenario is typical in Indonesia, where government bodies exert control over forest legislation and educational policies [9].

In the intermediary tier, Quadrant II includes relay actors such as local schools, universities, indigenous facilitators, customary institutions, and NGOs, who demonstrate both significant influence and dependence on the community. These actors serve as intermediaries, implementing national policies at the local level, relying on government support, and linking various stakeholders. Their role as intermediaries is crucial yet unstable, emphasizing the delicate balance between government directives and community-level execution. They play a crucial role in translating government strategies into localized practices.

At the base of the hierarchy, village governments, forest managers, and community groups possess limited power and are heavily reliant on external entities to meet their needs. Although they are responsible for the daily management of forests, they adhere to externally made decisions. These actors, vital for on-the-ground conservation and educational activities, have limited structural influence and heavily depend on other actors for resources and guidance in decision-making. This dependency highlights the marginalization of Indigenous and local community participation, despite their key role in conservation efforts.

Independently, agribusinesses and local media hold minimal power and do not depend on others. Nevertheless, they have the potential to become significant actors in deforestation or restoration initiatives if appropriately engaged. In Quadrant IV, autonomous actor business enterprises and local media content creators show low influence and dependence, appearing neutral yet having the potential for conflict. Economic actors may hinder conservation efforts if their interests clash with indigenous land rights, illustrating the tensions between commercial development and traditional ecological stewardship. This distribution reveals significant power imbalances. Government entities retain dominant authority, sidelining customary laws and indigenous community agencies. NGOs and customary institutions, despite their moderate influence, remain highly dependent, indicating the systemic marginalization of indigenous governance in forest management. Autonomous actors have ambiguous influences, potentially intensifying conflicts, especially concerning indigenous land recognition, which is identified as the most contentious strategic objective [9-11].

The analysis uncovers strong support for environmental conservation, the integration of indigenous knowledge into educational frameworks, and welfare programs rooted in conservation ideals, with these goals encountering little resistance. The strategies suggest that goals related to conservation, education, and land recognition are in harmony, although welfare is approached more cautiously because of possible disputes. Key participants include Indigenous leaders, local authorities, educational bodies, non-governmental organizations, and youth groups, with local media serving as partners in spreading the message. These partnerships underscore the need for cooperation among various stakeholders to achieve inclusive governance.

One suggested strategy involves legally bolstering the decision-making power of traditional institutions and creating platforms for conflict resolution among different

stakeholders. A gradual approach is advised, starting with agreement on less controversial goals, such as education, conservation, and welfare, before tackling sensitive matters, such as indigenous land recognition. In summary, strong coalitions and multilevel discussions are vital for addressing power imbalances and fostering fair and sustainable indigenous forest governance. Enhancing indigenous legal recognition and utilizing local ecological knowledge are key to balancing conservation goals, indigenous rights, and sustainable development. This approach aligns with emerging research advocating for justice-focused, trust-building frameworks in conservation governance, emphasizing the need to address power dynamics, justice, and collaboration to overcome historical marginalization and support socio-ecological resilience [11]. The MACTOR influence and dependence map elucidates a governance structure in which state actors dominate, indigenous institutions remain structurally subordinate, and educational implementers operate under high dependency.

3.2 Objective convergence and contention

Achieving the four conservation education objectives demands explicit strategies to rebalance these asymmetries, drawing on proven models of participatory conservation education, legal pluralism integration, and multistakeholder landscape governance [12]. Without such interventions, Obj03's (to strengthen the recognition and protection of customary territories/forests as a basis for conservation) high mobilization potential risks remain aspirational, hindered by the divergent interests of autonomous and dominant actors.

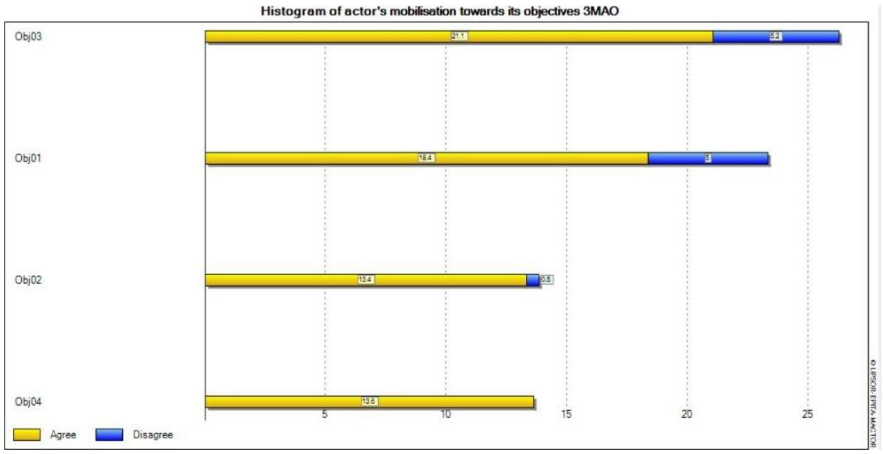

Fig. 5. Histogram 3MAO

The image shown is a histogram depicting the level of actor mobilization towards four strategic objectives (Obj01–Obj04) in the conservation and education of the Dayak Sintang indigenous community. The horizontal axis represents the total mobilization score, while each row represents one objective: Obj01 (biodiversity conservation based on local wisdom), Obj02 (integration of local wisdom into environmental education pocketbooks), Obj03 (recognition and protection of customary territories/forests), and Obj04 (conservation-based economic welfare).

Taken together, the histogram highlights the dual structure of consensus and contention in the Dayak Sintang governance system. Objectives related to knowledge and education (Obj 01 and 02) and conservation-based livelihoods (Obj04) enjoy strong net support and very low opposition, indicating fertile ground for building practical collaborations.

codeveloped curricula, intergenerational learning, women led weaving cooperatives, and eco-tourism initiatives that rely on intact customary forests. These findings echo broader evidence that conservation education programmes and NTFP based enterprises are effective entry points for strengthening community agency and conservation outcomes without immediately confronting the most politically sensitive land tenure questions [9, 13].

In contrast, Obj03 stands out as both the most mobilizing and conflict-prone objective. From a strategic perspective, the histogram suggests a phased approach, starting with actors who can first deepen partnerships around relatively consensual objectives, such as education, biodiversity practices, and conservation-oriented livelihoods, using these successes to build trust and evidence while gradually tackling the more contentious legal recognition agenda through multilevel negotiation platforms involving the government, customary institutions, NGOs, and private sector representatives. Thus, the 3MAO histogram does not merely quantify agreement and disagreement. It reveals where coalition building is easiest, where conflict management is most needed, and how the Dayak Ensaid Panjang community can leverage its strongest shared objectives to support a broader strategy for customary forest conservation.

The resilience of the Dayak indigenous community in Ensaid Panjang village, Sintang Regency, West Kalimantan, is closely linked to their local wisdom, which emphasizes a deep connection with their forest environment and traditional ecological knowledge. The Dayak community maintains resilience by preserving and practicing ancestral customs that foster harmony between humans and nature. This includes sustainable forest management and the transmission of ecological wisdom primarily through indigenous communities, who are the key custodians of both cultural traditions and forest knowledge. Their everyday activities in the forest play a vital role in upholding this balance and ensuring the community's long-term sustainability [5].

3.3 Implications and strategies for the role of conservation education in the Dayak indigenous community

The implications and strategies for conservation education within the Dayak indigenous community, particularly in Sintang, reveal a promising coalition framework that supports culturally grounded biodiversity education and the recognition of customary forests. The MACTOR analysis indicates that a strong majority of actors are positively mobilized towards this goal, although potential conflicts arise due to the ambivalence of key actors, such as KLHK technical units and agribusiness interests. This aligns with global evidence demonstrating that Indigenous conservation efforts achieve greater success when community-based coalitions engage collaboratively and negotiate with state agencies and the private sector rather than circumventing them through multilevel dialogue and arrangements [13].

Strategically, consolidating a central alliance focused on indigenous knowledge-based conservation education is crucial. Initiatives involving joint program development, forum discussions, and participatory monitoring anchored in Dayak ecological knowledge can strengthen cooperative efforts. Structured dialogues with KLHK aimed at pathways to legally recognize customary forests under frameworks such as social forestry and indigenous territories are recommended. Additionally, piloting livelihood schemes grounded in conservation principles with transparent benefit sharing and robust protections against land grabbing could mitigate divergences, especially with agribusiness actors. Grounding these strategies in the evidence of influence, convergence, and divergence derived from the MACTOR results enables policymakers and community leaders to devise realistic, politically nuanced approaches to sustain Dayak customary forests and their associated knowledge systems through education.

Leveraging the community's strong social capital is key to fostering active Dayak community participation in conservation and development activities. Kinship networks and regional ties engender trust, solidarity, and reciprocal obligations among the Dayaks, enhancing their entrepreneurial orientation. This social capital offers an enabling environment for community economic development and engagement. However, financial and non-financial barriers hinder individual initiatives, necessitating targeted educational programs designed to enhance self-efficacy. Collaborations with local universities and vocational schools have been effective in empowering the Dayak by building capacity in business and entrepreneurship, thereby strengthening their active participation in socio-economic initiatives [14].

Inclusion and collaboration in decision-making processes that respect the Dayak community's unique social and ecological context are essential to ensure informed consent and equitable benefit-sharing. These processes amplify the voices of all local social groups, including Indigenous peoples, ensuring just outcomes for restoration or development projects. Long-term integrated approaches that honor traditional ecological stewardship and practices underpin strategies for community resilience and participation, reinforcing both social and environmental sustainability [15].

In summary, conservation education in the Dayak indigenous community has significant implications for sustaining biodiversity and customary forest management. Successful strategies depend on fostering strong, culturally grounded coalitions that include Indigenous actors, negotiating constructively with the governmental and private sectors, and integrating customary knowledge systems into formal conservation education frameworks. Empowering the community through social capital and self-efficacy-enhancing educational initiatives further supports active participation and economic development. Collaborative and inclusive governance that balances traditional ecological knowledge with contemporary legal frameworks promises a resilient pathway for indigenous conservation stewardship and sustainable livelihoods.

4 Conclusions

The Dayak indigenous community of Ensaid Panjang village in Sintang Regency, West Kalimantan Province plays a crucial role in conservation education and forest management. The MACTOR analysis reveals power imbalances among stakeholders, with government entities dominating decision-making and indigenous community remaining marginalized. However, there is strong support for integrating Indigenous knowledge into conservation education and recognizing customary territories. Strategies for effective conservation education in the Dayak community include fostering culturally grounded coalitions, negotiating with the governmental and private sectors, empowering the community through social capital and self-efficacy initiatives, and promoting inclusive, collaborative governance that respects local wisdom.

This conclusion demonstrates how the results of this study not only map actors but also open up new ways of understanding coalitions and conflicts in the conservation of the Dayak Indigenous Forest in Sintang, Indonesia. The analysis reveals that the recognition and protection of Indigenous Forests and the integration of Dayak ecological knowledge into education are strategic meeting points that unite the customary-village-school-university-NGO coalition but also serve as an arena for critical negotiations with the Ministry of Environment and Forestry and business actors. These findings provide a scientific basis for the design of multi-level collaborative governance, in which Dayak communities are positioned as the main

drivers and the state and private sector are invited to compromise through gradual alliances based on shared goals rather than simply being objects of consultation. Future research could deepen the simulation of policy scenarios, such as various options for social forestry schemes, recognition of indigenous peoples, and economic models of NTFPs and ecotourism, and examine how policy changes at the national and global market levels shift the positions of actors and the stability of coalitions. Thus, this study adds value to the literature on community-based conservation in Indonesia and offers a practical framework for policymakers and Indigenous communities to design more equitable, effective, and sustainable Indigenous Forest conservation strategies.

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