Journal of Election and Leadership (JOELS)
ISSN 2723-5149

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Innovation in Forest Area Conservation Strategy at the Rokan Koto Ruang Ecotourism Location, Rokan Hulu Regency

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Abstract
Global deforestation continues to erode the climate system and biodiversity, and in Indonesia, one of the primary drivers over the past 25 years has been the conversion of forest areas into oil palm plantations. Addressing this requires innovative, politically grounded conservation strategies that can curb land conversion and maintain sustainable forest areas. This study analyzes the conservation strategy implemented through sustainable green tourism, driven by the Rokan Koto Ruang Village Government's own political leadership initiative, and develops a forest conservation strategy for its ecotourism sites. A mixed-methods design was used: a qualitative phenomenological approach addressed the first two research questions, while a quantitative approach employing the Analytical Hierarchy Process (AHP) was used to formulate the conservation strategy, supported by questionnaire data from 28 key informants. The results show that the Rokan Koto Ruang Village Government has developed ecotourism as a forest conservation strategy, but this strategy has not yet significantly curbed deforestation or forest conversion in the forest-margin sites where land tenure is contested. The proposed solution is a forest conservation strategy for the ecotourism site, with alternative strategies ranked by priority as follows: agroforestry, ecosystem rehabilitation, community empowerment and education, multi-stakeholder collaboration, and improvement of environmentally friendly infrastructure. Although agroforestry and ecosystem rehabilitation rank first and second, their implementation must be supported by community empowerment, education, and multi-stakeholder collaboration to be effective.
Keywords: *Conversion; Conservation; Ecotourism; AHP; Riau*

1. Introduction

Deforestation is a global crisis with direct consequences for the climate system, biodiversity, and the livelihoods of forest-dependent communities. The world lost an average of 10 million hectares of forest cover every year between 2015 and 2020, of which about 4.7 million hectares represented net loss after accounting for reforestation and natural regrowth (FAO, 2020); roughly 60 to 80 percent of this tropical deforestation is driven by the expansion of agricultural commodities, chief among them beef, soy, and palm oil (Ritchie & Roser, 2021). Indonesia and Brazil together account for close to half of all tropical forest loss worldwide, which is why the international community placed forest protection at the center of the Sustainable Development Goals Yandra, 2024 (notably SDG 15, Life on Land) and the 2021 Glasgow Leaders' Declaration on Forests and Land Use, to which Indonesia is a signatory (UNFCCC, 2021). In response, the Government of Indonesia has committed to the Forestry and Other Land Use (FOLU) Net Sink 2030 program, which sets a national target for the forestry sector to absorb more carbon than it emits by 2030 (Ministry of Environment and Forestry of the Republic of Indonesia, 2022). Achieving that target, however, depends on what happens at the level of individual villages and forest margins, where global commitments are translated, or fail to be translated, into everyday land-use decisions. Beyond deforestation writ large, one factor behind forest destruction in Indonesia over the

Received (2026-08-23); Accepted (2026-09-03); Published (2026-09-05)

past 25 years is specifically the conversion of forest areas into oil palm plantations (Hakim, 2001). The development of the oil palm industry generates significant ecological pressure: the death of plants and animals, declining soil quality and its capacity to absorb rainwater, the extinction of various plant species, the loss of wildlife and microorganisms that maintain ecosystem balance, the loss of areas that preserve air and soil humidity, and the loss of tall stands that regulate the microclimate of tropical regions — all of which contribute to ecosystem change and global warming (Khairunnisa, 2018).

Deforestation and forest area conversion have also occurred in Rokan Koto Ruang Village, Rokan IV Koto Sub-district, Rokan Hulu Regency, through illegal logging and the conversion of community forest (rubber gardens) into oil palm plantations. Before 2000, the majority of the community cultivated rubber; based on village profile data, the community's rubber gardens now cover only about 105 hectares, far smaller than the oil palm plantations, which have reached 1,500 hectares. As a result of land-use conversion and forest degradation, flooding has become an annual disaster: between 2016 and 2024, floods reached thigh height — something senior residents say had not happened since 1954. This flooding submerged 155 houses and destroyed a 30-meter section of the Sei Palis Dam's primary irrigation canal, which irrigates 75 hectares of rice fields — an event strongly suspected to be linked to land and forest area conversion.

In an effort to curb the rate of land conversion into oil palm plantations, the Rokan Koto Ruang Village Government built the Sawah Koto Tourism destination, a selfie bridge above an expanse of rice fields, aimed at conserving the rice fields, managing water, and preventing waste disposal in the paddy areas (El Amady et al., 2024). The success of this tourism-based conservation was intended to be extended to three other destinations in the village — the Rokan Royal Palace, Puncak Kabur, and Kajatan Baru Waterfall — the latter two located within the forest area.

Previous Research and the Empirical Gap

A number of studies on ecotourism-based conservation have not yet shown results capable of curbing land and forest area conversion. Rusiani (2019) examined environmental awareness among ecotourism visitors; Azizah et al. (2021), through a literature review of 251 cases worldwide, found that ecotourism can contribute to conservation only under certain conditions; Mu'Thasim and Indahsari (2021) examined ecotourism as a wildlife conservation tool. Other studies linking conservation and ecotourism for flora and fauna preservation have not shown significant impact, particularly because the time frame involved remains unmeasured (Stronza et al., 2019). Studies commonly conducted also tend to emphasize ecotourism development strategies rather than conservation strategies, as seen in Damanik and Weber (2006) and Sukma et al. (2022).

Three empirical gaps distinguish the present study from this body of work. First, none of the studies above measures conservation outcomes against an observable, quantifiable baseline of land-use change: visitor awareness, literature synthesis, and wildlife-protection framing are proxies for conservation success rather than direct evidence that land which had been converted, or was at risk of conversion, was actually retained or restored. This study instead anchors its analysis in a documented land-use record — 105 hectares of remaining community rubber gardens against 1,500 hectares of oil palm, and a flood history traceable to that conversion — against which the effectiveness of ecotourism-based conservation can be empirically assessed rather than assumed. Second, the governance

dimension of ecotourism-based conservation remains empirically thin in the Indonesian literature: research on Indonesian conservation programs has shown that outcomes hinge less on the ecological design of an intervention than on how local leadership mediates access, legitimacy, and benefit distribution among competing claimants (Steenbergen, 2016; Warren & Visser, 2016), yet this leadership variable is rarely built into a conservation-strategy assessment. Third, where a formal decision-support method is used to move from diagnosis to strategy — as this study does with the Analytical Hierarchy Process applied through an ecosystem-approach framework — the resulting strategy has seldom been benchmarked against a prior, less successful intervention, in this case ecotourism alone, to show empirically why one approach under-delivers and where a complementary approach is warranted.

Novelty of the Study

Positioning tourism as an instrument of conservation, rather than merely a destination-development strategy, is by now a familiar move in the ecotourism literature and, on its own, does not constitute a sufficient claim to novelty. What distinguishes this study is where that positioning is anchored: not in a tourism-management intervention designed and funded from outside the village, but in sustainable green tourism initiated, financed in its early stages, and sustained through the village government's own political commitment (Perez, 2025). The Sawah Koto destination was not the product of an NGO project, a corporate social-responsibility program, or a national conservation grant; it originated as the elected village leadership's own response to a locally observed problem — land conversion and its flood consequences — using the limited fiscal and regulatory instruments available to a village government under Indonesia's decentralization framework (Undang-Undang Nomor 6 Tahun 2014 tentang Desa [Law No. 6 of 2014 on Villages]). This matters theoretically as well as practically: research on Indonesian community-based conservation has repeatedly shown that program durability and legitimacy depend on how local leadership is constituted and sustained, not simply on whether a conservation instrument exists on paper (Steenbergen, 2016; Warren & Visser, 2016). The novelty of this study, then, lies in analyzing forest area conservation through ecotourism as a leadership-driven, politically embedded strategy — evaluating both its achievements and its limits when that same locally led model is extended from a low-conflict site, the rice-field destination, into contested forest-margin sites governed under different tenure regimes — and in translating that evaluation into a forest area conservation strategy grounded in the ecosystem approach. On this basis, the study is titled Forest Area Conservation Strategy at the Ecotourism Location of Rokan Koto Ruang Village, Rokan Hulu Regency, with the aims of (1) analyzing the conservation strategy through ecotourism, including the village leadership's own political initiative, and its implementation in Rokan Koto Ruang Village, and (2) developing a forest area conservation strategy for the village's ecotourism site.

2. Theoretical Perspective

Broadly, this study analyzes the conservation strategy through ecotourism in Rokan Koto Ruang Village by referring to the ecotourism theory and principles of Damanik and Weber (2006), and develops a forest area conservation strategy for the ecotourism site through the Ecosystem Approach as defined by the Convention on Biological Diversity (CBD).

Ecotourism and Conservation

Ecotourism is a tourism activity aimed at supporting environmental preservation (nature, biodiversity, and culture), containing elements of environmental education, involving community participation in its management, and providing economic benefits to local communities. Conservation, on the other hand, is a systematic effort to protect, maintain, and manage natural resources so they remain sustainable — encompassing not only flora and fauna preservation but also the social, cultural, and economic aspects of communities surrounding conservation areas (Nafi et al., 2017).

Conservation strategy is no longer based solely on strict protection but also involves communities and other sectors such as ecotourism, which holds great potential to support conservation when properly managed. Through ecotourism, visitors can be educated about the importance of environmental preservation, while the economic benefits obtained can support conservation activities and local community empowerment (Fennell, 1999).

The Ecosystem Approach

The ecosystem approach is an integrated management approach to land, water, and biological resources that promotes conservation and the fair and sustainable use of natural resources (UNEP & SCBD, 2004). In a conservation context, this approach aims to maintain the integrity and sustainability of ecosystem functions while attending to human needs. The ecosystem approach through ecotourism harnesses nature-based tourism activities to support environmental preservation while empowering local communities, thereby offering a strategic solution for sustainable conservation.

Applying the ecosystem approach is believed to help achieve a balance among the three objectives of the CBD, namely conservation, sustainable use, and the fair and equitable sharing of benefits arising from the utilization of genetic resources. This approach is used to understand ecological dynamics at a large scale — including land-use change, climate change, and human disturbance — emphasizing that all components of an ecosystem, including humans, are interconnected and must be managed holistically rather than in isolation (Likens, 1992).

Political Ecology, Governance, and Village Leadership

Ecotourism theory and the ecosystem approach explain what a conservation strategy should look like — participatory, ecologically integrated, and economically beneficial to surrounding communities — but neither, on its own, explains why some locally managed conservation efforts succeed in curbing land conversion while others do not. Political ecology supplies that missing explanatory layer by insisting that environmental outcomes cannot be separated from the political and economic relationships through which access to land and resources is contested, allocated, and defended (Robbins, 2020). In the Indonesian context, this literature has a specifically local genealogy: Peluso's (1992) historical account of forest control in Java shows that the very category of "state forest" (kawasan hutan) was itself a colonial and postcolonial political construction layered over long-standing local systems of forest use and customary (adat) authority, so that many contemporary "encroachments" are better understood as continuations of prior local claims than as recent lawlessness — a reading that resonates with Rokan Koto Ruang Village, where rubber gardens and customary swidden cultivation predate the plantation-era land rush by generations. Li (2007) extends this argument to development interventions themselves, arguing that programs framed around technical "improvement" often depoliticize what are, at root, contests over authority and resource access — a caution

against treating ecotourism-based conservation as a purely technical fix.

Read together, this body of work implies that a conservation strategy's prospects depend heavily on who leads it and on what political basis. Village leadership that acts on its own initiative, is answerable to its own community rather than to an external funder, and is backed by the legal authority that Indonesia's decentralization framework grants to village government carries a form of legitimacy that externally designed interventions often lack (Steenbergen, 2016; Warren & Visser, 2016). At the same time, where multiple public and private actors — village government, the Forest Management Unit (KPH), the Environment and Forestry Agency, and private landholders such as PT. Anugerah Niaga Sawindo — hold overlapping stakes in the same forest margin, conservation strategy becomes a problem of collaborative governance: aligning actors with divergent mandates and incentives around a shared course of action (Ansell & Gash, 2008). This study treats both dimensions — the political legitimacy of locally initiated leadership and the structural need for multi-stakeholder collaboration — as integral to explaining the ecotourism strategy's partial success in Rokan Koto Ruang Village, and builds both into the ecosystem-approach strategy developed in Section 4.6.

3. Method

This study employed a mixed-methods design. A qualitative approach grounded in phenomenology (Bertens, 1987) was used to address the first and second research questions, while a quantitative approach was used to analyze questionnaire data, which was then further deepened through qualitative explanation.

The research population consisted of 28 village institutional representatives and community group members, comprising village officials, the Tourism Awareness Group (Pokdarwis), business operators, tourists, and expert representatives who understand the condition of the forest area in Rokan Koto Ruang Village. Data were collected through observation, interviews, questionnaires, Focus Group Discussions (FGDs), and documentation study.

Data analysis for formulating the conservation strategy used the Analytical Hierarchy Process (AHP) model, a decision-making method that resolves complex problems by breaking them into smaller components and then comparing them pairwise to determine the priority and weight of each element (Saaty, 2008). The AHP analysis stages carried out included: identifying the problem within the conservation context; establishing the conservation concept, objectives, and alternatives; developing a decision scenario through a hierarchical structure; assessing the priority of alternatives; calculating priority weights; and conducting analysis and decision-making.

4. Result and Discussion

Overview of the Research Site

Rokan Koto Ruang Village is administratively located in Rokan IV Koto Sub-district, Rokan Hulu Regency, Riau Province, covering an area of 18,820 ha. Topographically, the village is a hilly region, as it lies within an upstream river area and partly within the Bukit Barisan mountain range, with most of its territory situated within the forest area. The travel distance from the Riau provincial capital (Pekanbaru) is about 175 km (± 4 hours), from the Rokan Hulu regency capital (Pasir Pengaraian) about 60 km (± 2 hours), and 2 km from the sub-district capital. The village population is recorded at 784 households, or 2,729 people (1,393 male and 1,336 female), the majority of whom are Muslim (98.31%), with the remainder Christian (1.68%).

Most of Rokan Koto Ruang Village's territory is forest area, comprising Limited Production Forest (HPT), Convertible Production Forest (HPK), and Other Use Areas (APL), as shown in Figure 1.

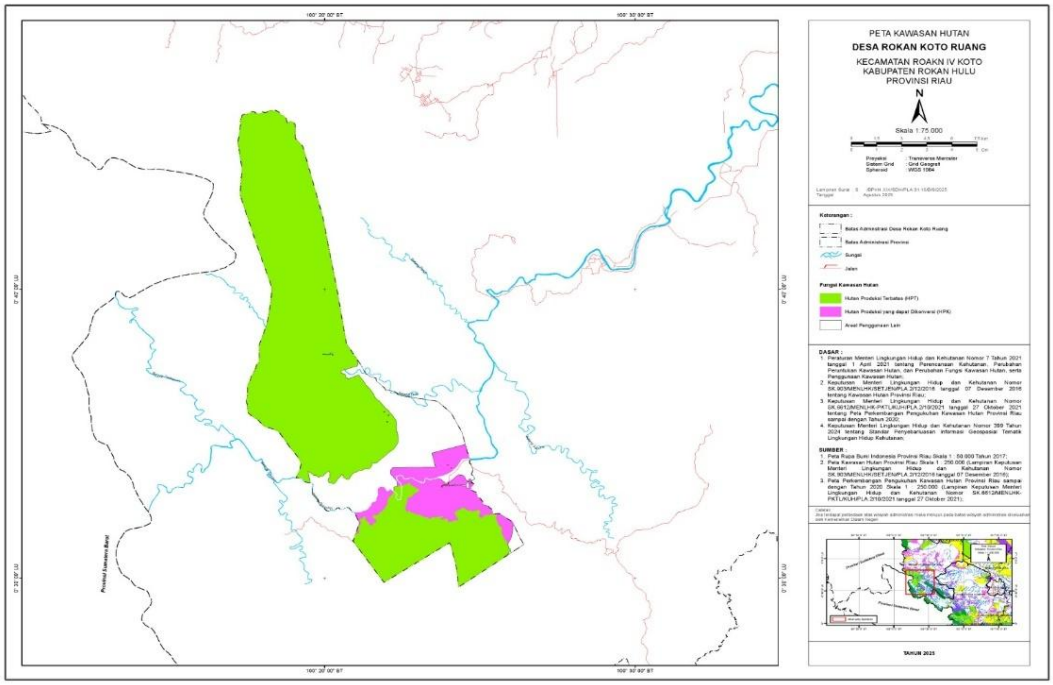


Figure 1. Map of the Forest Area in Rokan Koto Ruang Village

Source: BPKHW XIX Pekanbaru

Within this forest area lie various natural resource potentials — besides timber and coal, there is also ecotourism potential owing to its natural beauty. Recognizing this potential, the Rokan Koto Ruang Village Government has, since 2017, established a vision of becoming a Tourism Village, realized through the construction of a selfie bridge above an expanse of rice fields together with supporting facilities such as a tower, toilets, a prayer hall, a restaurant, and gazebos. The conservation value of the Sawah Koto Tourism destination is intended to be extended to three other tourism potentials in the village: the Rokan Royal Palace (cultural conservation), and Puncak Kabur and Kajatan Baru Waterfall (forest area conservation), as shown in Figure 2.



Figure 2. Sawah Koto Tourism, Puncak Kabur, and Kajatan Baru Waterfall

Source: Researcher's Documentation, 2025

Figures 1 and 2 together make legible the spatial logic behind the village government's conservation-through-ecotourism strategy, and the reason its early success has been difficult to replicate. Figure 1 shows that Rokan Koto Ruang Village's territory is layered across three distinct legal forest classifications — Limited Production Forest

(HPT), Convertible Production Forest (HPK), and Other Use Areas (APL) — each carrying a different regulatory regime and a different set of permissible land uses. Sawah Koto Tourism, the first and most successful destination shown in Figure 2, sits on cultivated rice-field land within the village's settlement area, entirely outside the forest estate; its governance therefore required no negotiation with forestry authorities, only coordination among villagers themselves and the Village-Owned Enterprise (BUM Desa). Puncak Kabur and Kajatan Baru Waterfall, by contrast, lie inside the forest area proper — the former within the HPT zone, the latter on APL land under a private company's concession, as detailed in Section 4.5 — placing both destinations at the intersection of village authority, state forestry regulation, and, at Kajatan Baru, a corporate land claim. This difference in legal and spatial positioning, rather than any lack of will on the part of village leadership, is central to explaining the pattern documented in Section 4.4: the conservation model that worked at Sawah Koto could not simply be transplanted to the forest-margin destinations, because the actors whose cooperation it required, and the rules under which that cooperation had to be secured, were fundamentally different.

Conservation Strategy through Ecotourism

The conservation strategy through ecotourism carried out by the Rokan Koto Ruang Village Government integrates conservation and ecotourism, on the assumption that this integration creates a mutually beneficial symbiotic relationship among environmental preservation, local economic development, and community education. Conservation through ecotourism provides a sustainable economic alternative for communities in protected areas, fairly shares conservation benefits with communities whose land and resources lie within such areas, and contributes to conservation by increasing awareness and protection of the area (Wijayanto et al., 2024). The current conservation trend also leans toward ecotourism-based concepts, as they are considered to offer hope for the sustainable protection of biodiversity (Al Hakim et al., 2022). Accordingly, the conservation-through-ecotourism policy pursued by the Rokan Koto Ruang Village Government is, in principle, headed in the right direction.

Implementation of this strategy is carried out through seven steps: managing and developing the village's ecotourism potential; enforcing environmental rules within the ecotourism area; developing accessibility; developing amenities; empowering the community and preserving local culture; raising environmental education and awareness; and promoting and marketing the ecotourism potential.

Management and development of the destinations were carried out by restructuring Pokdarwis into a single organization overseeing all destinations. Previously, the four destinations were managed by different entities — Sawah Koto by the Village-Owned Enterprise (BUM Desa), Puncak Kabur by Pokdarwis BARRAW (Barisan Rokan Mandera Wahana), the Palace by its own caretaker, and Kajatan Baru Waterfall by Pokdarwis Kajatan Baru. This consolidation was formalized through Village Head Decree No. 18 of 2024 on the Structure and Composition of the Sawah Koto Pokdarwis Management Board, aimed at ensuring more controlled and effective coordination across destinations and enabling the development of integrated tour packages.

Environmental rules are enforced through local wisdom — drawing on the knowledge, practices, and traditional values of the local community — in the form of appeals against waste dumping, self-managed waste collection, prevention of illegal logging through the customary principle of shifting cultivation, prevention of illegal fishing

through public appeals, and prevention of land conversion into oil palm through a policy of not issuing land-ownership legality documents, coupled with support for the Forest and Land Rehabilitation program.

Development of accessibility includes establishing a Tourism Information Center (TIC), providing transportation to Kajatan Baru Waterfall, building road access at Sawah Koto and Puncak Kabur, installing directional signage, and providing tour guides. Amenity development includes parking areas, toilets, a prayer hall, a restaurant, and gazebos at Sawah Koto; a parking area, camping ground, and food stalls at Puncak Kabur; changing facilities at Kajatan Baru; and toilets at the Rokan Royal Palace — supported by five homestay units with a combined capacity of about 20 tourists.

The community empowerment program is carried out through capital assistance for Micro and Small Enterprises (MSEs) producing palm sugar, traditional foods, and keychains, while cultural preservation is housed under the Rokan Malay Arts Group, which manages training in silat, dikir (gurdah), gong drumming, and randai performance. Environmental awareness education is delivered through billboards and banners prohibiting tree-felling, littering, and fishing using poison, electric shock, or bombs (illegal fishing) at Puncak Kabur and Kajatan Baru.

Evaluation of Digital Promotion

Sustainable tourism marketing and promotion are carried out through the village website (desakotoruang.com), Facebook (rokankoto.ruang), Instagram (Rokan Koto Ruang Official), YouTube (@rokankotoruang_official), and a dedicated Puncak Kabur Pokdarwis account on Instagram (Puncak Kabur) and TikTok (@dtw.puncak_kabur). However, none of these digital channels is yet optimally managed: the village website has not been officially launched; the Facebook account (created on 18 September 2019) has only 15 posts; the village Instagram account has 85 posts, 441 followers, and follows 708 accounts; and the village YouTube channel contains only 7 videos with 72 subscribers. A relatively better condition is shown by the Puncak Kabur Instagram account, with 1,357 posts, 5,306 followers, and 4,583 accounts followed, while the TikTok account @dtw_puncak_kabur has only 3 posts, follows 18 accounts, and has 24 followers.

Effectiveness of the Strategy: Why Conversion Has Not Been Curbed

Implementation of the forest area conservation strategy through ecotourism development policy has not been able to curb the rate of forest area conversion into oil palm and has not significantly influenced environmental preservation at the village's ecotourism sites. The success of the Sawah Koto Tourism destination in curbing the conversion of rice fields into oil palm has not yet spread to other ecotourism locations within the forest area — prohibited activities such as forest area conversion into oil palm, illegal logging, and small-scale illegal fishing are still occurring. This condition indicates that ecotourism activity in Rokan Koto Ruang Village has not yet achieved the core principle of ecotourism for conservation, namely reducing negative impacts on environmental damage, fostering environmental awareness, and growing the community's economy (Damanik & Weber, 2006).

There are five main weaknesses in the implementation of ecotourism policy as a conservation strategy (Wijayanto et al., 2024). First, the government's role remains suboptimal, particularly in supporting law enforcement, so that ecotourism areas frequently clash with local communities that remain dependent on forest products. Second, the economic benefits for local communities remain low, resulting in low community

concern for and sense of ownership over the destinations. Third, the human resource capacity and management of ecotourism have not met development standards, particularly regarding pro-conservation ethics, socio-cultural-economic capacity, and the ability to market the area's natural uniqueness to visitors — which in turn affects visitor satisfaction. Fourth, ecotourism's contribution to conservation interests and sustainable development remains low. Fifth, multi-stakeholder collaboration among government, research institutions, universities, and the private sector has not yet been established; most ecotourism development remains unintegrated with regional development planning at the regency, provincial, or national level.

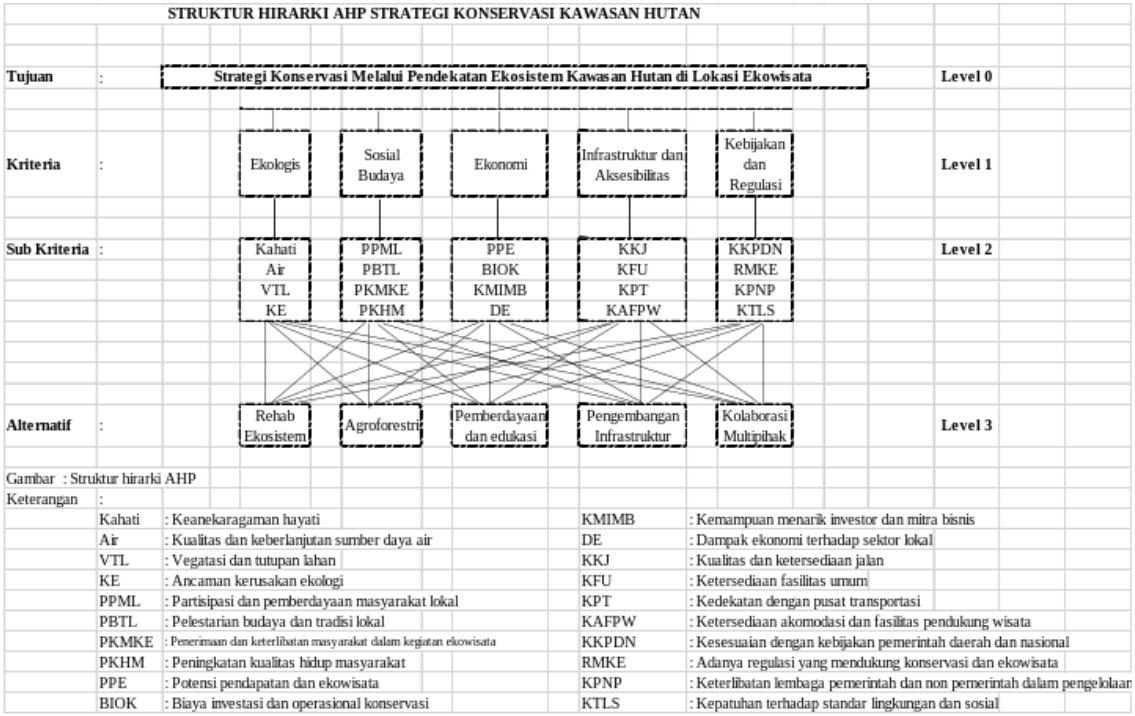
For the conservation-through-ecotourism strategy in Rokan Koto Ruang Village to be well realized, an integrated policy framework is needed, encompassing the strengthening of regulations based on environmental carrying capacity, a collaborative management model, community capacity building, and a fair benefit-sharing mechanism (Nicha & Zulkarnaini, 2025). Government support — whether from the Environment and Forestry Agency (DLHK), the Forest Management Unit (KPH), the Tourism Office, or universities — also determines the success of forest area conservation through ecotourism (Mulyadi et al., 2010), commonly referred to as a collaborative, community-empowerment-based ecotourism development strategy (Andita & Kahfi, 2019).

Forest Area Conservation Strategy through the Ecosystem Approach (AHP Analysis)

Because the conservation-through-ecotourism strategy has not had a significant impact, this study formulated a forest area conservation strategy through the ecosystem approach at the Rokan Koto Ruang Village ecotourism site using the AHP (Analytic Hierarchy Process) method, comprising the following stages: problem identification, establishment of the conservation concept and objectives, development of the hierarchical structure, assessment of alternative priorities, calculation of priority weights, and analysis and decision-making.

Problem identification shows that the Puncak Kabur site lies within an HPT area, while Kajatan Baru Waterfall falls within an APL area owned by PT. Anugerah Niaga Sawindo (ANS). Both locations have long been sites of illegal logging activity by village residents; the area around Puncak Kabur has even been converted into oil palm plantations by residents from outside the village who purchased land from local residents. Meanwhile, the Kajatan Baru Waterfall area remains forested, although timber with a diameter above 30 cm has become difficult to find due to illegal logging; this area has not yet been converted because its position amid rocky ravines is difficult for heavy equipment to access.

The concept and objective formulated in this study is a forest area conservation strategy for the Rokan Koto Ruang Village ecotourism site, with the AHP structure serving as the decision-making scenario shown in Figure 3.



Gambar : Struktur hirarki AHP

Keterangan :

Kahati	: Keanekaragaman hayati	KMIMB	: Kemampuan menarik investor dan mitra bisnis
Air	: Kualitas dan keberlanjutan sumber daya air	DE	: Dampak ekonomi terhadap sektor lokal
VTL	: Vegatasi dan tutupan lahan	KKJ	: Kualitas dan ketersediaan jalan
KE	: Ancaman kerusakan ekologi	KFU	: Ketersediaan fasilitas umum
PPML	: Partisipasi dan pemberdayaan masyarakat lokal	KPT	: Kedekatan dengan pusat transportasi
PBTL	: Pelestarian budaya dan tradisi lokal	KAFPW	: Ketersediaan akomodasi dan fasilitas pendukung wisata
PKMKE	: Penerimaan dan keterlibatan masyarakat dalam kegiatan ekowisata	KKPDN	: Kesesuaian dengan kebijakan pemerintah daerah dan nasional
PKHM	: Peningkatan kualitas hidup masyarakat	RMKE	: Adanya regulasi yang mendukung konservasi dan ekowisata
PPE	: Potensi pendapatan dan ekowisata	KPNP	: Keterlibatan lembaga pemerintah dan non pemerintah dalam pengelolaan
BIOK	: Biaya investasi dan operasional konservasi	KTLS	: Kepatuhan terhadap standar lingkungan dan sosial

Figure 3. AHP Structure for the Forest Area Conservation Strategy at the Rokan Koto Ruang Village Ecotourism Site

Source: Processed by Researcher, 2025

After conducting pairwise comparisons of the evaluation criteria based on expert judgments, the criteria were normalized, and the Consistency Index (CI) and Consistency Ratio (CR) values were calculated. A similar process was applied to pairwise comparisons of each alternative against each criterion. The AHP analysis results for the conservation strategy alternatives were obtained by summing the eigen vectors from each alternative-comparison matrix by criterion, multiplied by the average weight value of each criterion; conservation strategy priorities were then ranked by the highest resulting score. The recapitulation of eigen vectors from the alternative-comparison matrix by criterion is presented in Table 1.

Table 1. Recapitulation of Eigen Vectors from the Alternative-Comparison Matrix by Criterion

Strategy	Ecology	Socio-Culture	Economy	Accessibility	Policy & Regulation
Ecosystem Rehabilitation	0.34	0.17	0.19	0.15	0.24
Agroforestry	0.11	0.13	0.16	0.10	0.13
Community Empowerment	0.22	0.43	0.41	0.07	0.14
Infrastructure Improvement	0.04	0.05	0.10	0.47	0.10
Multi-Stakeholder Collaboration	0.30	0.20	0.14	0.22	0.38

Source: Processed by Researcher, 2025

The recapitulation of the eigen vectors from the alternative-comparison matrix multiplied by the average weight value of each criterion is presented in Table 2.

Table 2. Recapitulation of Weighted Eigen Vector Scores for the Strategy Alternatives

Strategy	Ecology	Socio-Culture	Economy	Accessibility	Policy & Regulation	Total
Ecosystem Rehabilitation	0.0612	0.0319	0.0356	0.0267	0.0443	0.1997
Agroforestry	0.0473	0.0579	0.0690	0.0412	0.0547	0.2701
Community Empowerment	0.0328	0.0663	0.0620	0.0099	0.0219	0.1930
Infrastructure Improvement	0.0031	0.0044	0.0083	0.0391	0.0085	0.0634
Multi-Stakeholder Collaboration	0.0453	0.0305	0.0207	0.0333	0.0575	0.1872

Source: Processed by Researcher, 2025

Based on Table 2, the ranking of the highest-scoring forest area conservation strategy alternatives for the ecotourism site in Rokan Koto Ruang Village is obtained, as shown in Table 3.

Table 3. Ranking of Forest Area Conservation Strategies through the Ecosystem Approach

Forest Area Conservation Strategy	AHP Score	Rank
Agroforestry	0.2701	1
Ecosystem Rehabilitation	0.1997	2
Community Empowerment and Education	0.1930	3
Multi-Stakeholder Collaboration	0.1872	4
Environmentally Friendly Infrastructure Improvement	0.0634	5

Source: Processed by Researcher, 2025

The AHP analysis of expert respondent perceptions found agroforestry to have the highest weight (0.2701), followed by ecosystem rehabilitation (0.1997), community empowerment and education (0.1930), multi-stakeholder collaboration (0.1872), and finally environmentally friendly infrastructure improvement (0.0634). Agroforestry — with its main programs of planting high-economic-value commodities, environmentally friendly farming/plantation training, and marketing of production output — emerges as the top priority, followed by ecosystem rehabilitation through vegetation planting, erosion and sedimentation control, and wildlife habitat restoration.

Agroforestry is considered suitable as the top priority because area degradation from deforestation and conversion into oil palm plantations at the Rokan Koto Ruang Village ecotourism site has occurred extensively; most of the land around the site has been claimed and converted by residents into oil palm plantations. The agroforestry solution is viewed as a win-win solution: residents who hold the land need not be evicted, nor does their land need to be reclaimed to be returned to forest area, yet they can still hold the land under slightly different rules in order to carry out land conservation gradually.

Agroforestry is an integrated land-use system that combines woody with non-woody plants grown simultaneously or in rotation on a single plot of land to obtain a variety of products and services, thereby forming ecological and economic interactions among plant components (Rianse & Abdi, 2010). Ecologically, high-economic-value woody plants on land already planted with oil palm can increase surface water infiltration; conversely, monoculture oil palm land causes higher surface runoff because low vegetation density allows rainwater to strike the soil surface directly, clogging soil macropores, inhibiting infiltration, and increasing surface runoff (Ullyta et al., 2022). This increased surface runoff causes higher erosion and landslide risk, particularly in locations with steep slopes and sandy soil — conditions consistent with the characteristics of the forest

area at Puncak Kabur and Kajatan Baru Waterfall, which are hilly, sandy, and rocky.

Although agroforestry is the top priority followed by ecosystem rehabilitation, neither can stand alone. Community empowerment and education, multi-stakeholder collaboration, and environmentally friendly infrastructure improvement must proceed in parallel to comprehensively support the implementation of agroforestry and ecosystem rehabilitation, as detailed in Table 4.

Steps of the Forest Area Conservation Strategy

Table 4. Steps of the Forest Area Conservation Strategy at the Rokan Koto Ruang Village Ecotourism Site

Target	Program	Action	Implementing Stakeholders
Agroforestry	Development of high-economic-value crops	Socialization & joint planning with landholders; joint commitment-building with farmers; provision of quality seedlings; site clearing (row system); planting & maintenance	Pokdarwis; farmers/smallholders; Village Government, Environment & Forestry Agency, BPDAS-KPH
	Environmentally friendly farming technique training	Education & field practice; land-condition survey; suitable-crop analysis; seedling selection	KPH facilitators; Pokdarwis; farmers/smallholders; Government
	Collective marketing of production output	Social-media promotion; building marketing networks; transportation facilitation	KPH facilitators; Pokdarwis; farmers/smallholders; Government
Ecosystem Rehabilitation	Planting of native vegetation	FGD on native vegetation; provision & planting of native vegetation seedlings; monitoring & maintenance	KPH facilitators; Pokdarwis; farmers/smallholders; Government
	Erosion & sedimentation control	Terracing construction; cover-crop planting; construction of simple check dams	KPH facilitators; Pokdarwis; farmers/smallholders; Government
	Wildlife habitat restoration	Installation of anti-poaching banners; routine joint patrols with stakeholders	KPH facilitators; Pokdarwis; Government; Forest Police; Police
Community Empowerment & Education	Ecosystem-based ecotourism management training	Training for Pokdarwis management on ecosystem-based ecotourism	PKH facilitators; Pokdarwis; Village Government; DLHK; Tourism Office
	Education on the importance of conservation	Socialization to farmers on land status & conservation; socialization to tourists	PKH facilitators; Pokdarwis; Government; Forest Police; Police
	Establishment/strengthening of Pokdarwis	Pokdarwis mentoring; drafting of the RKTL work plan for conservation & ecotourism development	PKH facilitators; Pokdarwis; Village Government; Tourism Office
Multi-Stakeholder Collaboration	Formation of a multi-stakeholder coordination forum	Socialization & establishment of a forest-area conservation coordination forum	PKH facilitators; Pokdarwis; Government; Police
	Joint policy formulation	Drafting the Conservation-Assisted Village concept; zoning designation; joint drafting of conservation-area rules	PKH facilitators; Pokdarwis; Government; Forest Police; Police
	Joint fundraising	Program & proposal drafting; proposal submission through hearings with relevant agencies	PKH facilitators; Pokdarwis; Government

Target	Program	Action	Implementing Stakeholders
Infrastructure Improvement	Construction of educational ecotourism trails	Installation of environmental-preservation signage along ecotourism trails	Pokdarwis; Village Government
	Provision of sanitation facilities & information center	Sanitation construction at ecotourism sites; construction of the TIC with its facilities	Pokdarwis; Village Government; Tourism Office
	Effective waste and refuse management	Provision of trash bins; installation of anti-littering banners; establishment of a cleaning duty roster	Pokdarwis; Village Government; Tourism Office

Source: Processed by Researcher, 2025

5. Conclusion

Based on the results and discussion, this study draws the following four conclusions.

First, implementation of the forest conservation strategy through the ecotourism development policy of the Rokan Koto Ruang Village Government has not substantially influenced environmental preservation of the forest area at the village's ecotourism site, as prohibited activities such as scattered waste, forest area conversion into oil palm, illegal fishing, and illegal logging are still occurring. Addressing this requires a forest area conservation strategy for the Rokan Koto Ruang ecotourism site comprising five alternative strategies: ecosystem rehabilitation, agroforestry, community empowerment and education, environmentally friendly ecotourism infrastructure development, and multi-stakeholder collaboration.

Second, the priorities of the forest area conservation strategy at the Rokan Koto Ruang Village ecotourism site, in sequence, are: agroforestry (eigen vector 0.2701), ecosystem rehabilitation (0.1997), community empowerment and education (0.1930), multi-stakeholder collaboration (0.1872), and environmentally friendly infrastructure improvement (0.0634).

Third, the priority strategies of agroforestry and ecosystem rehabilitation cannot stand alone — both must be supported by community empowerment and education, multi-stakeholder collaboration, and infrastructure improvement, all of which must proceed in parallel for the conservation strategy to be implemented effectively.

Fourth, read together, the study's findings sit at the intersection of two theoretical gaps. Ecotourism theory and the ecosystem approach are well equipped to specify what a conservation intervention should contain, but neither, by itself, adequately explains variation in outcomes across sites governed under the same policy umbrella, as this study found between Sawah Koto and the two forest-margin destinations. That variation is better explained through a political-ecology reading attentive to who initiates and legitimizes conservation action, and under what legal claim over land (Robbins, 2020; Peluso, 1992). The evidence from Rokan Koto Ruang Village suggests that locally initiated political leadership, operating within Indonesia's village-decentralization framework, can generate real if partial conservation outcomes even without external funding or NGO facilitation (Steenbergen, 2016; Warren & Visser, 2016), but that this leadership-driven model reaches a structural limit once it meets land under overlapping state-forestry and private-concession claims, precisely the condition documented at Puncak Kabur and Kajatan Baru Waterfall. This points to a theoretical gap worth pursuing in future research: existing ecotourism and ecosystem-approach frameworks would benefit from explicitly incorporating a governance-and-leadership variable, and from testing, across a

larger sample of villages, whether the AHP-ranked priority found here — that agroforestry and ecosystem rehabilitation outperform infrastructure-centered alternatives — holds where local leadership initiative is weaker or where land tenure is more heavily contested.

Based on these conclusions, this study offers three recommendations. First, efforts to preserve forest areas anywhere require firm and consistent government action (by BPDAS, KPH, the Forest Police, and the Indonesian Armed Forces/Police) regarding the status of forest areas and their conservation; active community participation will be easier to build when enforcement of area status is firm, given that one factor behind past conservation failures has been the ambiguous stance of law-enforcement officers toward forest encroachers. Second, forest area conservation in Rokan Koto Ruang Village requires comprehensive effort and special attention; a long-term Conservation-Assisted Village program is worth pursuing. Third, the forest area at the Rokan Koto Ruang Village ecotourism site requires zoning efforts to limit encroachment, one avenue being the pursuit of Social Forestry permits in the form of Community Forest (HKm) or Village Forest status, which should be driven by Pokdarwis.

6. Acknowledgement

The authors would like to thank the Rokan Koto Ruang Village Government, the Tourism Awareness Group (Pokdarwis), and all research informants for their support with data and information and their willingness to be interviewed throughout this study.

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