

COMMUNITY COEXISTENCE AND ATTITUDES TOWARD SUMATRAN ELEPHANT CONFLICT IN ARAS NAPAL KIRI, BESITANG, LANGKAT: A REVIEW OF HUMAN-ELEPHANT INTERACTION IN THE CONTEXT OF CONSERVATION

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Received: 22/04/2026 | Revised : 01/05/2026 | Accepted: 15/05/2026 | Published :26/05/2026

Abstract

The Sumatran elephant (*Elephas maximus sumatranus*) is a critically endangered species whose survival is increasingly threatened by human-elephant conflict (HEC) resulting from habitat fragmentation and expanding agricultural activities. This study investigates community coexistence and attitudes toward HEC in Dusun Aras Napal Kiri, Besitang, Langkat—a buffer zone adjacent to Gunung Leuser National Park (TNGL). A mixed-method approach combining quantitative surveys (n=28 households) and qualitative interviews was employed, supported by stakeholder analysis using an interest-influence matrix. Results show that 85% of respondents reported frequent conflicts, with 86% experiencing crop damage and annual economic losses equivalent to 1–1.5 months of household income. Despite the high conflict intensity, respondents exhibited a positive perception score of 1,191 out of 1,680, indicating ambivalent yet conservation-supportive attitudes—a condition defined as fragile coexistence. Stakeholder analysis identified UPT TNGL and UPT BKSDA as key players, community leaders and NGOs as agents to keep satisfied, while plantation companies and the general community occupy a monitoring role. The study recommends an integrated socio-ecological strategy encompassing community-based mitigation, adaptive agriculture, economic risk redistribution, and collaborative governance to transition toward sustainable coexistence.

Keywords coexistence, conservation, human-elephant conflict, stakeholder analysis, Sumatran elephant

INTRODUCTION

The Sumatran elephant (*Elephas maximus sumatranus*) is classified as Critically Endangered on the IUCN Red List and listed under CITES Appendix I, making it one of Indonesia's highest-priority conservation species (Ardiantiono et al., 2021). The estimated population declined drastically from 2,400–2,800 individuals in 2007 to approximately 924–1,359 individuals in the most recent assessment—a loss of nearly half the population in less than a decade (Kuswanda et al., 2022; Mossbrucker, 2021). Population decline is driven by three interrelated factors: habitat loss through deforestation and land-use conversion, illegal hunting, and escalating human-elephant conflict (HEC). Human-elephant conflict occurs when elephant behavior or spatial requirements create negative impacts on human livelihoods, or vice versa (Kansky et al., 2016). Across Sumatra, 36 elephant populations exist, the majority of which range outside formal protected areas and frequently overlap with agricultural landscapes (KSDAE, 2020). In this context, crop depredation constitutes the most prevalent form of negative interaction, while physical threats to humans and property destruction are less frequently reported but more psychologically damaging (Qomariah et al., 2019). Dusun Aras Napal Kiri, located in Desa Bukit Mas, Kecamatan Besitang, Kabupaten Langkat, represents a particularly sensitive interface zone. Positioned as an overlap landscape—where elephant home ranges directly intersect human agricultural production areas without effective buffer zones—the area exhibits structural conditions conducive to chronic and recurring conflict. The community's high economic dependence on agriculture, combined with the absence of coordinated mitigation mechanisms, creates a system of fragile coexistence that is vulnerable to collapse under continued conflict pressure. Previous studies in Sumatra have examined crop damage patterns (Qomariah et al., 2019; Kuswanda et al., 2022), mitigation strategies (Gunaryadi & Hedges, 2017), and community attitudes toward elephants in different districts (Ardiantiono et al., 2021; Abdullah et al., 2019). However, the socio-

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ecological dimensions of HEC in Langkat's buffer zone context—integrating stakeholder dynamics, community perception, economic vulnerability, and governance gaps—remain insufficiently explored. This study addresses that gap. This research aims to: (1) analyze community coexistence conditions with Sumatran elephants based on conflict incidence and community perceptions; and (2) identify stakeholder roles and develop an integrated adaptive strategy to support sustainable human-elephant coexistence in Dusun Aras Napal Kiri.

LITERATURE REVIEW

Sumatran Elephant Conservation Status

The Sumatran elephant is the smallest subspecies of the Asian elephant, with females averaging 200–230 cm in shoulder height and 2,000–3,000 kg, while adult males reach 225–280 cm and 3,200–5,000 kg (Mossbrucker, 2021). As a megaherbivore, it consumes over 400 plant species and plays a critical role in ecosystem engineering and seed dispersal, qualifying it as an umbrella species for tropical forest biodiversity (Salsabila et al., 2017). Despite this ecological importance, habitat fragmentation has reduced the species to 22 isolated population pockets across seven Sumatran provinces, with fewer than 1,500 individuals estimated to remain in the wild (Kuswanda et al., 2022).

Human-Elephant Conflict Dynamics

Human-wildlife conflict is broadly defined as interactions between humans and wildlife that generate negative outcomes for one or both parties (Kansky et al., 2016). In the context of elephants, HEC typically manifests as crop destruction, property damage, physical threats, and retaliatory killing. Ardiantiono et al. (2021) found that in Sumatran communities, 64% of respondents refused to support elephant conservation when crop damage threatened their livelihoods, highlighting the conditional nature of tolerance. The hidden costs of HEC—including psychological stress, sleep disruption, and reduced labor productivity—compound the visible economic losses (Qomariah et al., 2019). The concept of wildlife tolerance, as formalized by Kansky et al. (2016), emphasizes that factors beyond direct economic loss—including social norms, trust in institutions, cultural values, and perceived control—substantially determine whether communities accept or resist wildlife presence. This framework is central to understanding why economically similar communities may exhibit vastly different coexistence outcomes.

Stakeholder Analysis in Conservation

Effective management of human-wildlife conflict requires multi-stakeholder coordination. Reed (2018) proposed a theory of participation that identifies four determinants of effective stakeholder engagement in environmental management: initiation agency, engagement mode, institutional context, and clarity of shared objectives. Raum (2018) extended this framework specifically to ecosystem services research, emphasizing the importance of empirically categorizing actors based on interest and influence capacity. Bryson (2018) further elaborated stakeholder identification techniques for public and non-profit organizations, providing practical tools for strategic planning in conservation contexts.

Coexistence Frameworks

Coexistence in the human-wildlife literature is increasingly understood not as the absence of conflict, but as the capacity of socio-ecological systems to manage conflict adaptively while maintaining both human livelihoods and wildlife populations (Ardiantiono et al., 2021). Carter and Linnell (2016) describe 'fragile coexistence' as a transitional state characterized by normative support for conservation alongside high actual conflict frequency and tolerance contingent on mitigation effectiveness. This conceptual framing is directly applicable to the Aras Napal Kiri context, where positive ecological attitudes coexist with persistent economic grievances.

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METHOD

Study Area

The research was conducted in Dusun Aras Napal Kiri, Desa Bukit Mas, Kecamatan Besitang, Kabupaten Langkat, North Sumatra Province (approximately 115 km north of Medan), from November 2025 to March 2026. The study area is classified as a low-elevation tropical rainforest ecosystem (lowland forest type), directly adjacent to the Gunung Leuser National Park (TNGL), which serves as primary habitat for Sumatran elephants. The village represents an overlap landscape where elephant home ranges intersect agricultural land use without effective spatial separation, creating conditions for chronic and recurring conflict.

Research Design

A mixed-method approach was employed, integrating quantitative surveys and qualitative interviews to provide comprehensive insights into coexistence dynamics, community attitudes, and stakeholder relationships. This approach aligns with the multi-dimensional nature of HEC, which encompasses ecological, socio-economic, psychological, and governance dimensions.

Sampling

The research population comprised farmer households and key stakeholders in Dusun Aras Napal Kiri. Farmer households (n=25) were selected using simple random sampling, restricted to those whose agricultural land directly borders the national park boundary. Stakeholder respondents (n=4) were selected through purposive sampling: one representative each from local government, NGO, private sector (plantation companies), and local traditional leaders. Total sample: n=28 respondents.

Data Collection

Data collection instruments included: (1) structured questionnaires with 12 Likert-scale items (1–5, strongly disagree to strongly agree) covering four thematic domains: demographic characteristics, land management and conflict intensity, community perceptions and attitudes, and stakeholder relations; (2) in-depth interviews with key informants to capture narrative perspectives on conflict experiences and institutional relationships; (3) field observation of agricultural patterns and land use; and (4) multi-stakeholder Focus Group Discussions (FGD) to identify participatory mitigation strategies.

Data Analysis

Quantitative data were analyzed using descriptive statistics. Perception scores were calculated as total Likert scores, with theoretical minimum = 336 (28 respondents × 12 items × 1) and theoretical maximum = 1,680 (28 × 12 × 5). Stakeholder analysis used an interest-influence matrix following Reed (2018) and Bryson (2018), with each stakeholder scored on both dimensions (scale 1–5) and assigned to one of four quadrants based on a threshold value of 3.5. Qualitative data were analyzed thematically to identify patterns in attitudes, coping strategies, and institutional relations.

RESULTS AND DISCUSSION

Respondent Characteristics

The majority of respondents (75%) are in the productive age group (15–64 years), constituting the primary economic backbone of farming households. This demographic profile intensifies the socio-economic significance of HEC, as crop losses directly threaten the primary earners responsible for household food security, education, and healthcare. Income distribution showed that 36% of respondents earn Rp 2,100,000–3,000,000 per month, with nearly all income sourced from agriculture—indicating a low-diversification economic structure highly vulnerable to production disruption. Educational attainment is predominantly at the primary and lower-secondary level. In alignment with findings by Rianti and Garsetiasih (2018), lower formal education correlates with experiential rather than formal ecological knowledge formation, resulting in risk-based perceptions of elephants grounded in direct material losses rather than normative conservation values. This has important implications for communication strategies in conservation outreach.

Land Use and Conflict Intensity

Among respondents, 86% reported experiencing crop damage from elephant incursions, with 75% reporting conflict frequency exceeding 4–10 incidents per year. This pattern confirms the structural and chronic nature of HEC in the

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study area. The dominant crops (banana, paddy, oil palm) correspond closely to documented Sumatran elephant dietary preferences (Berliani et al., 2016), effectively making farmland an ecologically attractive foraging patch. Within the optimal foraging theory framework (MacArthur & Pianka, 1966), elephants rationally maximize energy intake by preferring cultivated crops over degraded secondary forest vegetation. Annual economic losses per household ranged from Rp 500,000 to Rp 3,000,000, with 55% of respondents reporting losses of Rp 500,000–1,000,000. When contextualized against monthly household income, this represents 1–1.5 months of earnings—a substantial burden in a subsistence-oriented rural economy. This finding aligns with Qomariah et al. (2019), who documented significant economic stress in HEC-affected Acehese communities, and with Ardiantiono et al. (2021), who showed that financial vulnerability is a primary determinant of willingness to coexist. The dominant mitigation method is direct field guarding (50%), supplemented by deterrent plants (12%), lighting (12%), while 27% report no mitigation effort. Effectiveness assessments show 56% rate their method as 'fairly effective', 32% as 'effective', and 12% as 'ineffective'. These results reflect the displacement mitigation characteristic—individual methods reduce incursions locally but merely relocate pressure to neighboring fields. Without collective coordination, this produces no systemic conflict reduction (Gunaryadi & Hedges, 2017).

Stakeholder Analysis

The interest-influence matrix analysis identified seven stakeholder groups across three quadrants (Table 1). UPT TNGL and UPT BKSDA Sumatra scored highest on both dimensions (K=5, P=5; Resultante=5.0), confirming their position as Key Players with formal authority over conservation policy and wildlife management. Their spatial data on elephant home ranges and movement corridors is irreplaceable for designing evidence-based adaptive agriculture strategies. Qomariah et al. (2019) and Kuswanda et al. (2022) consistently demonstrate that the quality of coordination between conservation agencies and affected communities is the strongest predictor of mitigation success in Sumatran HEC contexts.

Table 1. Stakeholder Interest-Influence Matrix Results

Stakeholder	Interest (K)	Influence (P)	Resultante (K+P)/2	Quadrant
UPT TNGL	5	5	5.0	I – Key Players
UPT BKSDA	5	5	5.0	I – Key Players
Community Leaders	4	4	4.0	II – Keep Satisfied
NGO/LSM	4	4	4.0	II – Keep Satisfied
PT Rapala	3	3	3.0	IV – Monitor
PT. Alongg	3	3	3.0	IV – Monitor
General Community	3	3	3.0	IV – Monitor

Source: Primary data analysis, 2026

Community leaders and NGOs occupy Quadrant II (Keep Satisfied, K=4, P=4), reflecting significant socio-cultural influence without formal decision-making authority. Kansky et al. (2016) emphasize that non-economic factors—including trust in community leaders and social norms—often exceed material loss in determining wildlife tolerance. Gunaryadi and Hedges (2017) demonstrated that community-based mitigation programs facilitated by NGOs achieved 91.2% success in repelling elephant crop raids at Way Kambas National Park. Both stakeholder groups are therefore essential conduits for translating conservation objectives into community behavioral change. Plantation companies (PT Rapala, PT Alongg) and the general community were assigned to Quadrant IV (Monitor, K=3, P=3), reflecting limited formal influence capacity despite their material stake in conflict outcomes. Abdullah et al. (2019) found that plantation concessions bordering elephant corridors without adequate mitigation constitute primary HEC triggers, particularly during harvest seasons. Engaging these stakeholders in Corporate Social Responsibility (CSR)-based mitigation—such as perimeter fencing or farmer compensation schemes—represents an underutilized governance opportunity.

Community Perceptions and Attitudes: Coexistence Analysis

Survey results reveal a pattern of ambivalent yet functionally constructive attitudes toward elephants (Tables 2 and 3). Among respondents, 71% acknowledged the positive ecological impact of elephants, while 85% confirmed high

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conflict frequency and 93% demanded immediate conflict resolution. The aggregate Likert score of 1,191 (out of 1,680 maximum) positions community perception in the positive range, indicating conservation-supportive attitudes maintained under persistent economic stress.

Table 2. Community Perceptions and Attitudes Toward Elephants (n=28)

No	Statement	STS	TS	R	S	SS
1	Elephant presence has positive ecosystem impact	-	-	29%	55%	16%
2	Elephant presence does NOT harm the village community	7%	18%	35%	40%	-
3	Human-elephant conflicts occur frequently	-	-	15%	51%	34%
4	Conflict must be resolved immediately without delay	-	-	7%	34%	59%
5	Conflict can be fully resolved by involving stakeholders	-	8%	5%	38%	49%

Note: STS=Strongly Disagree, TS=Disagree, R=Uncertain, S=Agree, SS=Strongly Agree; Source: Primary data, 2025.

This ambivalence is consistent with Dickman (2010), who found that community attitudes toward wildlife are rarely binary; conservation support can persist despite conflict because perceptions are shaped by a complex interplay of social, economic, and cultural factors. Notably, 87% of respondents expressed belief that stakeholder collaboration can resolve conflict—indicating significant social capital and institutional legitimacy that can be leveraged for governance interventions.

Table 3. Social Norms, Cultural Values, and Conservation Participation (n=28)

No	Statement	STS	TS	R	S	SS
1	Good knowledge of elephant status and presence	-	7%	47%	43%	3%
2	Protecting elephant populations is very important	-	11%	30%	46%	13%
3	Community and elephants can coexist harmoniously	10%	12%	45%	27%	6%
4	Government/NGO assistance in conflict management is needed	4%	20%	46%	27%	3%
5	Invited to attend HEC mitigation training/socialization	7%	19%	26%	41%	7%
6	Community-based mitigation programs are very important	-	-	11%	84%	5%
7	Willing to participate directly in conservation programs	-	30%	23%	38%	9%

Note: STS=Strongly Disagree, TS=Disagree, R=Uncertain, S=Agree, SS=Strongly Agree; Source: Primary data, 2025.

The attitude-behavior gap—89% supporting participatory mitigation versus only 47% willing to engage directly—reflects Kollmuss and Agyeman's (2002) framework of pro-environmental behavior barriers: economic constraints, perceived risk, and absence of direct incentives. Gifford (2011) identifies limited economic capacity and high-risk perception as primary inhibitors of environmental action. In the Aras Napal context, participation in mitigation is not perceived as a collective investment but as an activity with uncertain returns, especially in the absence of guaranteed compensation or institutional support.

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The overall coexistence condition at Dusun Aras Napal Kiri can be characterized as limited adaptive coexistence (Carter & Linnell, 2016)—a transitional state where normative conservation support persists but tolerance is structurally fragile. Three conditions define this state: (1) normative support for conservation remains, (2) actual conflict occurs at high frequency, and (3) community tolerance is contingent on mitigation effectiveness and perceived distributive fairness. Without systemic intervention, high conflict fatigue (Karanth et al., 2013) risks eroding this residual tolerance.

Integrated Socio-Ecological Adaptation Strategy

Based on research findings, an integrated five-pillar strategy for sustainable coexistence is proposed:

(1) Community-Based Mitigation System: Establishing a village-level conflict response unit (Tim Respons Konflik Desa) to transform individual reactive responses into collective early-warning and rapid-response mechanisms (Ostrom, 1990).

(2) Risk-Based Adaptive Agriculture: Implementing micro-zonation of high-risk agricultural land to promote non-preferred crop cultivation, agroforestry buffers, and bio-fencing arrangements that reduce the ecological attractiveness of farmland to elephants (Fahrig, 2003; Gunaryadi & Hedges, 2017).

(3) Economic Risk Redistribution: Developing micro-compensation schemes, participation-based incentives, and income diversification programs to reduce household vulnerability and widen tolerance thresholds (Dickman et al., 2011).

(4) Knowledge and Control Enhancement: Strengthening perceived behavioral control (Ajzen, 1991) through technical training, early-warning systems, and technology-based information access, thereby increasing community participation in mitigation activities.

(5) Collaborative Governance (Co-management): Establishing a structured multi-stakeholder coordination forum involving community, TNGL management, BKSDA, and NGOs, guided by principles of adaptive co-management (Carter & Linnell, 2016; Reed, 2018). This forum should integrate spatial data from Key Players, facilitation capacity from NGOs and community leaders, and behavioral inputs from the general community as primary program implementers.

This five-pillar framework aligns with the social-ecological systems (SES) approach advocated by Folke et al. (2005), recognizing that neither purely technical nor purely social interventions alone can produce sustainable coexistence. Lasting outcomes require restructuring the relationship between agricultural land use, elephant movement ecology, and institutional governance simultaneously.

CONCLUSION

This study demonstrates that human-elephant coexistence in Dusun Aras Napal Kiri represents a condition of fragile adaptive coexistence: 85% of the community reports frequent conflict, 86% have experienced crop damage, and economic losses equivalent to 1–1.5 months of household income are sustained annually. Despite these pressures, community attitudes remain positive (perception score 1,191/1,680), with 87% expressing confidence in collaborative conflict resolution—indicating latent social capital available for conservation governance. Stakeholder analysis identifies UPT TNGL and UPT BKSDA as irreplaceable Key Players, community leaders and NGOs as essential Keep Satisfied actors, and plantation companies and the community as monitoring-priority stakeholders. Sustainable coexistence requires an integrated socio-ecological transformation across five pillars: community-based mitigation, risk-based adaptive agriculture, economic redistribution, knowledge enhancement, and collaborative governance. Conflict in this landscape is structurally generated by the mismatch between agricultural land use and elephant movement ecology; its resolution demands landscape governance reform, not merely technical deterrence.

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