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Stakeholder's perspective on Sunda pangolin conservation governance in Indonesia's fragmented landscapes

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Abstract. *Novriyanti N, Masy'ud B, Soekmadi R, Buchori D. 2026. Stakeholder's perspective on Sunda pangolin conservation governance in Indonesia's fragmented landscapes. Asian J Ethnobiol 9: y090107. https://doi.org/10.13057/asianjethnobiol/y090107.* Within the framework of Nature's Contribution to People (NCP) of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the Sunda pangolin (*Manis javanica*) holds profound ecological and cultural significance for local communities. However, a shift toward valuing species primarily for their instrumental benefits has fueled poaching and habitat destruction, thereby sharply increasing extinction risk. Understanding the perspectives of people in fragmented landscapes is thus essential for shaping conservation priorities and preventing further population decline. This study was conducted across the Bukit Barisan Selatan (BBS), Sumatra, Indonesia, landscape, including Bukit Barisan Selatan National Park (TNBBS), forest management units (FMU/KPH), and other land use types (APL). Data were obtained from a focus group discussion and interviews with 55 stakeholders representing local communities, area managers, NGOs, and intermediaries, then analysed using prospective structural analysis (MICMAC and MACTOR methods). Ten key perspectives were identified, spanning ecological ethics, economic interests, and institutional policies, with certainty of land management right and access (*AksesPasti*) emerging as the primary driver of conservation outcomes. Governance challenges are strongly influenced by interference from non-governmental actors, such as illegal traders and poachers, compounded by community dependence on natural resourcesandy limited government institutional support. These findings highlight the need for an integrated governance model and initial paradigm shift that positions science, enriched by local knowledge and stakeholder capacity building, as the foundation for adaptive conservation in changing land-use contexts.

Keywords: Conservation governance, endangered species, local ecological knowledge, *Manis javanica*, prospective analysis

Abbreviations: APL: Non-forest area, BBS: Bukit Barisan Selatan, BKSDA: Natural Resources Conservation Center Bengkulu and Lampung, KPH Pesisir Barat: Pesisir Barat Forest Management Unit, MACTOR: Matrix of Alliance Conflict, Tactic, Objective and Recommendation, MICMAC: Matrice d'impacts croisés multiplication appliquée á un classment, TNBBS: Bukit Barisan Selatan National Park, WCS-IP: Wildlife Conservation Society - Indonesia Program

INTRODUCTION

Nature provides ecological, economic, and socio-cultural contributions to human well-being, as framed in the concept of Nature's Contributions to People (NCP) (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) 2016; Pascual et al. 2017). Human-nature relations shaped over thousands of years are embedded in local knowledge, beliefs, and socio-ecological interactions. To date, humans have utilized more than 50,000 wild species for food, medicine, energy, and cultural purposes to support their good quality of life (IPBES 2022). However, unsustainable exploitation practices has accelerated biodiversity loss and ecological degradation, intensified by market forces and global economic pressures. Within wildlife trade, the principles of "user need" (Herrmann et al. 2013) and commodification or the creation of new "market value" (Sullivan 2020), increasingly prioritized economic gain over intrinsic species value (Mauri et al. 2022; Sullivan et al. 2022).

The Sunda pangolin (*Manis javanica*), a scaly mammal native to Southeast Asia, including Indonesia, exemplifies this imbalance. Its population has sharply declined due to poaching and illegal trade, making it an icon of global wildlife trafficking (Heinrich et al. 2016; Thomson and Fletcher 2020). Ethnobiological evidence shows that, beyond its ecological role as an insect regulator (Lim and Ng 2008; Thai et al. 2014; Hua et al. 2015; Willcox et al. 2019), the species also carries symbolic and cultural significance in local communities (Novriyanti et al. 2016; Walsh 2020) and has been considered a rare commodity in

Indonesia (Hoeing et al. 2015). A shift from traditional use (Boakye 2018; Zanvo et al. 2021; Swiacká et al. 2022) to luxury and status-driven consumption (Mambeya et al. 2018; Emogor et al. 2021) has further accelerated its exploitation.

Despite strict protection under the International Union for Conservation of Nature (IUCN) with Critically Endangered status and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix I, as well as Indonesian national policies (Law 32/2024; Government Regulation 7/1999; MoEF Regulation 106/2018), stabilizing wild populations remains challenging. Ecological monitoring is hindered by the species' elusive behavior (Manshur et al. 2015; Withaningsih et al. 2018; Novriyanti and Takandjandji 2022), even though its presence has been confirmed across diverse land uses, including agroforests and oil palm landscapes (Manshur et al. 2015; Anasari et al. 2021). At the same time, ex situ breeding success is low (Masy'ud et al. 2011; Yan et al. 2021), emphasizing the need for effective in situ governance. Governance barriers are intensified in fragmented landscapes characterized by overlapping land tenure, multiple management regimes, and conflicting regulations that obstruct coordination and law enforcement (Pătru-Stupariu et al. 2024; Ayambire et al. 2025).

Therefore, this failure is not due to the absence of protection instruments, but rather to pangolin governance being a complex, non-linear socio-ecological issue shaped by interacting biological, cultural, economic, and institutional dimensions (Sharman and Mlambo 2012; Eastwood et al. 2020). Thus, pangolin conservation cannot rely solely on the implementation of top-down regulations; but requires the participation of multiple stakeholders who interact with and utilize the landscape that is the pangolin's habitat. Conservation outcomes are strongly influenced by how stakeholder objectives, land access, and socio-economic priorities are negotiated beyond formally protected areas, rather than by legal protection status alone (Soekmadi et al. 2025). This is important because human-nature relationships reflected in collective perspectives and values can determine the legitimacy, compliance, and collective action or participation (Díaz et al. 2015; Pascual et al. 2017), thereby avoiding trade-offs between conservation, and by unsustainable landscape-use choices (Sayer et al. 2013).

Despite its importance, research in Indonesia remains limited, particularly on how value-based perspectives shape conservation behavior and decision-making. Studies of endangered mammals are dominated by ecological assessments, with governance aspects like stakeholder engagement and perspective rarely integrated into analyses, especially in biodiversity hotspot like Indonesia (Novriyanti et al. 2025). While studies elsewhere show that local knowledge reflects stakeholder orientations (Emogor et al. 2023), most remain descriptive and rarely explore how different perspectives interact structurally to shape governance outcomes (Binley et al. 2025). Addressing this gap, this study aims to: (i) identify stakeholder perspectives on Sunda pangolin conservation; (ii) analyze the drivers of conservation behavior emerging from these perspectives; and (iii) synthesize these drivers to inform coherent policy and governance strategies relevant to Indonesia's complex socio-ecological landscape.

MATERIALS AND METHODS

Study area

This study was conducted in the Bukit Barisan Selatan (BBS) landscape of Lampung Province, Sumatra, Indonesia, from February to November 2024. The study area consists of the state-forest, i.e., Bukit Barisan Selatan National Park (TNBBS) and its surrounding areas, including the Pesisir Barat Forest Management Unit (KPH Pesisir Barat) and other land uses (APL). This location was selected based on preliminary studies confirming Sunda pangolin presence (Figure 1), including direct reports from local communities to TNBBS (Figure 2).

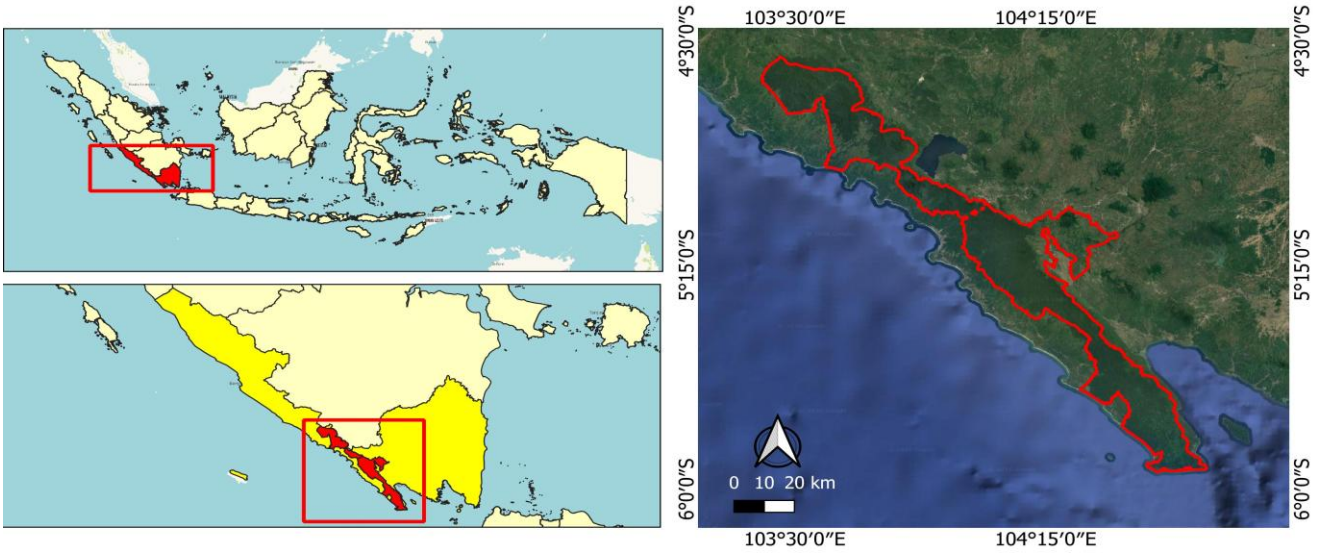

Figure 1. Sunda pangolin detection in Bukit Barisan Selatan National Park, Sumatra, Indonesia, as a reference for this study location

Figure 2. A pangolin was found by villagers/farmers around Bukit Barisan Selatan National Park, Sumatra, Indonesia, at night. He reports and submits this species to the area stakeholders to return to their habitat. Note: The informant has authorized the use of the image

This finding were corroborated by secondary data from citizen science platforms like the Global Biodiversity Information Facility (GBIF) and iNaturalist, filtered to *M. javanica* occurrence records within the TNBBS administrative boundaries. Furthermore, the selection of the BBS landscape is particularly appropriate due to its representation of a fragmented area encompassing not only forests but also a variety of land uses exhibiting diverse socio-cultural characteristics (Bakri et al. 2023; Wulandari et al. 2024), despite its biodiversity diversity (Munawaroh and Yuzammi 2019; Allen et al. 2020; Anasari et al. 2021), ranging from mountains to coastlines (Suyadi 2011; Weiskopf et al. 2019). Moreover, numerous reports of human-wildlife conflict (Allen et al. 2020) and the criminogenic dimensions of conservation within this landscape (Kahler et al. 2022) highlight the importance of this location for further study.

Data collection

This study collected primary data through a qualitative methodology, primarily utilizing semi-structured interviews guided by an open-ended question list. This approach is standard in conservation studies for its flexibility and focus on participant perspectives (Young et al. 2017). To strengthen the research information base, literature on ecology, social aspects, and pangolin trade was also studied, particularly to enrich the researcher's arguments during interviews. The interviews were designed to explore stakeholders' understanding of policies, opportunities, challenges, and their alignment with pangolin conservation. Three distinct interview formats were employed: (i) Focus Group Discussion (FGD). The FGD was conducted with local communities that utilize the forest landscape, both with and without formal partnerships with area managers, at the TNBBS resort and the Pesisir Barat Forest Management Unit (KPH Pesisir Barat). (ii) Individual Confidential Interview. This type of interview was administered to three specific community typologies: coastal communities, individuals identified in previous research as suspected former poachers, and middlemen. This confidential approach was essential for building trust and obtaining candid information about sensitive topics such as past poaching activities, motivations, and the structure of illegal trade networks, particularly in coastal port areas (Hague et al. 2022). The anonymity of all community-level sources was guaranteed. (iii) Expert Interview. This method was used to gain deeper insights into the findings from the community interviews and validate their accuracy against specialized knowledge (Krzton 2019).

The participants in this study were involved in the management and use of the Bukit Barisan Selatan landscape, which spans from mountainous to coastal regions. Informants are limited to those categorized in Figure 3. Although grouped under community categories, data analysis treated specific subgroups (e.g., former poachers vs. farmers) as distinct actors to identify divergent values and potential conflicts.

A key prerequisite for participation was the provision of Free, Prior, and Informed Consent (FPIC), which was communicated in writing via an invitation letter and confirmed verbally before each interview. Individuals or institutions deemed irrelevant to pangolin conservation or those who declined to be interviewed were excluded from the study. This purposive sampling was based on specific inclusion criteria: (i) permanent residency in the forest buffer zone for at least 5 years; (ii) direct livelihood dependence on forest resources; and (iii) verified knowledge of local wildlife. Sampling continued until data saturation was achieved, resulting in a final sample of 55 participants, as no new information or themes emerged from the final interviews (Fusch and Ness 2015). This number comprised 47 individuals from local community groups (including former poachers and middlemen), four forest area managers from central and provincial agencies, and one representative from a non-governmental organization. Additionally, nine experts who met the selection criteria agreed to participate. Experts were defined as individuals holding a minimum of a Master's degree in a relevant field or possessing at least 10 years of professional experience in wildlife conservation or law enforcement. The group included two wildlife conservation governance specialists, two State Forest Protection personnel, two law enforcement experts on illegal wildlife trade, and three academics.

Triangulation (sources, data, and methods) was employed throughout the data collection process to ensure data validity and mitigate bias (Santos et al. 2020; Jiang et al. 2021). Source triangulation was achieved by comparing data from different groups (local communities, area managers, and experts). Methodological triangulation involved cross-verifying findings from different interview formats. For example, sensitive information regarding poaching that a community member might withhold in an FGD could be more candidly shared during individual confidential interviews. This process then also confirms

them against existing literature. Finally, data triangulation was used to test the consistency of narratives between different informants and compare them with official documents.

Data analysis

Qualitative data from interviews were transcribed using web-based Turboscribe software, then matched and enriched with field notes. The results (specifically the narratives emerging from questions about challenges and opportunities related to future pangolin conservation) were grouped and briefly labeled, then converted into scaled questions for expert evaluation. Prospective analysis techniques were applied to assess the strength of factors and actors. The questionnaire resulting from factor weighting (the level of influence and dependency between variables or perspectives, in this study) was processed using Matrice d'Ampacts Croisés Multiplication Applique à un classement (MICMAC) software to generate a map of key factors. Meanwhile, the influence and interdependence of stakeholders, both among themselves and on the factors/variables/perspectives studied, were processed using Alliance and Conflict Matrix: Tactics, Goals, and Recommendations (MACTOR) software (Bendahan et al. 2004; Boumaour et al. 2018). This method sequentially identifies active and passive actors, alliances, conflicts, strategies, tactics, and goals (Boudoukha and Kachef 2022). Table 1 presents the factor and actor analysis weights and scales.

Table 1. The weighting or scale of the prospective (factor and actor) analysis

Matrix Scale	Meaning of each scale value		
	Variables or perspectives influence and dependency (MICMAC Analysis)	Stakeholder (actor) influence and dependency (MACTOR Analysis)	
		Between stakeholder (A → B)	Factor/variable/vision impact to stakeholder
0	No influence	Little to no influence	No relationship/influence/impact to the stakeholder
1	Weak influence	Able to influence the management process	(+) Crucial for supporting to the general managerial activities (-) Poses a threat to the general managerial activities
2	Moderate influence	Able to influence the success project	(+) Crucial for the success of ongoing programs/projects (-) Poses a threat to the success of ongoing programs/projects
3	Strong influence	Able to influence the mission implementation	(+) Essential for achieving the stakeholder's main mission (-) Poses a threat to achieving the stakeholder's mission
4	-	Able to influence the existence	(+) Esential for maintaining the stakeholder's existence (-) Poses a threat to the stakeholder's existence
P*)	Potential influence	-	-

Note: The 'P' notation is used to assess relationships whose effects are not direct or certain in the current state, but are expected to become significant in the future. Expert answers will be assigned a P (potential influence) score in the MICMAC software when the variable cannot be quantified at this time because the answer contains "possibilities." The P notation is only found in the intervariable analysis in MICMAC, not found in the actor analysis (in MACTOR software)

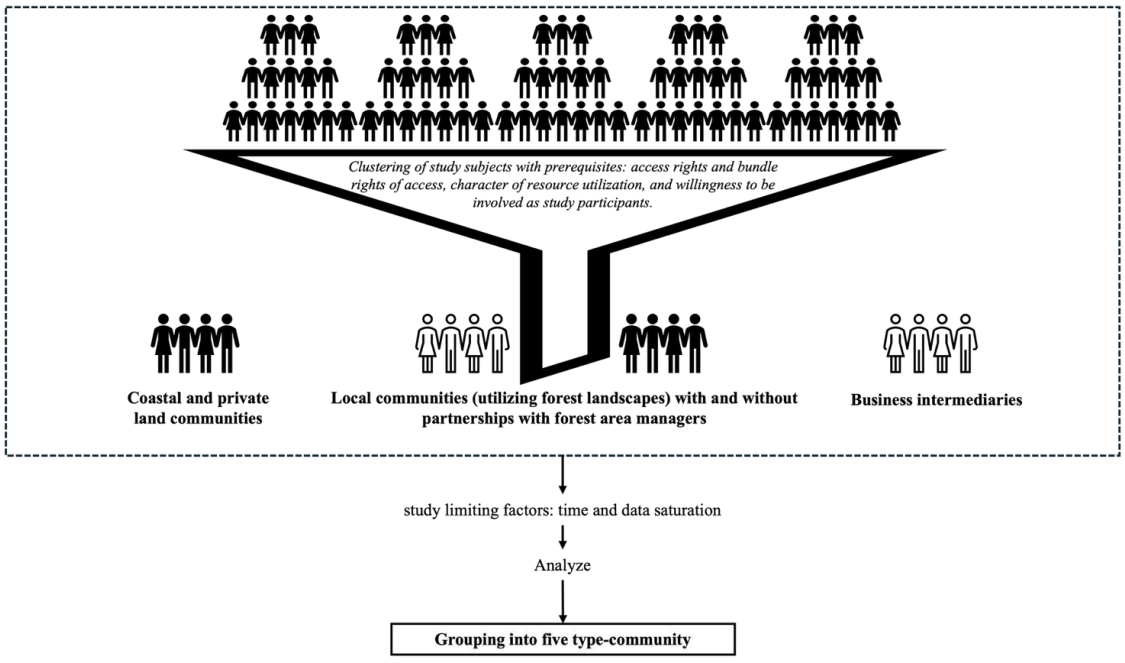

Figure 3. Selection of research subjects from community groups. While categorized broadly here for sampling purposes, the analysis distinguished between these subgroups to capture their distinct and potentially conflicting perspectives

RESULTS AND DISCUSSION

Stakeholder perspectives in the landscapes related to pangolin conservation

This study investigated stakeholders' knowledge of Sunda pangolin protection at the local level, particularly regarding the legal prohibitions on capture and trade. Although almost all actors were aware that the pangolin is a protected species and cannot be commercialized, most, especially local communities, lacked ecological and ethical understanding of why such protection exists. This reveals a gap between normative knowledge (merely knowing the rule) and substantive understanding (knowing the purpose of conservation). This condition reflects broader evidence showing that public perceptions of species deserving protection are often grounded in direct utility, perceived abundance, or visible traits, rather than legal or ecological reasoning used by conservation authorities (Cebrián-Piqueras et al. 2020; Ulicsni et al. 2024).

Beyond this general awareness, a spectrum of epistemic orientations emerged from stakeholder narratives. A portion of respondents demonstrated relatively detailed ecological knowledge, particularly those frequently interacting with forests. Such informants described nocturnal behavior, feeding specialization, and burrow use in ground or wood cavities: "*There are burrows in the ground and in tree logs… they rarely come out during the day… they eat many types of ants and termites*." This information is consistent with almost all research results indicating that pangolin nests are generally in the form of holes or burrows in soil, wood, and stones (Manshur et al. 2015; Withaningsih et al. 2018; Gray et al. 2023). Chinese (*Manis pentadactyla*) and Indian (*Manis crassicaudata*) pangolins make two types of burrows: resting burrows and feeding burrows. Resting holes are used for sleeping, sheltering, and raising offspring, while feeding holes are used to search for prey such as ants and termites (Karawita et al. 2018; Waseem et al. 2020; Sun et al. 2025). Nesting holes are usually deeper and larger than feeding holes for Indian pangolins, have tunnels that initially descend and then ascend to the rest chamber, often hidden under large rocks or tree roots (Karawita et al. 2018; Shrestha et al. 2021) while in Chinese pangolins, the rest holes are also permanent and are often reused (Sun et al. 2025). This kind of nest character is preferred by pangolins because it provides a stable thermal environment, which is essential for rest, mating, reproduction, and caring for their young (Chong et al. 2020). However, this ecological knowledge was unequally distributed; some respondents knew pangolins only from stories or were uncertain because they had never encountered them. This variation reinforces that Local Ecological Knowledge (LEK) is shaped by experiential engagement with landscapes, such as forest-edge farming or past hunting experiences (Büscher and Fletcher 2019; Nurhaida et al. 2022).

At the same time, there is a misperception about population abundance, for example: *"Pangolins will not go extinct, because there are still many in the National Park."* These claims contradict scientific data showing a drastic decline in pangolin populations in Southeast Asia due to organized poaching and habitat degradation (Masy'ud et al. 2011; Heinrich et al. 2016; Challender et al. 2019; Perera and Karawita 2020). The perception of abundance from sporadic encounters confirms that some people judge population status not on scientific evidence but on encounter-based inference. People also tend to consider pangolins useless because they are not consumed and do not harm humans, so their conservation value is considered low, a common pattern in a social landscape with no norms of protection for wildlife (Novriyanti et al. 2014; Büscher and Fletcher 2019).

Economic experiences formed another layer, shaping conservation attitudes. Several respondents recalled that pangolins were once treated as high-value commodities, particularly due to scale prices: *"In 2013, pangolin scales could reach one million rupiah per ounce… it was safer to sell them alive."* These memories correspond with market-driven exploitation documented in regional trade networks (Heinrich et al. 2016; Nijman et al. 2016; Challender et al. 2020). However, declining populations, increased legal risk, and unstable black-market prices have since shifted livelihood priorities. As one respondent said: *"I quit… It's better to focus on coffee farming."* Alongside this shift, surrendering pangolins to authorities emerged as a form of non-commercial incentive: *"It wasn't sold, but turned over to the park office."* Such practices represent a transition from use value to conservation value, driven by livelihood choices and incentive mechanisms. Literature confirms that these approaches are effective when supported by equitable compensation, transparent enforcement, and viable livelihood alternatives (Suich 2013; Oduor 2020; Fariss et al. 2023).

Together, these narratives illustrate that the interplay between ecological knowledge, economic history, perceived abundance, and individual ethics shapes community perspectives on pangolins. These orientations form conditional enabling or constraining factors for conservation outcomes. Based on thematic classification, ten such perspectives were mapped into four sustainability dimensions, ecological ethics, economy, institutional-policies, and social support, consistent with the IPBES value framework recognizing both material and non-material contributions of nature to human well-being (IPBES 2019; Piccolo et al. 2022). This classification is presented in Table 2.

A synthesis of the various perspectives is provided in Figure 4 to answer the question: *"How can pangolins be conserved in the wild within a fragmented socio-ecological landscape?"* A fundamental prerequisite is the species' value to humans (from an ecological ethics perspective). Only two value-based perspectives emerged. The first is a recognition of wildlife's right to exist as part of the ecosystem (code: *HakHidup*/Right to Live). This view implies that pangolins can be protected if there is a prevailing attitude of respect toward nature and an understanding that pangolins, as living beings, are entitled to utilize the landscape without disturbance or excessive exploitation. This intrinsic valuation is reflected in a respondent's statement, *".....Eventually I felt sorry, so I released it,"* suggesting that the right to live can be

acknowledged irrespective of human benefit (Kortenkamp and Moore 2001; Pascual et al. 2017; IPBES 2022). However, this ethical stance remains individual and has not matured into a collective norm, in contrast to examples from other Asian regions where pangolins hold ritual or symbolic value (Katuwal et al. 2015; Walsh 2020).

The second ethical perspective underscores that protecting pangolins is not socially difficult because the species does not pose a threat to humans (code: *Koeksisten*/Coexistence). As one respondent affirmed, *"It's actually the elephants that are dangerous. They're the ones that affect farming. Pangolins don't cause any harm."* This view of harmless coexistence is reinforced by the fact that several communities voluntarily report pangolin sightings to local authorities (see examples in Figure 2). Similar to findings from Emogor et al. (2023) in Nigeria, coexistence here is shaped not by cultural symbolism but by a practical assessment that pangolins are harmless and therefore acceptable in the landscape.

Table 2. Classification of enabling conditions for pangolin conservation based on stakeholder perspectives and sustainability dimensions

Stakeholder's perspective or enabling conditions for pangolin conservation	**Descriptions**	**Perspectives in sustainability aspect**
Right to Live (*HakHidup*)	A perspective of respect for nature, recognizing that pangolins, as living beings, have a right to exist without disturbance or over-exploitation (animal welfare).	Ecological ethics
Coexistence (*Koeksisten*)	Pangolin's behavior in habitat utilization does not threaten humans so that it is easy to coexist	Ecological ethics
Secure Land Access (*AksesPasti*)	Certainty and security of regional land use rights that encourage community compliance with species protection regulations	Economy
Community-based Conservation (*ComConserve*)	The government provides community-based collaborative in-situ conservation strategies and inter-stakeholder partnerships	Institutional-policies
Reward for Return (*ImbalSerah*)	Compensation (goods or services) for animals found and returned to their habitat	Economy
Economic Diversification (*DiversiEco*)	Changing orientation of pangolin hunting and trade: diversification of livelihoods and certainty of alternative commodity prices	Economy
Restrict Price Information (*StopInfo*)	Government blocks access to pangolin price information to prevent illegal trade	Institutional-policies
Monitoring and Funding (*PantauDana*)	There is a periodic monitoring program and priority funding for pangolin population management	Institutional-policies
Strict Law Enforcement (*TegasHukum*)	Consistency of law enforcement against various conservation violations	Institutional-policies
Grassroots Action (*AksiTapak*)	Routine socialization and facilitation at the site level	Social

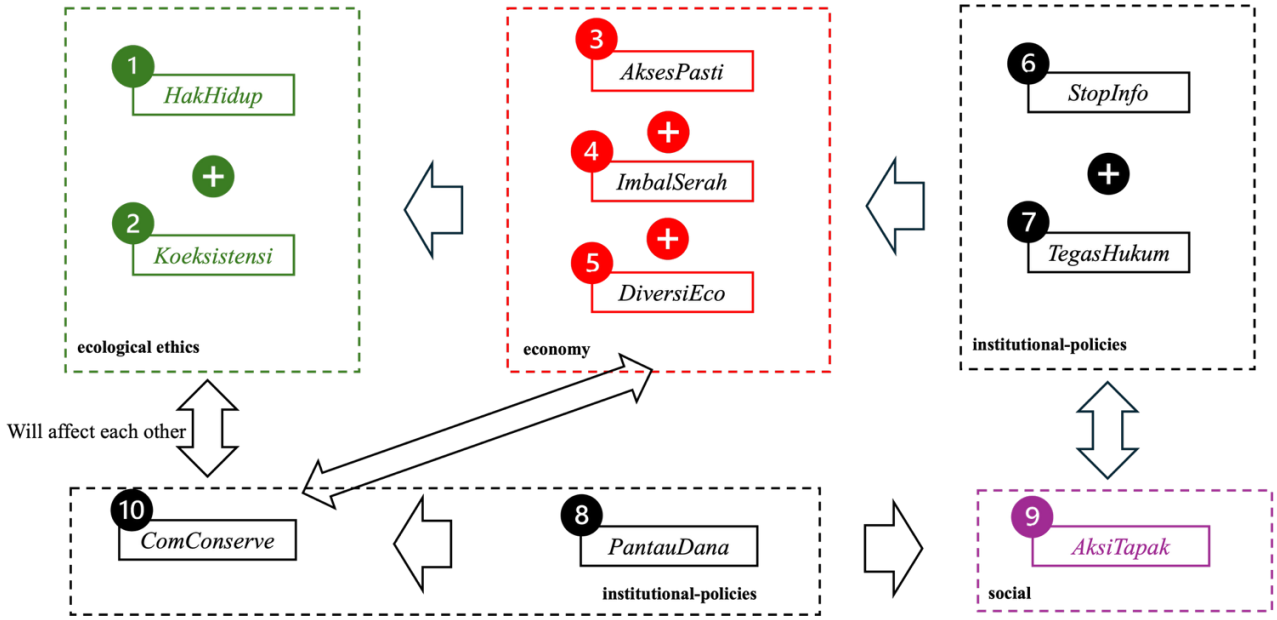

Figure 4. The map shows relationships between stakeholder perspectives based on influence and relevance in a fragmented landscape. Colors represent value categories: Green: Ecological ethics, Red: Economic aspect, Black: Institutional policy, Purple: Social aspect. Arrows indicate influence direction: ←: A influenced by B; →: A influences B; ↔: Mutual influence

The two aforementioned ethical prerequisites are influenced by three economic perspectives (see Figure 4). Even with ecological ethics in place, secure land tenure for local communities (code: *AksesPasti*/Secure the Land Access) is believed to encourage compliance with species protection regulations, given that most of the primary pangolin forest habitat is managed by communities through partnerships. Conversations in the interviews recorded anonymous statements that pointed to this perspective: *"I stopped (poaching and selling the Sunda pangolin) around 2015. The population was declining, the risks were high, and the price was no longer worth it. I thought it would be better to focus on coffee farming (within the forest area). Hopefully, we will be able to continue utilizing this area for a long time."* This anonymous statement suggests that at the grassroots level, there has been a noticeable shift in the community's orientation towards alternative livelihoods such as coffee and resin, particularly as the Sunda pangolin's population becomes increasingly scarce and legal risks increase. While not entirely reliable, the statement indicates a need for certainty regarding access to the forest area they manage to foster commitment to conservation. Furthermore, to enhance stakeholders' participation, especially among those near pangolin habitats, and to encourage a transition from hunting and trading to more sustainable activities, compensation (in the form of goods or services) could be offered for the Sunda pangolin that are found and returned to their habitat (code: *ImbalSerah*/Reward For Return). This incentive aligns with local practice, as one respondent noted: "*Residents found the pangolins... They (the pangolin) were not sold, but handed over to the resort/TNBBS.*" Efforts can be further strengthened by diversifying livelihoods and the availability of alternative, economically valuable commodities (code: *DiversiEco*/Economic Diversification). These three economic aspects must be reinforced by an institutional-policy framework that includes a collaborative, community-based in-situ conservation strategy provided by governments at both central and local levels (code: *ComConserve*/Community-based Conservation).

Nevertheless, the incentive-based approach is ambivalent. There is still considerable scepticism among the stakeholders involved as to whether economic incentives can successfully trigger in-situ conservation. Several studies find that "market-based" conservation cannot directly change human motivation towards pro-conservation behaviors for species with high economic value, as it can create dependency and does not always address the root causes of illegal poaching (Cooney et al. 2017; Cooney and Challender 2020). In theory, the economic aspect is not always reliable. Indeed, the shift from exploitation-based use value to conservation value is only effective when community-based conservation is supported by viable livelihood alternatives and transparent incentives that are not purely financial (Fariss et al. 2023; Oduor 2020), because a single monetary scheme risks strengthening the dominance of local elites rather than protecting biodiversity (Suich 2013; Okumu and Muchapondwa 2020). However, stakeholders hope, especially based on input from former illegal pangolin traffickers, that the government will, at least concurrently, restrict access to pangolin price information to prevent illegal trade (code: *StopInfo*/Restrict Price Information). According to former poachers, restricting this information is crucial; they argue that the ban on the species' trade has driven scarcity by inflating prices. *"If people can still easily find out the price of scales, there will definitely be those who are tempted (to buy and sell pangolins)."* Theory also dictates that negative practices hindering positive perspectives and behaviors, such as the continued availability of pangolin trade price information, must be altered or even prevented (Shackleton et al. 2023). However, this action requires international assistance, particularly regular and widespread awareness campaigns capable of changing consumer preferences (Veríssimo et al. 2020; Thomas-Walters et al. 2021).

On the technical side, regular monitoring programs and priority funding for pangolin population management are key to conservation success (code: *PantauDana*/Monitoring and Funding), as people said that *"Funding for these animals is almost non-existent, unlike for elephants or tigers."* Consistent law enforcement against conservation violations is also necessary to deter violations (code: *TegasHukum*/Strict Enforcement). People at the site level agree with this: *"Even if the law exists, but if there is no firm action, people still dare to poach and trade pangolin."* Furthermore, regular mentorship and outreach at the grassroots level (code: *AksiTapak*/Grassroots Action) can ensure that local communities understand and are actively involved in pangolin protection efforts (Suwal et al. 2022). This also aligns with recent research on conservation governance, although exemplified by orchids, which demonstrates that understanding the legal and illegal wildlife trade at the local level is crucial, especially if policies are tailored to the local context (Bashyal et al. 2023). In this way, everyone (including private landowners who own endangered species) will feel a responsibility for the conservation of those species (Toth and Rubino 2024). Through this holistic approach, pangolins are not only protected but also become part of a sustainable ecosystem where humans and nature can coexist harmoniously.

Despite these ten perspectives indicating potential enabling conditions for conservation, the BBS context shows that neither local ecological knowledge nor cultural norms can currently be relied upon as drivers of species protection. Ecological knowledge remains individualized and unevenly distributed, and ethical concern for pangolins appears at the personal level rather than as shared community values. Therefore, governance in BBS cannot assume collective norms as a precondition; instead, it must actively cultivate them. Targeted outreach, consistent facilitation, and livelihood-based incentives can help transform individual awareness into collective ethics, which may eventually serve as the foundation of stronger local conservation knowledge.

From a theoretical standpoint, such individual variation in human-nature relations is not unusual. Each person experiences nature's contributions differently and does not

always act in accordance with the values they express. Lehnen et al. (2022) show that attitudes, behavioral preferences, and actual actions often diverge; people may appreciate a species' existence yet fail to support practices that sustain it. These multivalent relations, ranging from passive tolerance to latent stewardship or involuntary opposition, create a gap between personal ecological values and collective conservation practice. The IPBES similarly illustrates that this gap is driven by indirect drivers such as sectoral policy and economic logics, which overpower Nature's Contributions to People (NCP). When governance systems fail to mediate between nature and human well-being, they reproduce inequality rather than enable conservation values to take root. Thus, in BBS, conservation must function not only as regulation but as a catalyst for enabling future social-ecological values capable of sustaining biodiversity outcomes.

Factors driving conservation of pangolins

The dependency analysis and direct influence between perspectives of the MICMAC tool yielded seven main factors that act as drivers of pangolin conservation. The seven factors are *AksiTapak*, *PantauDana*, *AksesPasti*, *TegasHukum*, *ImbalSerah*, *StopInfo*, and *DiversiEco*. None of these factors stands alone (as seen from the emptiness of Quadrant 3 in Figure 5). The interdependence between these factors forms a complex network of influence. The dynamic interaction between factors, especially these five, is the key to the effectiveness of conservation efforts.

Referring to Figure 5, factors such as collaborative community-based conservation (*ComConserv*), the view of pangolins as a non-conflict species (*Koeksisten*), and an ethical stance on wildlife's right to exist (*HakHidup*) certainly contribute to conservation support. However, these factors are largely consequential, their impact being contingent upon other pre-existing conditions. For instance, stakeholders who prioritize ecological and ethical perspectives are typically those who have already achieved stability in meeting their fundamental needs (colloquially, 'urusan perut' or 'matters of the belly'), allowing them to focus on non-material values such as conservation. In other words, non-material values like ecological ethics tend to emerge among stakeholders when they already secured their basic needs. Classical post-materialist theory argues that environmental concerns emerge strongly after material needs are met (Schlosberg and Coles 2016). However, a growing body of literature demonstrates that ecological values can also emerge and be enacted under conditions of material constraint through everyday socio-ecological relationships and livelihood practices. This pattern aligns with relational values and new materialism perspectives, which conceptualize values and practices as mutually constitutive rather than as outcomes of a linear post-material stage (Saxena et al. 2018; Brear and Mbonane 2019; Rosenberg 2022).

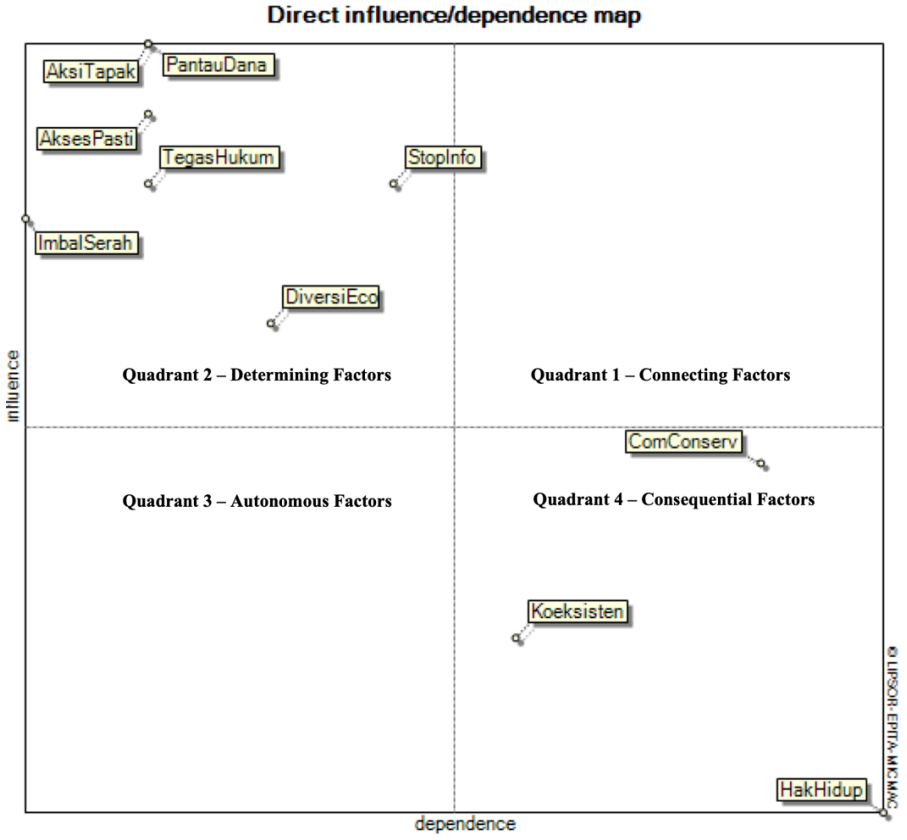

Figure 5. Direct influence-dependence map of factors supporting Sunda pangolin conservation. The vertical axis represents the level of Influence, while the horizontal axis represents the level of dependence. The map shows the distribution of factors into four quadrants: Determining Factors (high influence-low dependence), Connecting Factors (high influence-high dependence), Autonomous Factors (low influence-low dependence), and Consequential Factors (low influence-high dependence)

Figure 5 reveals that three economic perspectives in the determinant factor quadrant lack strong individual influence; instead, they function through interactions with other factors. For instance, the *AksesPasti* (certainty of access) factor is initially perceived as a primary driver for conservation compliance. However, the structural analysis summarized in Table 3 reveals a significant negative rank shift for this variable, dropping from rank 6 in direct influence (MDI) to rank 9 in indirect influence (MII). It indicates its effectiveness depends on institutional and social support, while stakeholders explicitly emphasize access certainty, its long-term impact is lower than expected. These findings align with IPBES (2022), which emphasizes the role of tenure rights in conservation and sustainable livelihoods. However, similar studies note that access certainty's impact on compliance relies heavily on institutional backing, a dynamic that risks systemic injustices, as seen in Southern Africa (Mundoga et al. 2025). Thus, the conservation of endangered species cannot be left entirely to incentive mechanisms; it requires a collaborative approach supported by structural regulations.

Stakeholder orientation to sunda pangolin conservation

Analysis of stakeholder orientation towards pangolin conservation reveals the complexity of actors' positions, influences, and interests in a fragmented landscape. All stakeholders in this study had a direct or indirect relationship to the habitat and dynamics of pangolin use (Figure 6). Through the MACTOR approach, this study compiled a stakeholder orientation and influences map to understand the configuration of forces and potential collaboration in conservation governance (Figure 7), which shows that orientation is important in effective multi-level governance to adapt relevant policies (Oduor 2020).

As shown in Figure 6, stakeholder orientations are very diverse. This difference cannot be separated from the role, incentives, and capacity of each type of stakeholder. Government conservation agencies and non-government partners such as TNBBS, the Bengkulu and Lampung Natural Resources Conservation Center (BKSDA), and Wildlife Conservation Society - Indonesia Program (WCS-IP) show strong support for pangolin conservation, giving by the institutional mandates, technical capacity, and access to conservation policies. Clear institutional mandates and regulatory legitimacy strengthen the position of governments and non-government partners in integrating ecological values and animal welfare into conservation policies and practices (Brakes et al. 2021; Edelblutte et al. 2023). In contrast, local government forestry institutions tend to be neutral (between conservation and socio-economic, shown on the blue arrow line in Figure 7), because their mandates focus more on forest product management and improving local economic well-being, so the conservation of certain species such as pangolins is not always a priority, especially when it is not included in formal performance targets and key political focuses (Rose et al. 2018).

Table 3. Displacement of variables between the Matrix of Direct Influence (MDI) and the Matrix of Indirect Influence (MII)

Variable	Rank		Rank Shift
	MDI Matrix	MII Matrix	
HakHidup	1	1	0
ComConserve	2	2	0
Koeksisten	3	3	0
StopInfo	4	4	0
DiversiEco	5	5	0
AksesPasti	6	9	-3
PantauDana	7	6	+1
TegasHukum	8	8	0
AksiTapak	9	7	+2

Note: MDI is the short-term impact of the variable if it's implemented, while the MII is the long-term impact

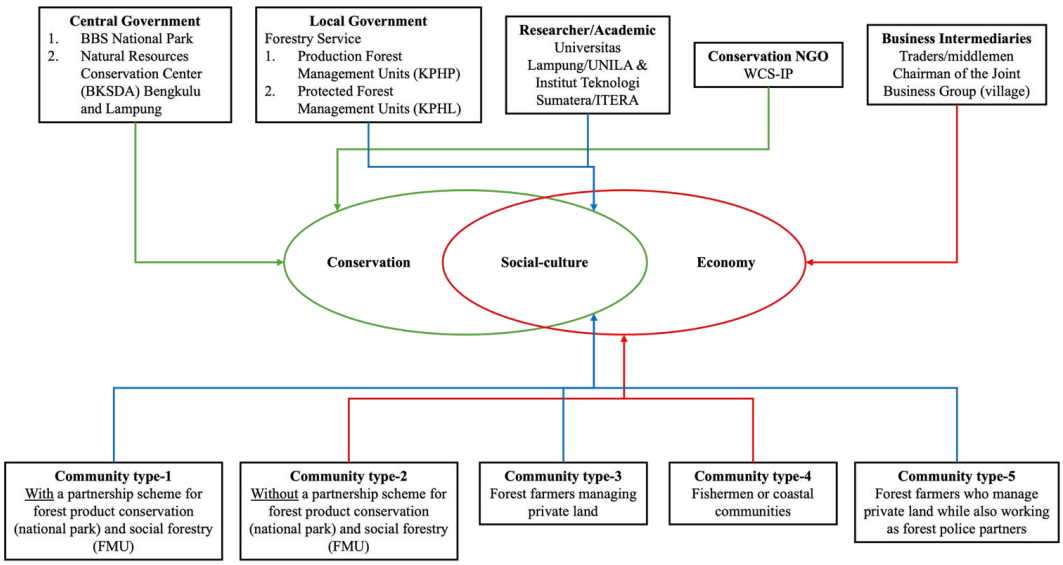

Figure 6. Stakeholder orientation in the Sunda pangolin conservation landscape. Colored arrows show each actor's primary alignment: Green: Ecological/conservation, Red: Economic, Blue: Mixed social-ecological-economic; Ellipses mark these domains, and boxes denote actor groups (government, researchers, NGO, business intermediaries, and five community types)

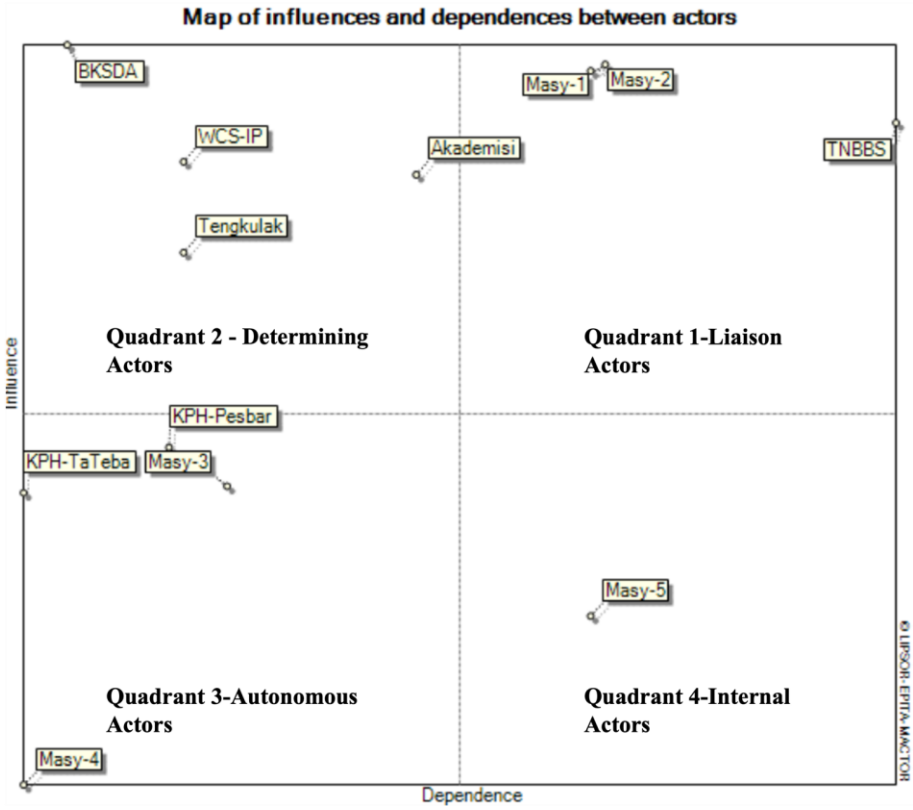

Figure 7. Stakeholder influence-dependence map showing four strategic positions in Sunda pangolin conservation. Liaison Actors (high influence-high dependence), Determining Actors (high influence-low dependence), Autonomous Actors (low influence-low dependence), and Internal Actors (low influence-high dependence)

Meanwhile, type 4 communities (non-forest, coastal) are less supportive of conservation because they prioritize fisheries-based livelihoods or other sectors relevant to daily needs, making the urgency of pangolin conservation seem distant from their immediate interests. Knowledge of pangolins and the importance of conserving this species is often low in communities that do not interact directly with their habitats, so the urgency of conservation is not felt. Studies show that support for conservation will increase if communities gain tangible economic or social benefits; conversely, without incentives or alternative livelihoods, especially those that have had economic benefits directly in the illegal wildlife trade, such as former Poachers, which is difficult to balance with ecological arguments (Ehrhart et al. 2022; Lucas et al. 2022; Skidmore 2023), tend to be neutral or reject pangolin conservation efforts (Mouafo et al. 2021; Suwal et al. 2022; Swiacká et al. 2022). This contrast reflects stakeholder theory, which posits that actors' positions are shaped by their interests, resource access, and network relationships (Ndonye et al. 2021).

Although the conservation of pangolins in the future looks separate from certain stakeholders who have a non-conservation orientation, the influence-dependency matrix (Figure 7) shows a clear "tug-of-war" between actors. Four stakeholders-BKSDA, WCS-IP, academics, and middlemen-hold strong influence but are weakly dependent. While the first three contribute positively to pangolin conservation, middlemen tend to exert a negative influence. BKSDA stands out for its legitimacy and formal authority in species surveillance, while WCS-IP serves as a field facilitator but is limited in strategic decision-making due to reliance on policy frameworks. NGO priorities depend not only on funding but also on national research agendas, which unfortunately do not specifically include pangolins. As a result, pangolin conservation often "hitchhikes" on large mammal programs such as those for Sumatran tigers and elephants. Globally, priority-setting systems like the IUCN Red List do identify endangered species, yet field implementation remains constrained by political, social, and economic pressures. However, implementation on the ground is often influenced by political, social, and economic pressures, rather than solely by the needs of species (Willer et al. 2019). In addition, intermediaries exert destructive systemic influence through illegal value chains, so their role, while destructive, cannot be ignored in holistic intervention strategies.

The TNBBS position depicted in Figure 7 is an important finding that warrants further discussion. As the core of the Sunda pangolin habitat, this national park is expected to serve as the primary protection area for this species. However, its role as Liaison Actor does not determine its effectiveness in this capacity. This is because TNBBS has high influence, but equally significant dependence, similar to type 1 and 2 communities involved in forest product partnerships or social forestry. This suggests that the central government's capacity to protect

pangolins cannot rely solely on formal authority; it instead relies heavily on collaboration and reciprocal relationships. This dynamic clearly illustrates Elinor Ostrom's principles of Governing the Commons (Janssen 2013; Scarlett and McKinney 2016). The emergence of *AksesPasti* (tenure security) as a key driver, for example, directly echoes Ostrom's principles of clearly defined community rights and the appropriateness of rules to local conditions. Similarly, the importance of *AksiTapak* (action at the site level) and *TegasHukum* (law enforcement) aligns with her principles of community monitoring and cascading sanctions. This suggests that successful governance at the site level depends on translating formal rules (rules-in-form) into recognized and implemented practices (rules-in-use). Ostrom's principles are relevant here, as there is no "one-size-fits-all" solution and must be tailored to the local political, social, and economic context (Delgado-Serrano and Ramos 2015; Chawla et al. 2024).

Within a political ecology framework, these findings also demonstrate the power and economic dynamics involved in pangolin conservation efforts. The roles of actors are clearly distinguishable: conservation institutions and NGOs act as norm entrepreneurs, academics as knowledge brokers, Type 1-2 communities as connecting actors, and trade intermediaries as instigators of value conflicts through illegal networks. These different roles create key tensions rooted in struggles over access and benefits, information asymmetries, and differing profit horizons (short-term economic vs. long-term ecological).

In this context, collaboration is essential to integrate socio-political realities with technical-biological approaches. Providing partner communities with guaranteed access and economic support fosters their commitment to conservation, creating a 'bridge of interest' between ecological objectives and social well-being (Arts et al. 2023). Such collaboration is essential for conserving biodiversity in human-dominated landscapes, like blue-rural-green areas (Donati et al. 2025). And the academics, positioned between influence and dependence, can bridge research and policy while advancing evidence-based advocacy. Moreover, Law 32/2024 explicitly recognizes community contributions to conservation. Evidence indicates that successful wildlife conservation depends on inclusive, transparent, and accountable governance (Decker et al. 2016; Pomeranz et al. 2021) supported by education, awareness, law enforcement, policy, and incentive programs (Nash et al. 2016; Harrop 2020), particularly in pangolin-range countries (Gu et al. 2024).

In conclusion, this study fulfills its three objectives by synthesizing the core implications of its findings. In response to the objective of identifying perspectives, this study confirms that effective conservation must be grounded in the site-level realities of competing values. Then, by analyzing the driving factors, this study concluded that certain factors are very strong in leveraging and influencing the structure, especially land tenure security (*AksesPasti*) which is closely linked with *TegasHukum* and *AksiTapak*, which is the most powerful lever in influencing conservation behavior, which has a greater weight than other social or ethical considerations. Finally, synthesizing these findings, the orientation analysis shows that a stakeholder's position is shaped by their institutional role and economic dependence. Therefore, the most coherent governance strategy must directly address these core power relations through two key actions: strategically empowering communities with recognized land rights, and simultaneously countering the destructive influence of illicit networks.

Addressing these challenges into action requires a dual strategy or targeted intervention series. The first is to internalize ecological values through the mainstreaming of on-site rules and norms. A paradigm shift in conservation is inevitable, as the dynamics of land use have changed. The second is to provide competitive livelihood alternatives. This approach allows high-dependence groups to adopt conservation ethics without incurring excessive social costs. For the central government, this means establishing a landscape co-management forum that sets clear pangolin-specific rules (monitoring, reporting, sanction-incentive), with a formal complaint mechanism and regular evaluations. Local governments should integrate pangolin indicators into performance plans (Renja/Renja-SKPD), results-based budget schemes, and align permits and operations with habitat corridors. For forest-dependent communities (types 1 and 2), compliance-bound benefit agreements, such as access to non-timber forest products or conservation partnerships, are essential, while communities with low support for pangolin conservation require relevant livelihood programs (sustainable fisheries, non-wildlife micro-enterprises) linked to conservation compliance indicators. The negative orientation fostered by middlemen must be addressed with a "disrupt and replace" approach: cutting off illegal trade routes through targeted law enforcement while creating profitable legal market alternatives for non-wildlife products. Given that *AksesPasti* stands as a key driver, policymakers are expected to translate it explicitly into *rule-in-form* for conservation partnerships and social forestry schemes, ensuring it is no longer implicit. In parallel, technological measures to control price information should be explored to reduce market incentives for illegal trade-an area requiring targeted research to refine and operationalize this policy recommendation.

The design of a collaborative governance model within a stakeholder engagement framework must be value-based and contextually relevant. Here, science needs to play a key role as the main foundation, enriched by local knowledge and capacity building among stakeholders so that ecological data ("cold data") can be transformed into a basis for more contextual, transparent, and accountable decision-making ("warm data"). This is critical because our study has limitations. It is geographically focused on the Bukit Barisan Selatan landscape and may be influenced by selection bias, particularly toward communities more accessible to researchers. Nevertheless, these findings provide actionable insights for relevant cross-sector stakeholders to improve the success of Sunda pangolin conservation and other threatened species in similarly fragmented socio-ecological contexts. Future research

should focus on designing and empirically testing policy interventions based on the determining drivers/factors identified in this study, particularly to measure how tenure security (*AksesPasti*) influences community conservation behavior over time.

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