

Stakeholder Analysis and Sustainable Environmental Financing Strategies Based on the Simple Additive Weighting Method in Pulau Weh Nature Tourism Park Aceh

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Abstract

Conservation area management in developing countries faces challenges related to funding gaps and weak coordination among stakeholders. This study aimed to map stakeholder positions and perceptions, and to prioritize sustainable environmental financing strategies in Pulau Weh Nature Tourism Park, Sabang, Aceh. A descriptive-quantitative approach was applied by integrating power-interest grid-based stakeholder analysis and the Simple Additive Weighting (SAW) method within a Multi-Criteria Decision Making (MCDM) framework. Data were collected through interviews and structured questionnaires involving 30 respondents representing 11 stakeholder categories. Mapping results identified four groups: Key Players (Natural Resources Conservation Center/BKSDA and Panglima Laot), Subjects (50%), Context Setters (10%), and Crowds (33%). Power asymmetry was identified as a structural characteristic, where groups with the highest ecological dependency held the most limited formal influence. SAW analysis of five financing mechanisms produced the following priority ranking: Corporate Social Responsibility (CSR) funds (1.00), tourism operator contributions (0.92), entrance fees (0.90), voluntary donations (0.80), and Payment for Ecosystem Services (PES) (0.79). The findings support a blended financing approach comprising three complementary layers and provide an empirical basis for developing participatory governance and financing of conservation areas.

Keywords: Stakeholder Analysis, Power-Interest Grid, Sustainable Environmental Financing, Simple Additive Weighting

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INTRODUCTION

Sustainable management of conservation areas remains one of the most pressing challenges faced by developing countries, including Indonesia. Globally, conservation funding needs are estimated at USD 722–967 billion per year, while available funding ranges only between USD 124–143 billion per year, representing approximately 16–19 percent of total needs (Deutz et al., 2020). This problem is not solely related to funding limitations, but is also influenced by weak coordination among stakeholders and the lack of integrated governance of conservation areas (Meng et al., 2023; Newig et al., 2023). These conditions cause conservation financing and area management to frequently face obstacles in simultaneously supporting ecological, social, and economic sustainability.

Pulau Weh Nature Tourism Park (TWA) in Sabang City, Aceh, is one conservation area facing these conditions. Covering 6,506.46 hectares and established through Ministerial Decree of Agriculture Number 928/KPTS/UM/12/1982, the area encompasses diverse marine and terrestrial ecosystems, including coral reefs, mangroves, protected forests, and habitat for various protected species (Aris et al., 2017). Land use changes in Sabang City have exerted additional pressure on the

ecological conditions of the area, including implications for local climate and terrestrial ecosystem sustainability (Achmad et al., 2019). In recent years, tourist visits have increased at an average growth rate of 20.9 percent per year, reaching 269,824 visitors in 2024. Tourism activities have contributed to Sabang City's Regional Original Revenue (PAD) of Rp 52.5 billion (BPS Kota Sabang, 2024). However, the conservation operational budget was recorded at only approximately Rp 158.4 million per year based on pre-survey findings with the Sabang In-Situ Conservation Resort. Furthermore, direct marine tourism contributions to PAD reached only Rp 170 million against a target of Rp 1.7 billion, while formal coordination mechanisms among area management institutions remain unavailable (Surry, 2024).

From an ecological perspective, live coral cover in the area declined by nearly 46 percent following the 2004 tsunami (Purbani et al., 2014). Additional pressures including illegal fishing activities and increasing accumulation of tourism waste continue to be identified within the area. These conditions indicate an imbalance between increasing tourism activity and the financing and management capacity of the conservation area.

Management of TWA Pulau Weh involves multiple parties with differing interests and levels of influence, including the Natural Resources Conservation Center (BKSDA) Aceh, local government, tourism operators, fishing communities, and the customary maritime law institution Panglima Laot. In the local context, Panglima Laot has played a role in managing the Iboih waters before the area was designated as a conservation zone (Aris et al., 2018). Previous research indicates that management based on Hukom Adat Laot has contributed to the socioeconomic and governance dimensions of the area. However, the ecological dimension remains in the less sustainable category due to ongoing anthropogenic pressures (Aris et al., 2018). These conditions indicate that formal management and customary knowledge-based management continue to operate in a fragmented manner (Munazir & Mujiburrahman, 2018).

Under these conditions, identifying the roles and positions of each stakeholder becomes critical in supporting conservation area management. The power-interest grid approach can be used to identify the distribution of interests and influence among actors in area management (Oguz, 2022). Furthermore, determining sustainable environmental financing strategies requires an approach capable of simultaneously considering multiple aspects, including conservation effectiveness, financial sustainability, legality, and social acceptability. The Simple Additive Weighting (SAW) method within the Multi-Criteria Decision Making (MCDM) framework can be used to systematically and measurably evaluate and rank alternative environmental financing strategies based on multi-stakeholder assessments (Ishizaka & Nemery, 2013; Taherdoost, 2023).

Several previous studies on TWA Pulau Weh have been conducted from different perspectives. Aris et al. (2018) focused on management sustainability based on Hukom Adat Laot, Hasnan (2023) emphasized economic valuation of the area using the Travel Cost Method (TCM), while Satria et al. (2025) examined marine ecotourism development strategies in Sabang City. Nevertheless, research integrating stakeholder analysis using the power-interest grid approach with multi-criteria based prioritization of sustainable environmental financing strategies has never been conducted at TWA Pulau Weh. The high value of the area and the large number of parties involved demand an integrated approach encompassing institutional aspects, stakeholder participation, and financial sustainability (Bennett et al., 2019).

Based on the foregoing, this study aims to: (1) map and analyze stakeholder positions and perceptions in TWA Pulau Weh management using the power-interest grid approach; and (2) identify and prioritize sustainable environmental financing strategies using the SAW method based on multi-stakeholder assessments. The findings are expected to provide an empirical basis for the Sabang City Government, BKSDA Aceh, and relevant parties in developing participatory and sustainable conservation area governance and financing.

METHOD

Data were collected through field observations, semi-structured interviews, documentation studies, and structured questionnaires involving 30 respondents representing 11 stakeholder categories: BKSDA Aceh, Sabang City Government, Department of Tourism, Department of Marine and Fisheries (DKP), Panglima Laot, tourism operators, the Sabang Free Trade Zone and Free Port Management Agency (BPKS), fishermen, academics, community groups, and Non-Governmental Organizations (NGOs). Respondents were selected using purposive sampling based on their knowledge and role in area management.

Each actor was assessed based on their level of power (decision-making authority) and interest (concern toward management issues) using a scale of 1–4 (Hatmoko et al., 2021). Based on the framework proposed by Ackermann & Eden (2011), stakeholders were mapped into four quadrants as shown in Figure 1.

Interest	High	Subjects Low power, high interest. Can be engaged to increase their power and convert them into players, or at least maintain.	Players High power, high interest. Key stakeholders who are suitable to receive attention from sustainable management.
	Low	Crowds Low power, low interest. Have potential, since their interest and/or power can be increased, but are not aligned with the effort and time required.	Context setters High power, low interest. Influence the overall context of the future, and can increase awareness and build interest to turn them into players.
		Low	High
		Power	

Figure 1. Stakeholder Power-Interest Grid
(Ackermann & Eden, 2011; Hatmoko et al., 2021)

The Simple Additive Weighting (SAW) method was used to determine the priority of sustainable environmental financing strategies in TWA Pulau Weh based on multi-criteria assessment. This method was selected because it is capable of evaluating and ranking alternatives in a simple, systematic, and comprehensible manner (Taherdoost, 2023). The evaluated alternatives consisted of entrance fees, tourism operator contributions, Payment for Ecosystem Services (PES), Corporate Social Responsibility (CSR), and Willingness to Pay (WTP)-based donations. Assessments were conducted based on five criteria, namely legality (K1), financial sustainability (K2), equity (K3), conservation effectiveness (K4), and social acceptability (K5).

The SAW procedure comprised four stages. First, a decision matrix X of size $m \times n$ was constructed, where m represents the number of alternatives (5 mechanisms) and n represents the number of criteria (5 criteria), with X_{ij} representing the rating value of the i -th alternative on the j -th criterion:

$$X = \begin{bmatrix} X_{11} & X_{12} & X_{13} & \dots & X_{1n} \\ X_{21} & X_{22} & X_{23} & \dots & X_{2n} \\ X_{31} & X_{32} & X_{33} & \dots & X_{3n} \\ \dots & \dots & \dots & \dots & \dots \\ X_{41} & X_{42} & X_{43} & \dots & X_{4n} \end{bmatrix} \dots \dots \dots (1)$$

Second, the preference weight of each criterion was determined, expressed as:

$$W = W_1, W_2, \dots, W_n \dots \dots \dots (2)$$

Third, since all criteria are of the benefit type, normalization was performed by dividing each alternative value by the maximum value of the corresponding criterion, where R_{ij} represents the normalized performance rating value, X_{ij} represents the value of the i -th alternative on the j -th criterion, and $\max X_{ij}$ represents the maximum value for each j -th criterion:

$$R_{ij} = \frac{X_{ij}}{\max_{ij} X_{ij}} \dots \dots \dots (3)$$

Fourth, the preference value of each alternative was calculated through weighted summation of the normalized values and criterion weights, where V_i represents the preference value of the i -th alternative, W_j represents the weight of the j -th criterion, and R_{ij} represents the normalized performance rating value (Agustin et al., 2025):

$$V_i = \sum_{j=1}^n W_j \times R_{ij} \dots \dots \dots (4)$$

The alternative with the highest preference value is designated as the main priority in the sustainable environmental financing strategy at Pulau Weh Nature Tourism Park.

RESULT AND DISCUSSION

Stakeholder identification was conducted through interviews involving 30 respondents representing 11 stakeholder categories in TWA Pulau Weh. Stakeholder mapping employed the power-interest grid approach of Ackermann and Eden (2011) by assessing the level of interest and power of each party using an ordinal scale of 1–4. Assessment was performed through a combination of respondent self-assessment and researcher evaluation based on observations and in-depth interviews to produce a more representative categorization (Sarami-Foroushani et al., 2024). Mapping results indicated that the Key Players group (7%) consisted of BKSDA and Panglima Laot Iboih, both possessing high levels of power and interest. The Subjects group (50%) consisted of fishermen, tourism operators, local communities, the Department of Marine and Fisheries (DKP), and an NGO (WCS), all of whom demonstrated high interest but limited power. The Context Setters group (10%) consisted of the Department of Tourism and the Sabang Free Trade Zone and Free Port Management AgencWy (BPKS), characterized by high power but relatively lower interest, while the Crowds group (33%) comprised tourists and academics with relatively low levels of both power and interest. The complete distribution is presented in Table 1.

Table 1. Power and Interest Assessment Results of Stakeholders in Pulau Weh Nature Tourism Park

Stakeholder Category	Interest	Power	Group
BKSDA	4	4	<i>Key Players</i>
<i>Panglima Laot</i>	4	3	<i>Key Players</i>
Fishermen	4	2	<i>Subjects</i>
Tourism Operators	4	2	<i>Subjects</i>
Local Community	3	2	<i>Subjects</i>
DKP	3	2	<i>Subjects</i>
NGO (WCS)	3	2	<i>Subjects</i>
Department of Tourism (DISPAR)	2	3	<i>Context Setters</i>
BPKS	2	3	<i>Context Setters</i>
Tourists	2	1	<i>Crowds</i>
Academics	1	1	<i>Crowds</i>

The distribution of each stakeholder group's position within the power-interest matrix is visualized in Figure 2. This visualization indicates that half of all stakeholders are concentrated in the Subjects quadrant, representing the area of high interest but limited power, while only two parties occupy the Key Players position as the primary controllers of area management.

In-depth interviews generated perceptual data reflecting differences in perspectives among groups regarding the condition and threats of the area. All groups consistently identified three main threats: tourist waste, illegal fishing by outside parties, and weak surveillance. Regarding the assessment of area conditions, tourism operators and some local communities perceived conditions as tending to deteriorate, particularly in terms of water quality and waste accumulation. Panglima Laot and the Department of Marine and Fisheries, conversely, assessed the ecosystem as showing improvement alongside the reduction of destructive fishing practices. BKSDA assessed conditions as relatively stable, yet identified the dualism between customary rules and state conservation regulations as a structural barrier. A summary of stakeholder perceptions is presented in Table 2.

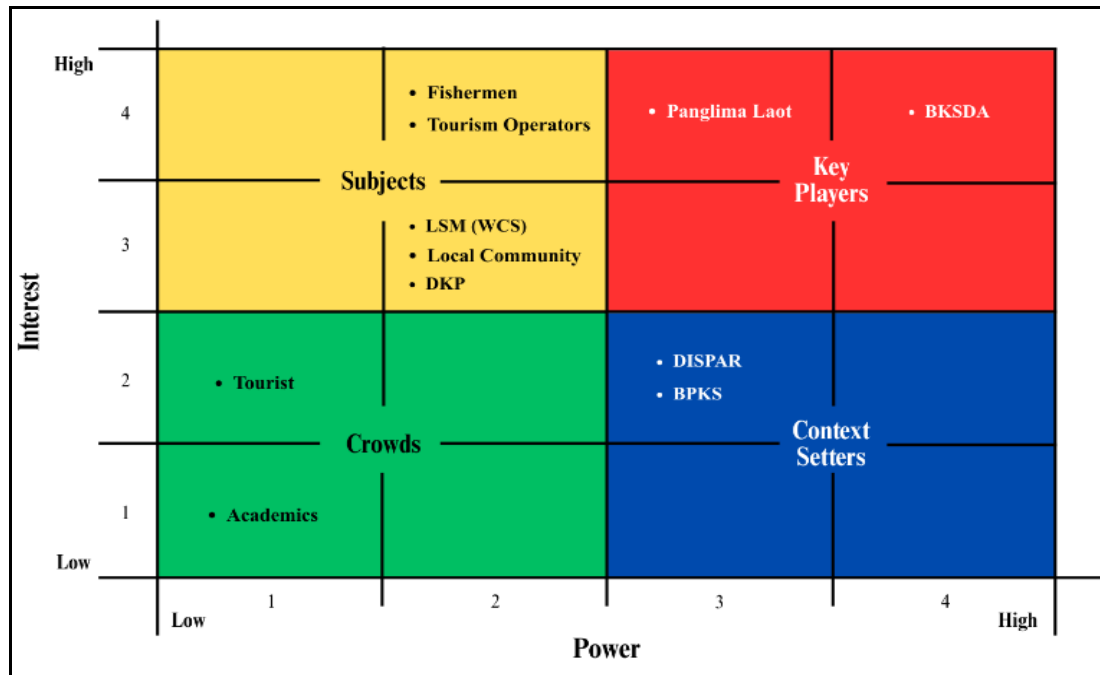


Figure 2. Power-Interest Grid Model of Stakeholders in Pulau Weh Nature Tourism Park

Table 2. Stakeholder Perceptions of Conditions and Threats in Pulau Weh Nature Tourism Park

Group	Perceived Condition	Identified Main Threats
BKSDA	Relatively stable	Illegal fishing, dualism of customary rules vs. conservation regulations
<i>Panglima Laot</i>	Improving	Illegal fishing by large vessels, minimal patrol funding
Fishermen	Stable to improving	Fluctuating catches, illegal fishing by outside parties
Tourism Operators	Deteriorating	Plastic waste, coral bleaching, harmful sunscreen
Local Community	Varied	Tourist waste, illegal fishing, weak surveillance
Department of Marine and Fisheries (DKP)	Improving	Coral damage due to tourism pressure
NGO (WCS)	Relatively stable	Waste pollution, spatial planning violations
Department of Tourism	Relatively stable	Tourism pressure, absence of integrated management blueprint
BPKS	Relatively stable	Continuously increasing tourism pressure
Tourists	Varied	Waste, coral reef degradation, lack of surveillance
Academics	Varied	Illegal fishing, pollution, suboptimal management

Five financing mechanisms were evaluated based on five criteria: legality (K1, 25%), financial sustainability (K2, 25%), equity (K3, 20%), conservation effectiveness (K4, 20%), and social acceptability (K5, 10%). Decision matrix values were obtained from the average assessment of 30 respondents as presented in Table 3.

Normalization was performed by dividing each alternative value by the maximum value of the corresponding criterion, so that all values fell within the range of 0 to 1 and could be compared proportionally. The final preference value of each alternative was then calculated through weighted summation based on the predetermined criterion weights. Normalization and ranking results are presented in Table 4 and Table 5.

Table 3. Decision Matrix of Respondent Average Assessments

Alternative	K1	K2	K3	K4	K5
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M1 – Entrance Fee	3.70	3.47	3.27	3.57	3.50
M2 – Tourism Operator Contributions	3.20	3.67	3.57	3.77	3.70
M3 – PES	2.93	2.80	3.50	3.27	2.77
M4 – CSR Funds	4.00	3.80	3.73	4.07	3.87
M5 – Voluntary Donations	2.83	2.97	3.37	3.20	3.50
Maximum Value	4.00	3.80	3.73	4.07	3.87

Table 4. Normalized Matrix

Alternative	K1	K2	K3	K4	K5
M1 – Entrance Fee	0.93	0.91	0.88	0.88	0.90
M2 – Tourism Operator Contributions	0.80	0.97	0.96	0.93	0.96
M3 – PES	0.73	0.74	0.94	0.80	0.71
M4 – CSR Funds	1.00	1.00	1.00	1.00	1.00
M5 – Voluntary Donations	0.70	0.78	0.90	0.77	0.90

Table 5. Ranking Results of Conservation Financing Mechanisms

Rank	Mechanism	Code	SAW Value
1	Corporate CSR Funds	M4	1.00
2	Tourism Operator Contributions	M2	0.92
3	Entrance Fee	M1	0.90
4	Voluntary Donations	M5	0.80
5	PES	M3	0.79

Mapping results indicate that the governance structure of Pulau Weh Nature Tourism Park is dominated by two key players, namely BKSDA as the formal state authority and Panglima Laot as the representative of customary maritime law. This condition forms a dual authority structure in area management. Nevertheless, coordination between these two actors continues to operate in a fragmented manner. BKSDA identified overlaps between customary rules and formal conservation regulations, while the Department of Tourism highlighted the absence of an integrated management blueprint among institutions. These findings indicate that institutional aspects constitute an important factor in area management beyond ecological and funding issues. Governance fragmentation of this nature is known to be one of the factors inhibiting the effectiveness of conservation area management in various developing countries (Meng et al., 2023).

The Subjects group, comprising fishermen, tourism operators, local communities, the Department of Marine and Fisheries (DKP), and NGO (WCS), demonstrated high levels of dependency on the area yet lacked adequate access to decision-making processes. Fishermen recorded dependency levels of up to 100% with involvement spanning 25–50 years and stated they had never been included in formal area planning. Similar conditions were found among tourism operators who depend largely on ecosystem sustainability for their economic activities. This disparity between dependency levels and capacity for influence indicates that the groups most affected by environmental changes still have limited involvement in area governance. Reed et al. (2009) explain that the involvement of groups with direct dependency on natural resources is an important factor in supporting the long-term effectiveness of conservation policy implementation.

Differences in stakeholder perceptions of area conditions reflect variations in experience and intensity of interaction with the ecosystem. Tourism operators who interact directly with the area on a daily basis tend to perceive environmental conditions as deteriorating, particularly regarding water quality and increasing tourism waste. In contrast, Panglima Laot and the Department of Marine and Fisheries, who monitor area conditions over longer periods, assessed that destructive fishing practices have begun to decline compared to previous periods. These differing perspectives indicate that each group possesses distinct yet complementary ecological information. Kujala et al. (2022) affirm that the integration of diverse stakeholder perspectives can enhance decision-making quality in the management of complex natural resources.

Despite holding different perceptions of area conditions, nearly all stakeholders identified the same primary threats, namely tourist waste, illegal fishing, and weak area surveillance. This convergence of perceptions indicates an opportunity for developing inter-stakeholder coordination toward more collaborative area management (Rouse et al., 2025).

SAW analysis results indicate that the CSR fund mechanism obtained the highest preference value compared to other alternatives. This high value was primarily influenced by the legality and conservation effectiveness aspects, which were rated most favorably by respondents. This assessment is associated with the existence of a relatively clear regulatory framework through Law Number 40 of 2007 and Government Regulation Number 47 of 2012 concerning corporate social and environmental responsibility. Furthermore, stakeholders assessed that CSR funds possess utilization flexibility that enables direct allocation to area conservation programs. In the context of Pulau Weh Nature Tourism Park, companies that derive economic benefits from tourism activities, such as airlines and travel agencies, have the potential to become significant sources of conservation funding if formally integrated into the area financing scheme. Kedward et al. (2023) explain that private sector involvement in conservation financing is increasingly important to reduce the dependence of conservation areas on limited government budgets.

Tourism operator contribution and entrance fee mechanisms ranked next with relatively small value differences. This condition indicates that both mechanisms are considered sufficiently feasible for supporting environmental financing of the area. The high assessment of tourism operator contributions was primarily influenced by equity and social acceptability aspects, as tourism operators perceive a direct connection between their economic activities and the sustainability of the area (Ridwan et al., 2026). Field findings also indicate that informal conservation contribution practices have actually been occurring despite lacking a structured management system, suggesting that social acceptability toward user-based financing mechanisms has organically developed (Booth et al., 2022). With tourist visits continuing to increase annually, user-based financing mechanisms have the potential to become a more stable long-term funding source for conservation area management. These findings are consistent with Atmodjo et al. (2017), who demonstrated that tourism-based contributions in Raja Ampat were able to support sustainable marine conservation area financing.

On the other hand, voluntary donations and the Payment for Ecosystem Services (PES) mechanism received relatively lower values compared to other alternatives. The low assessment of PES was primarily influenced by insufficient institutional support, market mechanisms, and technical regulations to support the implementation of such schemes at the local level. This condition indicates that PES implementation in Pulau Weh Nature Tourism Park still faces structural challenges, particularly regarding institutional capacity and certainty of benefit distribution mechanisms. Le et al. (2024) explain that limited institutional capacity and unclear access rights constitute the main barriers to PES implementation in many developing countries. Nevertheless, this mechanism retains potential for development in the long term as regulations and area management capacity are strengthened.

Overall, research findings indicate that environmental financing management in Pulau Weh Nature Tourism Park is more relevantly implemented through a blended financing approach, combining multiple funding sources simultaneously. This approach enables the area to avoid dependence on a single funding source, thereby reducing the risk of budget constraints. The combination of CSR funds, tourism operator contributions, entrance fees, and voluntary mechanisms is assessed as having higher implementation potential in supporting sustainable area management. A diversified financing approach is also important given the relatively low operational budget of the area compared to the estimated annual ecosystem economic value generated by the area (Ridwan, 2026). The OECD (2020) affirms that diversification of funding sources is one of the primary strategies for supporting sustainable conservation area management. The effectiveness of implementing these mechanisms still requires more collaborative and transparent governance that involves stakeholder groups which have high levels of dependency on the area but have not yet been formally accommodated in decision-making processes.

CONCLUSION

This study produced two main findings in accordance with the established objectives. First, stakeholder mapping in Pulau Weh Nature Tourism Park identified four groups based on the power-interest grid approach: Key Players (BKSDA and Panglima Laot), Subjects (fishermen,

tourism operators, local communities, the Department of Marine and Fisheries/DKP, and NGO WCS), Context Setters (the Department of Tourism and BPKS), and Crowds (tourists and academics). The dominance of the Subjects group at 50% reflects a condition of power asymmetry, where the group with the highest economic dependency on the area has the most limited access to formal decision-making. All groups consistently identified tourist waste, illegal fishing, and weak surveillance as the three main threats to the area.

Second, SAW analysis of five financing mechanisms produced the following priority ranking: corporate CSR funds (1.00), tourism operator contributions (0.92), entrance fees (0.90), voluntary donations (0.80), and Payment for Ecosystem Services (0.79). The small value differences among the top three rankings indicate that these three mechanisms are complementary and support a blended financing approach comprising three layers: CSR as the core layer, tourism operator contributions and entrance fees as the second layer based on the beneficiary pays principle, and voluntary donations and PES as the third layer to be developed incrementally. The effectiveness of this approach requires a fund governance structure that formally involves the Subjects group in the allocation oversight mechanism.

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