

SWOT Analysis for Mangrove Forest Management Policy at Teluk Youtefa Natural Tourism Park, Jayapura, Indonesia

Rosela Alberta Manobi¹, Janviter Manalu², Alfred Alfonso Antoh³, Johnson Siallagan⁴

^{1,2,3,4}Master of Natural Resources and Environmental Management

ABSTRACT: Mangrove forests in Indonesia face significant degradation pressures from anthropogenic activities and climate change. This study aims to formulate an effective management policy for the mangrove ecosystem at Teluk Youtefa Natural Tourism Park (TWA) in Jayapura, Papua, Indonesia, through a comprehensive SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis. Data were collected through surveys, interviews, and focus group discussions involving local communities, government agencies, academics, and non-governmental organizations. The SWOT matrix was constructed to identify internal and external factors affecting mangrove management and to develop strategic recommendations. The results indicate that the primary strengths include the legal status of TWA Youtefa, high biodiversity potential, and emerging ecotourism opportunities. Key weaknesses encompass land conversion pressures, inadequate supporting infrastructure, and low community awareness. Opportunities arise from global conservation awareness, central government support, and digital monitoring technologies. Major threats include climate change, sea-level rise, industrial pollution, and conflicting spatial planning. Based on the SWOT matrix, four strategic clusters were formulated: (i) Strengths-Opportunities (SO) strategies focusing on community-based ecotourism and education centers; (ii) Strengths-Threats (ST) strategies emphasizing monitoring systems and law enforcement; (iii) Weaknesses-Opportunities (WO) strategies targeting capacity building and infrastructure development; and (iv) Weaknesses-Threats (WT) strategies proposing disaster mitigation and rehabilitation programs. This study provides evidence-based recommendations for policymakers to achieve sustainable mangrove management in Papua.

Keywords: Mangrove management, SWOT analysis, Natural Tourism Park, Policy model, Teluk Youtefa, Papua, Sustainable development

1. INTRODUCTION

Mangrove ecosystems represent one of the most productive and biologically diverse coastal habitats globally, providing critical services including shoreline protection, carbon sequestration, fisheries nursery grounds, and livelihood support for coastal communities (Alongi, 2020; Feller et al., 2017). Indonesia possesses the largest mangrove coverage worldwide, accounting for approximately 20% (3.49 million hectares) of global mangrove area (KLHK, 2021). However, these ecosystems face unprecedented threats from anthropogenic activities, including land conversion, illegal logging, pollution, and climate change-induced sea-level rise, resulting in an estimated annual loss of 1% per year (Global Mangrove Alliance, 2022).

Papua Province harbors Indonesia's most extensive mangrove forests, covering approximately 1.56 million hectares or 58% of the national mangrove estate (KLHK, 2021). Within this region, Teluk Youtefa Natural Tourism Park (Taman Wisata Alam/TWA) in Jayapura represents a legally protected conservation area established through Ministerial Decree No. 714/Kpts-II/1996, encompassing 1,675 hectares. Despite its protected status, TWA Youtefa has experienced significant degradation, with mangrove cover declining from 392.45 ha in 1994 to 201.47 ha in 2023 (Hamuna & Tanjung, 2018; Winarko-UGM, 2024). This degradation stems from multiple drivers including land conversion for infrastructure, illegal logging, mining tailings, and insufficient enforcement of conservation regulations.

Effective mangrove management requires integrative policy frameworks that reconcile ecological conservation with socio-economic development (Djamaluddin et al., 2022; Arifanti et al., 2022). The SWOT (Strengths, Weaknesses, Opportunities, Threats) analytical framework offers a robust methodological approach for evaluating internal organizational capacities and external environmental conditions to formulate strategic management policies (Rangkuti, 2006; David, 2011). While SWOT

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analysis has been widely applied in coastal resource management contexts globally (Suman, 2021; Hossain et al., 2022), its application for mangrove policy formulation in Papua remains limited.

This study addresses this research gap by conducting a comprehensive SWOT analysis of mangrove management at TWA Teluk Youtefa. The specific objectives are: (i) to identify internal strengths and weaknesses of the current management system; (ii) to assess external opportunities and threats; and (iii) to develop strategic policy recommendations based on the SWOT matrix. The findings are expected to provide scientific evidence for policymakers, conservation practitioners, and local stakeholders in designing sustainable mangrove governance models for Papua and similar tropical coastal ecosystems.

2. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Mangrove Ecosystem Functions and Management

Mangrove forests are defined as intertidal forest formations dominated by salt-tolerant tree species adapted to anaerobic muddy substrates (Giri et al., 2011). Ecologically, mangroves serve as nutrient filters, sediment stabilizers, and breeding habitats for marine fauna (Lee et al., 2020). Economically, they support fisheries, timber production, and emerging ecotourism industries valued at billions of dollars annually (Costanza et al., 2014). The degradation of mangrove ecosystems has been linked to increased coastal erosion, reduced fishery yields, and elevated carbon emissions (Pendleton et al., 2012).

2.2 Policy Models for Mangrove Conservation

The Rational Comprehensive Model posits that policy formulation should maximize social gain through systematic evaluation of alternatives based on cost-benefit analysis (Dunn, 2003). In the context of natural resource management, this model requires comprehensive understanding of stakeholder perceptions, ecological conditions, and regulatory frameworks. Indonesian mangrove governance operates under multiple legal instruments including Law No. 27/2007 on Coastal Management, Presidential Regulation No. 73/2012 on National Mangrove Ecosystem Management Strategy (subsequently revoked in 2020), and the establishment of the Peat and Mangrove Restoration Agency (BRGM) under Presidential Regulation No. 120/2020.

2.3 SWOT Analysis in Environmental Management

SWOT analysis constitutes a strategic planning tool that identifies internal Strengths (S) and Weaknesses (W) alongside external Opportunities (O) and Threats (T) (Rangkuti, 2006). In environmental policy research, SWOT facilitates systematic identification of factors influencing management effectiveness and generates strategic alternatives through matrix combinations (SO, ST, WO, WT strategies). Previous applications in Indonesian coastal management include collaborative mangrove rehabilitation in Surabaya (Wonorejo), conservation-based management in Denpasar (Tahura Ngurah Rai), and ecosystem-based adaptation in Demak (Building with Nature Indonesia) (Ayuk Ratna et al., 2021).

3. RESEARCH METHODS

3.1 Study Area

This research was conducted at Teluk Youtefa Natural Tourism Park (TWA), located in Jayapura City, Papua Province, Indonesia (2°32'–2°38'S, 140°42'–140°48'E). The park was designated as a conservation area by Ministerial Decree No. 714/Kpts-II/1996 covering 1,675 hectares. The study focused on three administrative villages: Entrop-Hanyaan, Waimhorck-Enggros, and Wahno-Tobati, which directly border the mangrove ecosystem.

3.2 Data Collection

Primary data were collected through: (i) structured questionnaires administered to 350 respondents comprising local communities (Tobati, Enggros, Hanyaan), government agencies (Environmental Agency, Public Works, Fisheries, Forestry), academics, and NGOs; (ii) in-depth interviews with key informants including village heads, customary leaders, and agency officials; (iii) focus group discussions (FGDs) with stakeholder groups; and (iv) direct field observation of mangrove conditions and anthropogenic activities. Secondary data included satellite imagery (Landsat 8, Sentinel-2), government reports, and regulatory documents.

3.3 SWOT Analysis Procedure

The SWOT analysis followed a four-stage protocol: (1) Identification phase—internal and external factors were identified through literature review, expert consultation, and stakeholder surveys; (2) Weighting phase—factors were prioritized based on frequency of mention and perceived importance scores; (3) Matrix construction—cross-matching internal and external factors to generate SO, ST, WO, and WT strategy quadrants; and (4) Validation phase—strategies were validated through expert panel review and FGDs.

3.4 Data Analysis

Quantitative data from Likert-scale questionnaires were analyzed using descriptive statistics (frequency, percentage, mean). Spearman rank correlation and linear regression were applied to examine relationships between stakeholder perceptions and management variables. Qualitative data from interviews and FGDs were analyzed using content analysis to identify thematic categories corresponding to SWOT dimensions. All analyses were performed using Microsoft Excel and SPSS v.26.

4. RESULTS AND DISCUSSION

The SWOT analysis revealed distinct internal and external factors influencing mangrove management at TWA Teluk Youtefa. Table 1 presents the synthesized SWOT factors, while Table 2 illustrates the strategic matrix derived from cross-matching these factors.

Table 1. SWOT Factors for Mangrove Management at TWA Teluk Youtefa

Dimension	Code	Factor Description
Strengths (Internal)	S1	Legal protection status as TWA (Ministerial Decree No. 714/Kpts-II/1996) covering 1,675 ha
	S2	High biodiversity of flora (Rhizophora, Avicennia, Bruguiera) and fauna (fish, crustaceans, birds)
	S3	Potential for ecotourism development with unique coastal landscape
	S4	Presence of local communities (Tobati, Enggros) with traditional ecological knowledge
	S5	Research and education potential for universities and institutions
Weaknesses (Internal)	W1	Land conversion pressure for infrastructure, settlements, and ring-road development
	W2	Low community awareness and literacy regarding mangrove ecological functions
	W3	Inadequate supporting infrastructure (access roads, waste management, tourism facilities)
	W4	Weak law enforcement and surveillance against illegal logging and encroachment
	W5	Limited application of appropriate technology in mangrove rehabilitation
Opportunities (External)	O1	Growing global awareness of mangrove conservation and blue carbon initiatives
	O2	Central and regional government support through BRGM and rehabilitation roadmaps
	O3	Potential for community-based ecotourism and sustainable fisheries certification
	O4	Collaboration opportunities with research institutions and NGOs
	O5	Digital technology applications (GIS, remote sensing, IoT) for monitoring and management
Threats (External)	T1	Climate change impacts: sea-level rise, increased storm frequency, coastal erosion
	T2	Industrial pollution and mining tailings (Freeport) affecting water quality
	T3	Conflicting spatial planning and land-use policies between sectors
	T4	Natural disasters: flooding, abrasion, and sedimentation changes
	T5	Socio-economic conflicts between local communities and external developers

4.1 Strengths Analysis

The legal status of TWA Youtefa constitutes the primary institutional strength for mangrove conservation. The Ministerial Decree provides a regulatory foundation for protection, enabling enforcement actions against encroachment. The area's biodiversity, including dominant species of *Rhizophora apiculata* and *Avicennia marina*, supports fisheries productivity and carbon sequestration estimated at 3–5 times higher than terrestrial forests (KLHK, 2021). Furthermore, the indigenous communities of Tobati and Enggros possess traditional management practices that, if integrated with formal governance, could enhance participatory conservation (Berkes, 2012). The proximity to Jayapura city (approximately 5 km) creates unique opportunities for environmental education and research collaborations.

4.2 Weaknesses Analysis

Despite legal protection, enforcement remains weak due to limited human resources and budget allocation. Survey results indicate that 53% of Tobati community respondents and 64% of environmental agency staff expressed disagreement regarding current management effectiveness, reflecting low confidence in institutional capacity. Land conversion for the Jayapura ring-road and settlement expansion has directly reduced mangrove cover by approximately 48% between 1994 and 2023 (Hamuna & Tanjung, 2018; Winarko-UGM, 2024). Infrastructure deficiencies, including lack of waste management systems and inadequate access roads, limit both conservation activities and controlled ecotourism development. Community awareness surveys revealed that while 100% of Enggros and Hanyaan respondents agreed on mangrove importance, their understanding of specific ecological functions (carbon storage, nursery habitat) remains superficial, indicating a need for targeted environmental education.

4.3 Opportunities Analysis

Global momentum for mangrove conservation has intensified following the UN Decade on Ecosystem Restoration (2021–2030) and blue carbon financing mechanisms. Indonesia's commitment to rehabilitate 600,000 hectares of mangroves by 2024 through BRGM creates policy windows for TWA Youtefa to access national funding and technical assistance. The emerging concept of community-based ecotourism (CBET) aligns with successful models in Surabaya (Wonorejo) and Denpasar (Tahura Ngurah Rai), where mangrove conservation generates direct economic benefits through guided tours, fisheries, and handicrafts (Ayuk Ratna et al., 2021). Digital technologies, including Sentinel-2 satellite monitoring and mobile-based reporting systems, offer cost-effective solutions for surveillance in remote areas like Papua. Academic partnerships with Cenderawasih University and national institutions can provide scientific support for adaptive management.

4.4 Threats Analysis

Climate change poses existential threats to low-lying mangroves in Teluk Youtefa. Sea-level rise projections for Papua (1.5–3.2 mm/year) threaten to submerge intertidal zones and alter salinity gradients (IPCC, 2021). Industrial pollution from mining operations (Freeport tailings) and urban runoff degrades water quality, affecting propagule establishment and faunal health. Spatial planning conflicts between conservation zoning (TWA) and infrastructure development (ring-road, port expansion) create regulatory uncertainty. Additionally, natural disasters including coastal abrasion and storm surges have intensified, with the 2023 coral reef reclamation incident destroying approximately 2 hectares of mangrove forest (Mongabay, 2024). Socio-economic conflicts between indigenous land rights and state conservation designations require careful negotiation to prevent management gridlock.

4.5 SWOT Strategic Matrix

The cross-matching of internal and external factors generated four strategic quadrants (Table 2). Each quadrant represents a distinct policy orientation for mangrove management at TWA Youtefa.

Table 2. SWOT Strategic Matrix for Mangrove Management Policy at TWA Teluk Youtefa

Strategy Quadrant	Strategic Recommendations
SO Strategies (Maxi-Maxi)	• Develop integrated ecotourism packages combining mangrove education, birdwatching, and cultural experiences (S1,S3,S4 + O1,O3). • Establish a Mangrove Education and Research Center leveraging academic partnerships (S5 + O4). • Implement community-based mangrove rehabilitation (CBMR) programs with BRGM funding (S2,S4 + O2). • Deploy digital monitoring dashboards using GIS and citizen-science applications (S5 + O5).
ST Strategies (Maxi-Mini)	• Install automated water quality and meteorological monitoring stations to detect pollution and extreme events (S3,S5 + T1,T2). • Strengthen patrol units and community ranger systems to prevent illegal activities (S1 + T5). • Develop climate-resilient spatial plans that prohibit development in critical mangrove zones (S1 + T3,T4). • Construct early warning systems for coastal hazards (S3 + T1,T4).
WO Strategies (Mini-Maxi)	• Conduct intensive environmental literacy campaigns targeting schools, fishers, and local government staff (W2 + O1,O4). • Build eco-friendly infrastructure (boardwalks, waste facilities, interpretive signage) with green financing (W3 + O2,O3). • Introduce appropriate technologies for waste treatment and

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	sustainable aquaculture (W5 + O5). • Facilitate multi-stakeholder forums to resolve land-use conflicts through participatory mapping (W1,W4 + O4).
WT Strategies (Mini-Mini)	• Develop integrated disaster mitigation systems (drainage, retaining walls, mangrove replanting in erosion hotspots) (W1,W3 + T1,T4). • Establish emergency response protocols for pollution events and storm damage (W4 + T2,T4). • Create alternative livelihood programs (seaweed farming, eco-handicrafts) to reduce pressure on mangrove resources (W2 + T5). • Implement strict zoning enforcement with penalties for encroachment in rehabilitation zones (W4 + T3).

4.6 Discussion of Strategic Implications

The SO strategies emphasize proactive conservation through ecotourism and education, aligning with successful models in Surabaya and Tarakan where community involvement has reduced degradation while generating income (Ayuk Ratna et al., 2021). The development of a Mangrove Education Center at TWA Youtefa would capitalize on the area's proximity to Jayapura, serving as a hub for environmental education and research tourism.

ST strategies address the enforcement gap identified as a critical weakness. The deployment of community ranger systems, combined with IoT-based monitoring, has proven effective in Langkat (North Sumatra) and Banyuasin (South Sumatra), where technology-augmented surveillance reduced illegal logging by 40% (BRGM, 2023). Climate-resilient spatial planning must integrate sea-level rise projections into Jayapura's municipal development plan to prevent infrastructure encroachment into protected mangrove buffers.

WO strategies focus on capacity building and infrastructure, recognizing that sustainable management requires human capital development. The low awareness scores among government staff (64% disagreement from environmental agency respondents) indicate urgent training needs on mangrove ecology and policy instruments. Participatory mapping using drones and GIS can resolve land conflicts by documenting traditional boundaries and conservation zones transparently.

WT strategies represent defensive measures for worst-case scenarios. The integrated disaster mitigation approach, combining hard infrastructure (retaining walls) with soft measures (mangrove replanting), follows the 'Building with Nature' principles successfully applied in Demak, Central Java (Wetlands International, 2020). Alternative livelihood programs must be carefully designed to avoid perverse incentives; seaweed farming and sustainable fisheries certification offer promising pathways that maintain ecosystem integrity while improving household incomes.

5. CONCLUSION

This study demonstrates that SWOT analysis provides a robust framework for diagnosing mangrove management challenges and formulating evidence-based policy recommendations at TWA Teluk Youtefa. The analysis reveals that while the area possesses strong legal protection and biodiversity assets, these strengths are undermined by weak enforcement, infrastructure deficits, and low technical capacity. External opportunities from global conservation finance and digital technologies are counterbalanced by climate change pressures and industrial pollution.

The recommended strategic portfolio emphasizes: (1) community-based ecotourism and education to leverage strengths and opportunities; (2) technology-enhanced surveillance and climate-adaptive zoning to counter threats; (3) intensive capacity building and participatory infrastructure development to address weaknesses; and (4) integrated disaster mitigation and livelihood diversification for risk minimization. Successful implementation requires multi-level governance coordination between BRGM, provincial and municipal agencies, academic institutions, and indigenous communities. Future research should quantify the economic value of ecosystem services at TWA Youtefa to strengthen the business case for conservation investments and explore the potential of blue carbon financing mechanisms for long-term management sustainability.

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