



MULTI-STAKEHOLDER MANAGEMENT OF MANGROVE ECOSYSTEMS IN THE SAWO-LAHEWA MARINE CONSERVATION AREA, INDONESIA

PENGELOLAAN EKOSISTEM MANGROVE BERBASIS MULTI-PEMANGKU KEPENTINGAN DI KAWASAN KONSERVASI PERAIRAN SAWO-LAHEWA, INDONESIA

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ABSTRACT

The mangrove ecosystem in the Sawo-Lahewa Marine Conservation Area (MCA), North Nias Regency, North Sumatra Province, was degraded by 86.64 hectares between 2014 and 2016. This degradation was partly attributed to tectonic earthquakes in northern Nias Island and a lack of public awareness regarding the sustainable benefits of mangroves. Furthermore, multiple parties are involved in the management of this mangrove ecosystem. Achieving sustainable management requires collaboration among the various sectors and stakeholders playing a role in the ecosystem's management within the Sawo-Lahewa MCA. This study aimed to analyze the levels of influence and dependency regarding mangrove ecosystem management in the Sawo-Lahewa MCA, North Nias. The research was conducted from November to December 2023 using the MACTOR stakeholder analysis approach, involving 13 actors associated with mangrove ecosystem management in the area. The results indicate that the stakeholders possessing high influence and low dependency are the North Sumatra Provincial Marine and Fisheries Agency and the North Sumatra Regional Development Planning, Research, and Innovation Agency (BAPPERIDA). These actors serve as the leading sectors for mangrove management in the Sawo-Lahewa MCA. Stakeholders exhibiting both high influence and high dependency include the Gunung Sitoli Forest Management Unit (KPH), the North Nias Regional Development Planning Agency (BAPPEDA), the North Nias Marine and Fisheries Agency (DKP), the Head of Sawo Village, and the Head of Teluk Siabang Sisarahili Village. These actors play a highly influential role in the management of the mangrove ecosystem within the Sawo-Lahewa MCA.

Keywords: actor, MACTOR, North Nias, stakeholders

ABSTRAK

Ekosistem mangrove di Kawasan Konservasi Perairan (KKP) Sawo-Lahewa, Kabupaten Nias Utara, Provinsi Sumatera Utara, dari tahun 2014–2016 mengalami degradasi seluas 86,64 ha. Degradasi disebabkan oleh faktor gempa tektonik yang terjadi di Pulau Nias bagian utara dan faktor kurangnya pengetahuan masyarakat tentang manfaat ekosistem mangrove secara berkelanjutan. Selain itu, banyak pihak yang terlibat dalam pengelolaan ekosistem mangrove. Untuk mencapai pengelolaan yang berkelanjutan, diperlukan kolaborasi antarsektor/*stakeholder* yang memiliki peran dalam pengelolaan ekosistem mangrove di KKP Sawo-Lahewa. Tujuan penelitian ini adalah menganalisis tingkat pengaruh dan ketergantungan dalam pengelolaan ekosistem mangrove di KKP Sawo-Lahewa Nias Utara. Penelitian ini dilakukan pada bulan November–Desember 2023. Metode analisis yang digunakan adalah pendekatan analisis MACTOR *stakeholder*, yang terdiri atas 13 aktor terkait dengan pengelolaan ekosistem mangrove di KKP Sawo-Lahewa. Hasil penelitian menunjukkan bahwa *stakeholder* yang mempunyai peranan atau pengaruh yang tinggi dan mempunyai ketergantungan yang rendah adalah Dinas Kelautan dan Perikanan Provinsi Sumatera Utara, dan Badan Perencanaan Pembangunan, Riset, dan Inovasi Daerah (BAPPERIDA) Sumatera Utara. Aktor tersebut merupakan *leading sector* dalam pengelolaan mangrove di KKP Sawo-Lahewa Nias Utara. *Stakeholder* yang mempunyai pengaruh tinggi dan ketergantungan tinggi adalah Kesatuan Pengelolaan Hutan Gunung Sitoli, BAPPEDA Nias Utara, DKP Nias Utara, Kepala Desa Sawo, dan Kepala Desa Teluk Siabang Sisarahili. Aktor-aktor ini sangat berpengaruh dalam pengelolaan ekosistem mangrove di KKP Sawo-Lahewa.

Kata kunci: aktor, MACTOR, Nias Utara, *stakeholder*

INTRODUCTION

Mangrove ecosystems provide numerous benefits to both the environment and local communities, primarily through their high productivity in delivering various ecosystem services. Furthermore, they support the survival of associated biota by providing essential feeding and spawning grounds. However, these highly productive mangrove forests have recently come under pressure from development activities (Akhrianti and Gustomi 2020; Sudrajat *et al.* 2023). This situation affects the mangrove ecosystems located within the Sawo-Lahewa Marine Conservation Area (Sawo-Lahewa MCA), hereafter Sawo-Lahewa MCA, in North Nias Regency, North Sumatra Province.

Through the Decree of the Minister of Marine Affairs and Fisheries of the Republic of Indonesia Number 67 of 2024, the waters of the Sawo-Lahewa region in North Sumatra Province were designated as a conservation area to improve ecosystem management. Nevertheless, the mangrove ecosystems in the area are undergoing degradation due to both natural and anthropogenic factors. Natural factors include the tectonic earthquake that struck Nias Island on March 28, 2005; this event caused coastal land uplift in the northern part of the island, leaving many mangrove areas no longer inundated by seawater. A significant anthropogenic factor contributing to the decline in mangrove ecosystem quality is the relatively low level of knowledge and awareness among the local population, evidenced by practices such as converting mangrove land into plantations and harvesting mangrove wood for charcoal production (Mendrofa *et al.* 2018).

According to Siringoringo *et al.* (2015), North Nias Regency had a total mangrove area of 178.96 hectares in 2014. Subsequently, Mendrofa *et al.* (2018) reported a reduction in mangrove coverage, noting a decrease to 92.32 hectares by 2016. It can be concluded that the mangrove area in North Nias has decreased by 86.64 hectares over the two years, from 2014 to 2016. Administratively, the mangrove ecosystem in North Nias serves as a supporting ecosystem for a conservation area designated for biodiversity conservation (Firdiansyah *et al.* 2020). This is in accordance with the Regulation of the Minister of Marine Affairs and Fisheries Number PER.17/MEN/2008 concerning Conservation Areas in Coastal Zones and Small Islands. The conservation of coastal zones and small islands entails efforts to protect, preserve, and utilize these areas and their ecosystems, thereby ensuring the

continued existence and sustainability of their resources while simultaneously maintaining and enhancing the quality of their biodiversity (Rochmah *et al.* 2022).

A critical issue in mangrove ecosystem management is the persistent overlap in the planning and organization of activities across various sectors, including local and provincial governments, local communities, and the private sector, each with differing interests (Nijamdeen *et al.* 2022). Relevant sectors with a stake in mangrove ecosystem management include forestry, marine affairs and fisheries, the environment, local and provincial governments, and private industry (Marlianingrum *et al.* 2021). Research mapping the interests of various stakeholders or actors can be conducted using the Matrix of Alliances and Conflicts: Tactics, Objectives, and Recommendations (MACTOR) method. MACTOR recommendations provide an empirical basis for formulating strategic measures to strengthen alliances, mitigate potential conflicts, and optimize synergy among actors in mangrove ecosystem management. The MACTOR method has frequently been applied in management planning; for instance, Nopriani *et al.* (2022) utilized it to assess the sustainability of "Reduce, Reuse, Recycle" (TPS 3R) waste processing facilities in Pangkalpinang City. Multi-actor-based management is an approach to managing a marine conservation area that involves all relevant stakeholders. Therefore, all decision-making processes in the management of the area take into account the interests and perspectives of all parties involved. This approach is expected to produce better management outcomes while ensuring that no stakeholder is left behind. However, no research has yet been conducted on the roles of actors in mangrove ecosystem management within the Sawo-Lahewa MCA. Consequently, synergy among relevant actors is essential to support mangrove ecosystem management in the Sawo-Lahewa MCA, North Nias Regency. This study aims to analyze the levels of influence and dependency regarding mangrove ecosystem management in the Sawo-Lahewa MCA, North Nias Regency. The findings are expected to serve as a source of scientific information, providing a foundation for policy-making regarding mangrove ecosystem management in the study area.

METHODS

This study was conducted from November to December 2023 in the Sawo-Lahewa Marine Conservation Area, North

Sumatra Province (Figure 1). Primary data obtained through interviews were analyzed using a prospective analysis approach. The prospective analysis employed the Matrix of Alliances and Conflicts: Tactics, Objectives, and Recommendations (MACTOR) method. The stakeholder analysis steps using MACTOR followed the methodologies of Godet (1991), Godet (2006), Godet *et al.* (2008), and Fauzi (2019). The first step involved interviewing informants who had previously been briefed by the authors on mangrove management concepts and the role of mangrove ecosystems. Subsequently, a list of variables was compiled based on the participants' understanding, knowledge, and experience. The study involved 13 stakeholders, comprising government bodies, academic institutions, NGOs, and community groups. Informants were selected via purposive sampling; a Direct Influence Matrix (MDI) was then created to illustrate the influence between actors, alongside an Actor-Objective Matrix (MAO) to show actors' stances regarding the formulated strategies. Respondents were selected based on their close association with mangrove ecosystem utilization, such as fishermen and those harvesting mangrove products like firewood. The respondents were divided into six groups. The first group was the provincial government, with three respondents: one each from the North Sumatra Regional Development Planning, Research, and Innovation Agency (BAPPERIDA), the North Sumatra Marine and Fisheries Agency (DKP), and the Gunung Sitoli

Forest Management Unit (KPH). The second group was the North Nias Regency government, with two respondents: one from the Marine and Fisheries Service and one from the Regional Development Planning Agency (BAPPEDA). The third group was academia, with one respondent from a higher education institution. The fourth group was non-governmental organizations, with two respondents: one from the Indonesian Conservation Foundation (Yayasan Konservasi Indonesia) and one from the Indonesian Coastal Conservation Foundation (Yayasan Konservasi Pesisir Indonesia). The fifth group was village government, with two respondents: the village heads of Lasara Sawo and Sisarahili Teluk Siabang. The sixth group was local resource users, with three respondents: one each from the community-based surveillance group (POKMASWAS), the fishers' group, and the charcoal producers who use mangrove wood. The MDI and MAO were populated using a 0 to 4 scoring scale representing the level of influence, ranging from "no influence" to "very strong influence" on the existence of other actors. Experts or informants filled out the MDI and MAO; the results were then calculated based on the mode (the most frequently occurring value) and entered into the MACTOR software. Finally, the analysis examined convergence (the level of alignment between actors) and divergence (conflicts of interest between actors) by assigning scores for each actor: +6 (strongly supportive), 0 (neutral) and -6 (strongly opposed), where 6 represents the Delphi scale used in the relative-score assessment.

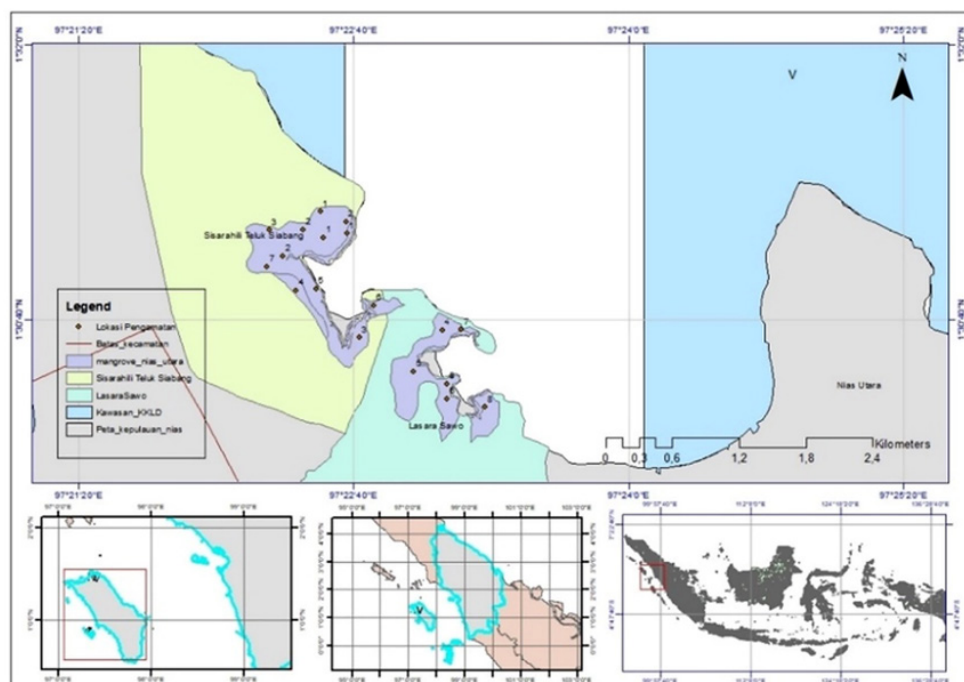


Figure 1. The Sawo-Lahewa Marine Conservation Area, North Sumatra Province.

RESULTS AND DISCUSSION

This study involves diverse actors with heterogeneous interests in mangrove ecosystem management. Actors possessing the highest levels of influence and dependency were identified through the mapping of stakeholders involved in mangrove management within the Sawo-Lahewa MCA, North Nias Regency, North Sumatra Province. The results of this mapping are presented in Figure 2. Meanwhile, Tables 1 and 2 present the list of actors involved in managing the Sawo-Lahewa MCA and their roles.

The subsequent step involves establishing objectives for each stakeholder based on their primary roles. These objectives are defined according to the key responsibilities of each stakeholder regarding their involvement in the mangrove ecosystem conservation process, as outlined in Table 2. Prospective analysis using the MACTOR application reveals actor interdependence in mangrove management within the Sawo-Lahewa MCA and its surrounding waters (Table 3). Table 3 indicates that the North Sumatra Marine Affairs and Fisheries Agency (DKPSU) exerts the greatest influence, with an Ii score of 217. This aligns with the agency's mandate as a driving

stakeholder in the regional conservation area's mangrove management program, specifically regarding policy formulation, budgeting, and regulation to ensure successful management within the Sawo-Lahewa MCA and surrounding waters, over which it holds full authority for management and oversight within the 0 to 12 nautical mile zone (Utomo 2020). Conversely, the stakeholders with the least influence on other actors are fishers and timber-based business operators, each with a score of 83. This reflects the roles of fishers and local communities, who currently lack understanding regarding the utilization and management of mangroves within regional conservation areas. The Sisarahili Teluk Siabang Village Government is highly dependent on other actors, given that 64.03% of the village's territory consists of dense mangrove ecosystems. Siringoringo *et al.* (2015) and Mendrofa *et al.* (2018) note a positive correlation between education levels and knowledge of mangrove ecosystems, as well as an influence on natural resource management; consequently, the low education levels among communities near the Sawo-Lahewa MCA and surrounding waters correlate with limited knowledge regarding the functions and benefits of mangrove forests, resulting in less attention paid to their preservation.

Table 1. Actors and their roles in mangrove ecosystem management in the Sawo-Lahewa Marine Conservation Area.

No.	Institutions	Symbols	Categories	Roles
1	North Sumatra Provincial Regional Development Planning, Research, and Innovation Agency (BAPPERIDA)	BAPLTBANG	Government	Regional development planner
2	North Sumatra Marine Affairs and Fisheries Agency	DKPSU	Government	Fisheries activity regulator
3	Gunung Sitoli Forest Management Unit (KPH)	KPHGS	Government	Forestry activity regulator
4	North Nias Regency Marine Affairs and Fisheries Agency	DKPNS	Government	Fisheries activity regulator
5	North Nias Regional Development Planning Agency (BAPPEDA)	BAPEDANS	Government	North Nias development planner
6	Head of Sawo Village	KADES_SAWO	Government	Village community activity regulator
7	Head of Teluk Siabang Sisarahili Village	KADES_TELUK	Government	Village community activity regulator
8	Higher Education Institutions	PERTI	Academia	Knowledge information
9	Yayasan Konservasi Indonesia	YKI	NGO	Knowledge information
10	Yayasan Konservasi Pesisir Indonesia	YAKOPI	NGO	Knowledge information
11	Community-Based Surveillance Groups (POKMASWAS)	POKMASWAS	Civil Society	Community-based oversight group
12	Fishermen Groups	NELAYAN	Civil Society	Resource user
13	Timber Product Business Operators	Peng_Kayu	Civil Society	Resource user

Table 2. Stakeholder roles in mangrove ecosystem management in the Sawo-Lahewa Marine Conservation Area.

Roles	Symbol	Stakeholder
Formulating regulations and regional action plans for mangrove management	Action Plan	Government
Conducting in-depth research on the potential of conservation areas	Research	Academia
Protecting dense mangrove forests that serve as major carbon sinks	Protection	General
Optimizing community involvement in sustainable mangrove management	Optimization	Public
Establishing conservation partnerships	Partnership	General
Enhancing the marketing of alternative livelihoods for the community	Income	Government

Table 3. Matrix of influence and dependency among actors in the Sawo-Lahewa Marine Conservation Area.

Influence/ Dependence between Actors	BAPLTBANG	DKPSU	KPHGS	DKPNS	BAPEDANS	PERTI	YKI	YAKOPI	POKMASWAS	KADES_SAWO	KADES_TELUK	NELAYAN	Peng_Kayu	li
BAPLTBANG	10	10	21	19	19	9	9	10	19	18	15	21	21	191
DKPSU	10	10	21	22	22	11	10	12	22	21	18	24	24	217
KPHGS	10	10	18	21	21	11	10	12	23	21	19	21	21	200
DKPNS	10	10	18	21	21	11	10	12	23	21	19	21	21	197
BAPEDANS	10	10	18	21	21	11	10	12	23	21	19	21	21	197
PERTI	6	6	12	14	14	9	7	9	15	14	12	12	12	133
YKI	6	6	12	14	14	9	7	9	15	14	12	12	12	135
YAKOPI	6	6	12	13	13	8	7	8	14	13	11	11	11	125
POKMASWAS	6	6	8	8	8	7	6	7	8	8	8	8	8	88
KADES_SAWO	8	8	15	18	18	10	9	11	20	17	15	19	19	170
KADES_TELUK	10	10	19	22	22	11	10	12	24	21	19	23	23	207
NELAYAN	5	5	9	8	8	5	6	6	8	8	7	8	8	83
Peng_Kayu	5	5	9	8	8	5	6	6	8	8	7	8	8	83
Di	92	92	174	188	188	108	100	118	214	188	162	201	201	2026

Note:

Di = Value indicating the degree of direct and indirect net dependence

li = Value indicating the direct and indirect net influence

Based on Figure 2, it can be seen that the North Sumatra Marine and Fisheries Agency (DKP) and the North Sumatra Regional Development Planning, Research, and Innovation Agency (BAPPERIDA) are located in Quadrant I (top left). The two stakeholders in this quadrant possess significant influence and low dependency regarding the mangrove management scenario in the Sawo-Lahewa MCA. The North Sumatra DKP holds a full mandate from the Ministry of Marine Affairs and Fisheries to manage the Sawo-Lahewa MCA. This result aligns with the role of the Marine and Fisheries Agency, which received the

mandate to manage the area through a decree of the Minister of Marine Affairs and Fisheries. The role of the North Sumatra DKP in coastal and small-island management is outlined in North Sumatra Governor Regulation Number 53 of 2015 concerning the Implementation of Government Affairs under Provincial Authority in the Marine and Fisheries Sector. Conversely, in Quadrant III (bottom right), timber product business operators, fishers, and Community-Based Surveillance Groups (POKMASWAS) exhibit high dependency and very low influence regarding the mangrove management scenario in the Sawo-Lahewa MCA. In Quadrant II, the

Gunung Sitoli Forest Management Unit (KPH), the North Nias Fisheries Agency, the North Nias Regional Development Planning Agency (BAPPEDA), and the Sawo and Sisarahili Village Governments act as "relay-level" stakeholders. Relay-level stakeholders depend on those in Quadrant I but exert significant influence on Quadrant III stakeholders through the impact of Quadrant I stakeholders' actions on them. Meanwhile, the Yayasan Konservasi Pesisir Indonesia, Yayasan Konservasi Indonesia, and universities occupy Quadrant IV as autonomous stakeholders characterized by low dependency and low influence (Ikhsanudin *et al.* 2018). The Indonesian Coastal Conservation Foundation and the Indonesian Conservation Foundation represent the presence of NGOs in the field.

Actors involved in mangrove ecosystem management

The Convergence Actor (CAA) matrix identifies the convergence between actors regarding established goals, thereby illustrating the strong relationships formed among actors aligned toward achieving shared objectives. Godet (2006) and Enserink *et al.* (2022) identify various potential alliances, wherein the convergence value reflects the degree of alignment in goals between actors. A higher convergence value indicates a greater likelihood

of cooperation, whether direct or indirect, among the actors involved in pursuing shared goals (Table 4).

Table 4 presents the results of the 1CAA (simple convergence) analysis, illustrating the degree of positional alignment among actors regarding the success and objectives of mangrove ecosystem management in the Sawo-Lahewa MCA. Convergence is interpreted based on the interconnections between actors; the extent to which they share common goals is reflected in their respective scoring values. This analysis allows for a description of the potential for forming alliances among the actors. Eleven actors, including BAPPERIDA, DKPSU, KPHGS, North Nias DKP, North Nias BAPPEDA, universities, Yayasan Konservasi Indonesia, Yayasan Konservasi Pesisir Indonesia, POKMASWAS, and the village governments of Sawo and Teluk Siabang, are capable of collaborating or forming alliances to achieve mangrove management goals in the Sawo-Lahewa MCA. Conserving mangroves within a conservation area cannot be accomplished by a single actor alone; rather, the effort requires an accommodating approach from relevant parties both within and outside the conservation area to facilitate a multi-use, multi-actor management framework (Mahardika *et al.* 2022; Guaman-Quintanilla *et al.* 2023).

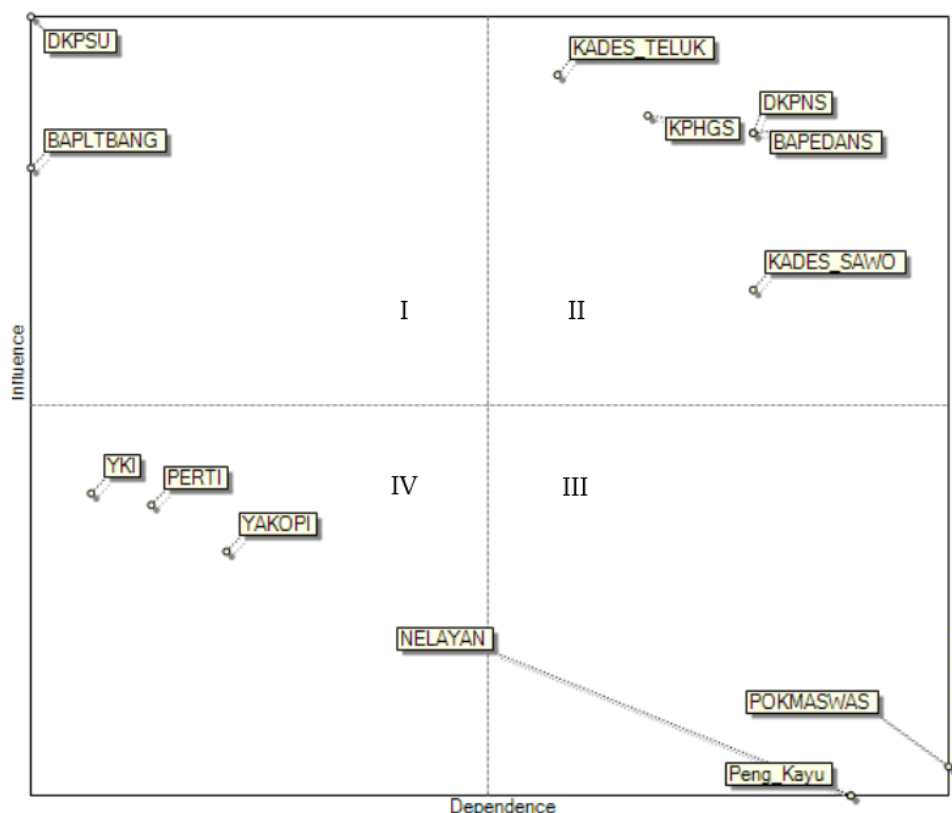


Figure 2. Influence and dependence among actors based on MACTOR analysis results.

Description:

1. Quadrant I consists of actors capable of influencing the objectives of other actors.
2. Quadrant II consists of actors considered unstable and highly sensitive to the presence of other actors.
3. Quadrant III consists of actors dependent on changes in other actors.
4. Quadrant IV consists of actors not directly linked to other actors.

Figure 3 illustrates that the level of convergence among the actors can be gauged by the thickness of the connecting lines shown in the matrix; the North Sumatra DKP and the North Sumatra Provincial BAPPERIDA exhibit the strongest level of convergence. This implies that if both actors commit to collaboration and coordination, there is a high probability of successfully managing the mangrove ecosystem. Furthermore, this requires policy support that avoids overlaps, as well as joint planning implemented by both actors (Lestari *et al.* 2024).

Analysis of the influence of actors in achieving mangrove management objectives in the Sawo-Lahewa Marine Conservation Area (MCA)

The roles of actors in determining stances regarding mangrove management in the Sawo-MCA can be assessed using the Matrix of Actors and Objectives (3MAO), with a value range of -6 to 6 for each entry. The 3MAO matrix serves as an input matrix for actor-relationship degrees, assigning positive values (+) to various mangrove management objectives within the Sawo-Lahewa MCA. Table 5 presents the actors' stances regarding these mangrove management objectives.

Based on Table 5, the 3MAO matrix outlines the objectives or strategies for the successful management of the mangrove ecosystem in the Sawo-Lahewa MCA. The values in this matrix account for the level of competition among actors, the hierarchy of objectives, and the degree of support each actor offers for each objective. The magnitude of an actor's support for an objective is indicated by the value itself; conversely, a negative score signifies opposition to the objective, with the magnitude of the negative value reflecting the intensity of that opposition. Formulating a mangrove management action plan for the Sawo-Lahewa MCA is a priority task for various stakeholders, including the North Sumatra Marine Affairs and Fisheries Agency, North Sumatra BAPPERIDA, the Gunungsitoli Forest Management Unit (KPH), the North Nias DKP,

North Nias BAPPEDA, academic institutions, Yayasan Konservasi Indonesia, Yayasan Konservasi Pesisir Indonesia, Community-Based Surveillance Groups (Pokmaswas), and the village governments of Sawo and Teluk Siabang Sisarahili. The development of this mangrove management action plan must align with North Sumatra Governor Regulation Number 22 of 2020 concerning the North Sumatra Sustainable Development Action Plan.

Subsequently, the actors devised strategies to increase revenue from ecosystem services. The North Sumatra DKP exhibited the highest degree of mobilization (score of 42), followed by the North Sumatra Regional Development Planning, Research and Innovation Agency (BAPPERIDA) with a score of 32. This aligns with the DKP's role as the manager of the Sawo-Lahewa Marine Conservation Area and BAPPERIDA's role in evaluating the DKP's contribution to implementing Sustainable Development Goal programs. The DKP's role in managing the 12-nautical-mile marine zone and mangrove ecosystems, specifically regarding coastal ecosystem protection and rehabilitation activities, is stipulated in Law Number 23 of 2014 concerning Regional Government.

Based on the actor scale in the MACTOR analysis, the only actors who disagreed with formulating a mangrove management action plan were those from the community involved in the timber forest product business, specifically community groups utilizing the forest for timber products such as charcoal and building foundation materials (as shown in Figure 4).

Figure 4 presents the number of disagreements; negative values indicate that the community members utilizing mangrove wood do not agree with the objectives of rehabilitation activities, the implementation of oversight, or the establishment of conservation partnerships. This disagreement stems from timber-based business actors who rely on the mangrove ecosystem for wood harvesting. The proximity between strategies is depicted in red, indicating a stronger connection than that shown in blue. This graph also illustrates scenarios where actors adopt the same stance whether in support or opposition (Mangifera and Isa 2019), as shown in Figure 5.

As shown in Figure 5, the mangrove management action plan strategy is closely linked to optimizing community participation in sustainable mangrove management. Formulating regulations and action plans is essential to prevent management overlaps and to enhance mangrove conservation efforts, with the long-term goal of reducing carbon emissions (Mursyid *et al.* 2021). In addition to developing

action plans, it is necessary to optimize the protection of mangrove habitats with high carbon value and to consider vegetation stand structure and species suitability for reforestation activities within the management area (Feng *et al.* 2024). Policy formulation

for mangrove ecosystem management in the study area should be based on comprehensive planning that actively engages key stakeholders, particularly within local governments at both the North Sumatra Provincial and North Nias Regency levels to serve as driving forces.

Table 4. Matrix of convergence and divergence levels among actors in mangrove management in the Sawo-Lahewa Marine Conservation Area.

Convergence/ Divergence	BAPLTBANG	DKPSU	KPHGS	DKPNS	BAPEDANS	PERTI	YKI	YAKOPI	POKMASWAS	KADES_SAWO	KADES_TELUK	NELAYAN	Peng_Kayu
BAPLTBANG	0	6	6	6	6	6	6	6	6	6	6	4	1
DKPSU	6	0	6	6	6	6	6	6	6	6	6	4	1
KPHGS	6	6	0	6	6	6	6	6	6	6	6	4	1
DKPNS	6	6	6	0	6	6	6	6	6	6	6	4	1
BAPEDANS	6	6	6	6	0	6	6	6	6	6	6	4	1
PERTI	6	6	6	6	6	0	6	6	6	6	6	4	1
YKI	6	6	6	6	6	6	0	6	6	6	6	4	1
YAKOPI	6	6	6	6	6	6	6	0	6	6	6	4	1
POKMASWAS	6	6	6	6	6	6	6	6	0	6	6	4	1
KADES_SAWO	6	6	6	6	6	6	6	6	6	0	6	4	1
KADES_TELUK	6	6	6	6	6	6	6	6	6	6	0	4	1
NELAYAN	4	4	4	4	4	4	4	4	4	4	4	0	1
Peng_Kayu	1	1	1	1	1	1	1	1	1	1	1	1	0
Number of convergences	65	65	65	65	65	65	65	65	65	65	65	45	12

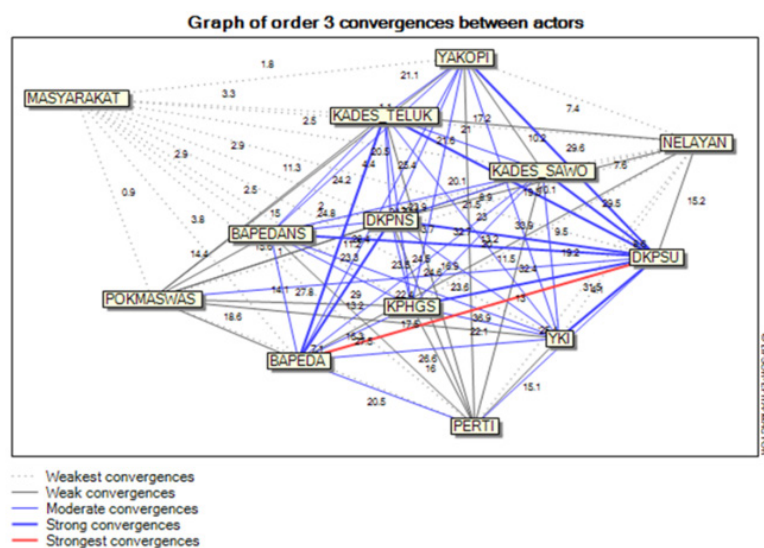


Figure 3. Convergence among actors in mangrove management in the Sawo-Lahewa Marine Conservation Area.

Table 5. Actors' attitudes towards mangrove management objectives in the Sawo-Lahewa Marine Conservation Area.

3MAO	RAN_AKSI	Funding	Rehabilita- tion	Monitoring	Partner	Income	Mobilization
BAPLTBANG	6	6	5	3	5	6	32
DKPSU	8	8	6	8	6	8	42
KPHGS	5	3	4	5	3	4	23
DKPNS	5	5	4	5	4	5	26
BAPEDANS	5	5	4	2	4	5	24
PERTI	4	1	2	1	1	1	9
YKI	4	4	3	4	4	3	21
YAKOPI	3	3	2	3	3	2	17
POKMASWAS	1	1	1	1	1	1	5
KADES_SAWO (Village head-Sawo)	4	2	2	4	2	4	17
KADES_TELUK (Village head-Teluk)	6	3	3	6	3	6	25
NELAYAN (Fisherman)	0	0	1	1	1	1	4
Peng_Kayu	-1	0	-1	-1	-1	1	5
Number of agreements	49	39	35	43	34	46	
Number of disagreements	-1	0	-1	-1	-1	0	
Degree of mobilization	50	39	36	44	35	46	

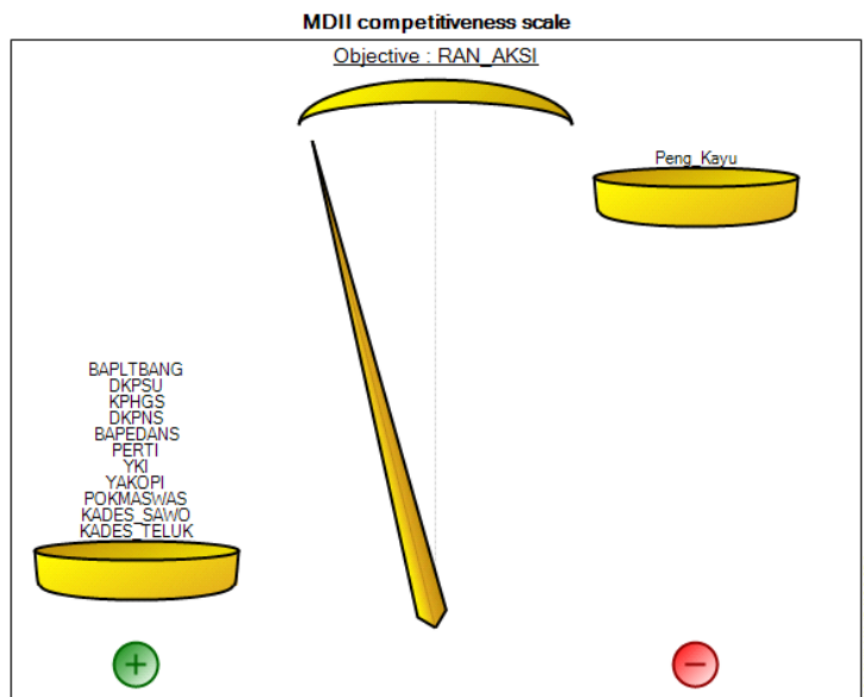


Figure 4. Scale of stakeholder roles in mangrove management in the Sawo-Lahewa Marine Conservation Area.

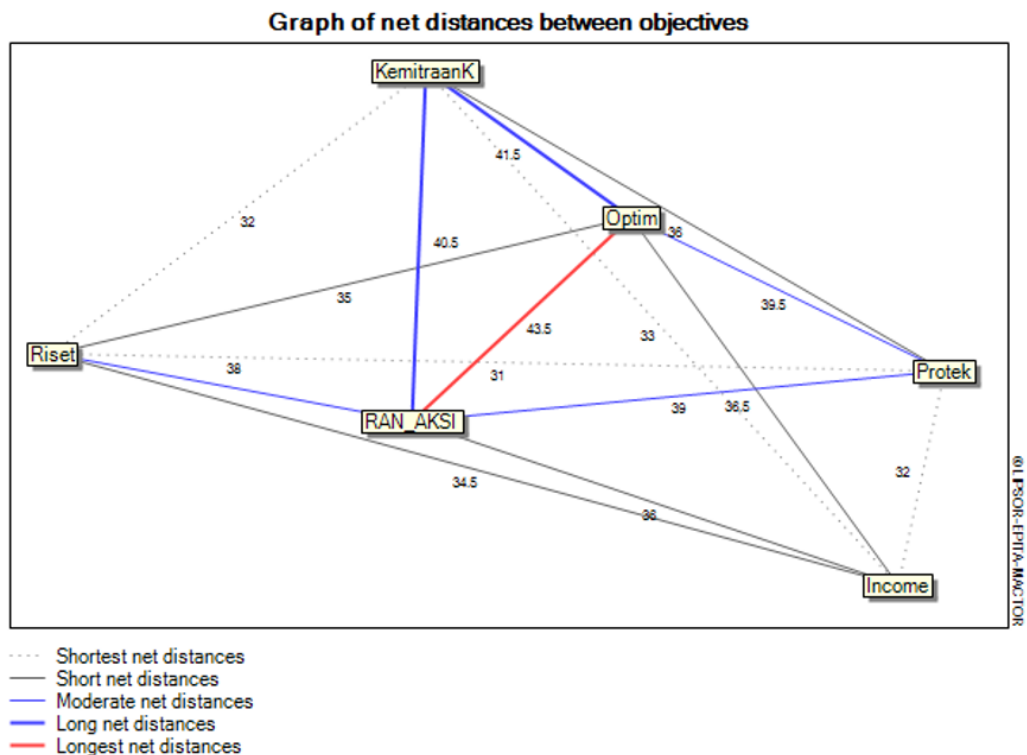


Figure 5. Graph of distances between strategies for mangrove ecosystem area management in the Sawo-Lahewa Marine Conservation Area.

CONCLUSION

The stakeholder mapping for mangrove ecosystem management in the Sawo-Lahewa Marine Conservation Area (MCA) was conducted by analyzing the influence and interdependence among the various actors and agencies involved. The North Sumatra Marine Affairs and Fisheries Agency and the North Sumatra Regional Development Planning, Research, and Innovation Agency (BAPPERIDA) are key actors exerting significant influence on mangrove ecosystem management. Meanwhile, the primary management objectives, specifically the formulation of regulations and action plans for mangrove carbon management in the Sawo-Lahewa MCA and the enhancement of revenue from ecosystem services, involve a wide range of active stakeholders.

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