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# Inter-Regional Cooperation for Sustainable Mangrove Management in Jakarta Bay

**R. Budiono Subambang** [1], **Ario Damar** [2], **Taryono** [3], **Rahmat Kurnia** [4], **Dietriech G. Bengen** [5]

[1, 2, 3, 4]Coastal and Marine Resources Management Study Program, Faculty of Fisheries and Marine Sciences, Department of Aquatic Resources Management, IPB University, Bogor, Indonesia

[2]Center for Coastal and Marine Resources Studies (PKSPL), Bogor, Indonesia

[5]Department of Marine Science and Technology, Faculty of Fisheries and Marine Science, IPB University, Bogor, Indonesia

budionosubambang@apps.ipb.ac.id

**Abstract:** An integrated institutional approach is expected to be a solution to overcome this policy fragmentation. With integrated mangrove management across jurisdictions, it can be clearer to maintain the sustainability of the mangrove ecosystem while supporting sustainable development in the coastal area of Jakarta Bay. This study aims to develop an ideal inter-jurisdictional institutional framework for mangrove management in Jakarta Bay. The study used primary and secondary data. Data analysis uses stakeholder analysis, multidimensional scaling (MDS), and interpretive structural modeling (ISM). The results of the stakeholder classification showed that local communities occupy the subject category, the key players are the central government and regional governments, universities and NGOs occupy the context setter position, and the crowded category is the private sector. The results of the MDS analysis using RAP Mangrove show a sustainability index value for the institutional dimension of 11.59%. The institutional design of the three elements, which are divided into 11 sub-elements, shows that the availability of adequate data and planning for the implementation of mangrove rehabilitation, restoring mangrove ecosystems in damaged conditions, improving the quality of degraded mangrove cover and ponds, and mangrove rehabilitation at the multi-strata government policy and program level (multi-related sectors, regional government, and village government) are the basis for the achievement of the other sub-elements. Synchronization of regulations and policies across sectors, as well as active participation from various stakeholders, are the keys to success in maintaining the sustainability of mangrove ecosystems.

**Keywords:** Mangrove; Inter-Regional Cooperation; Inter-Jurisdictional.

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## 1. Introduction

Mangrove ecosystems play an important role in maintaining the balance of the coastal environment, protecting the coastline from abrasion, providing habitat for various flora and fauna, and supporting the resilience of coastal communities (Hamza et al., 2024). The mangrove ecosystem in Jakarta Bay, which is located between three provinces and three city districts, namely DKI Jakarta (North Jakarta Administrative City), West Java (Bekasi Regency), and Banten (Tangerang Regency), This area faces various challenges originating from human activities, such as coastal urbanization, pollution, and land conversion (Sofian et al., 2020). The ecosystem degradation is alarming, with approximately 60% of mangroves in Jakarta Bay categorized as damaged or severely degraded, leading to increased vulnerability to flooding, loss of biodiversity, and declining livelihoods for communities reliant on mangrove resources (Mahardika et al., 2023).

Therefore, mangrove management is a crucial issue in maintaining the ecosystem's sustainability and the community's welfare around Jakarta Bay, thus requiring a holistic and cross-jurisdictional ecosystem management approach. The main challenge in managing the mangrove ecosystem in Jakarta Bay is the lack of synchronization of regulations, policies, and management practices among the various levels of government and agencies involved. This situation creates fragmentation in handling mangrove ecosystem problems that require cross-sectoral and cross-regional synergy (Kustanti, 2019).

The institutional management of mangroves in Jakarta Bay is still sectoral, where several government agencies, such as the Ministry of Environment and Forestry (KLHK), the DKI Jakarta Provincial Government, the West Java Provincial Government, the Banten Provincial Government, and district/city governments, each have different authorities. This institutional fragmentation results in a lack of coordination in implementing mangrove conservation and rehabilitation policies (Mursyid et al., 2021). Inter-jurisdictional coordination between the central and regional governments is important to ensure effective and sustainable mangrove management (Salminah & Alviya, 2019).

The main challenge in mangrove management in Jakarta Bay is the lack of policy integration between local governments and related ministries. National programs, such as those led by BRGM, emphasize restoration. At the same time, regional governments prioritize divergent objectives—urban infrastructure in DKI Jakarta, aquaculture in West Java, and tourism in Banten—resulting in fragmented planning and resource allocation. This fragmentation stems from overlapping mandates, limited coordination mechanisms, and misaligned budgets, leading to inefficient resource use, conflicting land-use priorities, and inconsistent enforcement of conservation rules. An integrated institutional approach is essential to harmonize policies, align priorities, and clarify agency roles, ensuring the sustainability of mangrove ecosystems while supporting cohesive coastal development. In addition, differences in development priorities in each region are also a factor that complicates cross-jurisdictional management (Mahardika et al., 2023). An integrated institutional approach is expected to be a solution to overcome this policy fragmentation. With integrated mangrove management across jurisdictions, it is hoped that the role of each agency can be clearer in maintaining the sustainability of the mangrove ecosystem while supporting sustainable development in the coastal area of Jakarta Bay (Salminah & Alviya, 2019).

Good coordination between the central government, provinces, districts/cities, and local communities will be the key to the success of optimal mangrove

management. The synergy between stakeholders is important in overcoming various challenges, ranging from law enforcement to ecosystem rehabilitation to providing incentives for communities involved in mangrove conservation (Mahardika et al., 2023). In addition, it is important to strengthen the institutional capacity of mangrove management by involving the private sector, civil society organizations, and local communities. Active participation from various parties will enrich the management approach that is adaptive, responsive to environmental changes, and socially and economically sustainable (Mursyid et al., 2021).

Mangrove management in Jakarta Bay is not only the government's responsibility but also requires the involvement of various cross-sectoral actors. By building an inclusive and collaborative institutional framework, it is hoped that the mangrove ecosystem in this area can recover and provide benefits to all parties who depend on it. Therefore, this study aims to develop an ideal inter-jurisdictional institutional framework for mangrove management in Jakarta Bay. We present a novel contribution by developing an inter-jurisdictional institutional framework tailored to address these challenges. This research emphasizes collaborative governance, unlike prior studies, which primarily examine mangrove management through ecological or sectoral lenses (Mahardika et al., 2022; Muzani, 2014). It integrates stakeholder analysis, multidimensional scaling, and interpretive structural modeling to identify and optimize the roles of key actors, including local communities, private sectors, and NGOs. The stakeholder classification reveals that while the central government and regional governments are pivotal players, collaboration with community and academic stakeholders is critical for long-term success.

## 2. Methods

### 2.1. Research Location

This research was conducted in the mangrove ecosystem area of Jakarta Bay. The selection of the research location was based on several facts: that part of Jakarta Bay is an area with coastal or water characteristics with various potentials and complex problems in utilizing natural resources, especially concerning the trade-off between community interests and ecological preservation. In addition, Jakarta Bay consists of


**Figure 1.** Research Location in Jakarta Bay

three provinces and three regencies/cities, namely Banten Province—Tangerang Regency, DK Jakarta Province—North Jakarta Administrative City, and West Java Province—Bekasi Regency (Figure 1).

## 2.2. Data Collection and Analysis

This study uses secondary data and primary data. Primary data comes from direct observations in the field, interview results, and focus group discussion (FGD) results from selected respondents. The interview respondents selected in this study were stakeholders in mangrove ecosystem management in Jakarta Bay, consisting of elements of both central and regional government (23 respondents), academics (1 respondent), private sectors (2 respondents), local community (30 respondents), and other stakeholders such as NGOs and community (3 respondents). Interview guidelines guide the interview process. Meanwhile, secondary data is obtained from publications from the Central Statistics Agency (BPS), related ministries and institutions, such as Bappenas, the Ministry of Marine Affairs and Fisheries, the Ministry of Home Affairs, related provincial and regency/city governments, research results, and scientific journals.

Data analysis uses stakeholder analysis, multidimensional scaling (MDS), and interpretive structural modeling (ISM). The stakeholder analysis method consists of several stages: first, stakeholder identification, where Reed et al. (2009) provide guidelines or stages for identifying stakeholders, namely a list of stakeholders, stakeholder influence, and participation opportunities. Second, an analysis of the main institutional tasks and functions is carried out to explore how stakeholders, in this case, government organizations, carry out their rights and responsibilities based on their duties and identify overlapping main tasks in the mangrove ecosystem management aspect. Third is stakeholder categorization, where stakeholders are classified based on their position in mangrove management in accordance with the criteria developed by Reed et al. (2009). These criteria include:

a. Stakeholder subject, a high level of interest and low influence.
b. Stakeholder key player, a high level of interest and influence on a phenomenon.
c. Stakeholder context setter, a low interest and high influence.
d. Stakeholder crowd, a low level of interest and low influence.

Scoring using assessment guidelines through questions to measure the level of stakeholder influence and interest modifies the five-level data measurement.

The Multidimensional Scaling Analysis (MDS) method is used to analyze the condition of sustainable mangrove ecosystem management on the coast of Jakarta Bay. MDS is a multivariate analysis that shows the relationship between several objects in a multidimensional space based on the respondent's similarity assessment. MDS is used to determine interdependence relationships or interdependencies between variables or data. This relationship is known by comparing each object's variables using a perceptual or configuration map.

Sustainability analysis is expressed in a sustainability index with the following stages: (1) determining the attributes of the mangrove ecosystem area in institutional dimensions with a total of 8 attributes (based on Haris et al., 2021; Khairuddin et al., 2016; Muhsimin, 2018); (2) assessing each attribute on an ordinal scale from the sustainability criteria for each dimension; and (3) determining the management sustainability index values, which have a value range of 0 (bad) to 100 (good), which are arranged into four categories as presented in Table 1 (Fauzi & Anna, 2005).

**Table 1.** The Range Index Value of Sustainability in MDS Analysis

| No. | Range Value | Sustainability status |
|---|---|---|
| 1 | 0-25 | Not sustainable |
| 2 | 26-50 | Less sustainable |
| 3 | 51-75 | Moderately sustainable |
| 4 | 76-100 | Sustainable |

Changes in the root mean square ordination, especially on the x-axis or sustainability scale, show the influence of each attribute. Monte Carlo analysis evaluates the influence of errors in estimating the ordination value of mangrove management.

Mangrove management has complex and dynamic characteristics. Therefore, one approach to solving effective problems is with a system approach, namely interpretive structural modeling (ISM), a tool for strategic planning that involves broad links from various institutions. The ISM technique is divided into the hierarchy arrangement and the classification of sub-elements. The basic principle is the identification of structures within the system effectively for good decision-making (Watson, 1978). The steps of the ISM technique are as follows: 1). Identify elements relevant to the problem or issue that can be done through a survey; 2). Determine the contextual relationship between elements, especially the pair of elements to be tested; 3). Compile a Structural Self-Interaction (SSIM) of elements that show the pairwise relationship between system elements; 4). Transform the SSIM into a binary reachability matrix (RM) and test whether the matrix is transitive. The transitivity of contextual relationships is a basic assumption in ISM, which states that if element A is related to element B and B is related to C, then A is related to C; 5). Create parties from the Reachability matrix (RM) into various levels; 6). A directional graph is created based on the relationships arranged in the Reachability matrix (RM), and transitive links are removed; 7). Convert the graph into an ISM-based model by changing elements with statements; 8). Review the model to test for conceptual inconsistencies and make modifications as necessary.

The hierarchical arrangement of a system is needed to explain the understanding of the problem being analyzed. Each program element being studied is described in the form of sub-elements. Then, the contextual relationship between sub-elements is determined, which has a direction in the terminology of subordinates, leading to a pairwise comparison. Pairwise comparisons that describe the relationship between sub-elements or the presence or absence of contextual relationships are carried out by experts in the field of mangroves. If there is more than one expert, an averaging must be carried out. The assessment of contextual relationships in the pairwise comparison matrix uses the symbol:

$$V \text{ if } e_{ij} = 1 \text{ and } e_{ji} = 0;\ X \text{ if } e_{ij} = 1 \text{ and } e_{ji} = 1;\ A \text{ if } e_{ij} = 0 \text{ and } e_{ji} = 1;\ O \text{ if } e_{ij} = 0 \text{ and } e_{ji}$$

The definition of $e_{ij}$ value = 1 is that there is a contextual relationship between the 1st and $j_{th}$ sub-elements, while the $e_{ij}$ value = 0 is that there is no contextual relationship between the 1st and $j_{th}$ sub-elements. The assessment results above are arranged in a structural interaction or self-interaction matrix (SSIM). Furthermore, the SSIM value is made as a reachability matrix (RM) table by replacing V, A, X, and O with numbers 1 and 0. The results of the ISM analysis describe the position and relationship of institutions in the mangrove management process, outlined in the driver power matrix and the structural diagram of institutional functions. The DP-D matrix (driver power dependence), describes the classification of sub-elements into 4 (four) categories, namely:

1. Quadrant 1: weak driver-dependent variables (autonomous). Institutions in an autonomous position have weak influence and low levels of interconnectedness with other institutions. Sub-elements that enter sector 1 if the DP value ≤ 0,5 X and the D value ≤ 0.5 X.
2. Quadrant 2: weak driver-strongly dependent variables (dependent). Institutions in a dependent position have weak influence and a high level of interconnectedness with other institutions. Sub-elements included in this sector are generally not free. Sub-elements are included in sector 2 if the DP value ≤ 0,5 X and the D value ≤ 0,5 X.
3. Quadrant 3: strong driver-weak dependent variables (linkage). Institutions in the linkage position have strong influence and a high level of connection with other institutions. Sub-elements included in this sector must be studied more deeply because the relationship between sub-elements is unstable. Every action on a sub-element will have an impact on other sub-elements, and the feedback effect increases the impact. Sub-elements are included in sector 3 if the DP value > 0,5 X and the D value ≤ 0,5 X.
4. Quadrant 4: strong driver-weak dependent variables (independent). Institutions that are in an independent position have strong influence and low levels of connection with other institutions. Sub-elements that fall into category 4 are the remainder of the system and are independent variables. Sub-elements that fall into this sector are generally not related to the system. Sub-elements fall into sector 4 if the DP value > 0,5 X and the D value ≤ 0,5 X.

## 3. Results and Discussion

### 3.1. The Institution Conditions of Mangrove Ecosystem Management

The coastal region of Jakarta Bay spans three administrative areas across provincial and district/city governments. These areas include Banten Province with Tangerang Regency, DKI Jakarta Province with North Jakarta Administrative City, and West Java Province with Bekasi Regency. Based on the findings from field observations,

**Table 2.** Findings From the Institutional Investigation Into Mangrove Ecosystem Management in the Coastal Area of Jakarta Bay

| Grouping of Stakeholders | Institutional |
|---|---|
| Central Government | Ministry of Environment and Forestry (MKLHK); Ministry of Marine Affairs and Fisheries (MKP); Peatland and Mangrove Restoration Agency (BRGM); Coordinating Ministry for Maritime and Investment Affairs (MARVEST); Coordinating Ministry for Economic Affairs (MENEKON); Ministry of Villages, Development of Disadvantaged Regions, and Transmigration (MENDESA); Ministry of National Development Planning/National Development Planning Agency (MBAPPENAS); Ministry of Home Affairs (MENDAGRI); Ministry of Tourism and Creative Economy (MREKRAF); Ministry State-Owned Enterprises (MBUMN); BRIN; and BIG. |
| Local Government | • Banten Province and Tangerang Regency:<br>Regional secretariat of Banten Province; Environment and Forestry Agency of Provincial and Regency; Provincial Maritime Affairs and Fisheries Agency; BAPPEDA of Provincial and Regency.<br>• DKI Jakarta Province and North Jakarta City:<br>Regional secretariat of DKI Jakarta Province; Parks and Urban Forest Agency of Provincial and City; BAPPEDA of Provincial and City; Food Security, Marine Affairs and Agriculture Agency of Provincial and City; Provincial Environment Agency; Naval Main Base III Jakarta; BKSDA DKI Jakarta Province; Citarum-Ciliwung River Watershed Management and Protected Forest Center; North Jakarta City Administration.<br>• West Java Province and Bekasi Regency:<br>Regional secretariat of West Java Province; Forestry Agency; BAPPEDA of Provincial; Public Company of Perhutani Regional Division of West Java and Banten; Marine Affairs and Fisheries Agency of West Java Province; BKSDA West Java Province; Regional Agrarian and Spatial Planning Office/National Land Agency (ATR/BPN) West Java Province; BPDASHL Citarum-Ciliwung; BPDASHL Cimanuk-Citanduy. |
| Private Sector | PT Asianagro Agungjaya |
| Local Community | Forest Farmers Group, Pond Farmers Group, and Fishermen's Group |
| Other Stakeholders | • College: ITB, IPB, UNPAD, UNSOED.<br>• Non-Government Organization: Lestari Mangrove dan Alam (LEVA), Komunitas Mangrove Muara Angke (KOMMA), Lindungi Hutan. |

interviews, and focus group discussions aimed at identifying the institutional management of mangrove ecosystems along the Jakarta Bay coast, the details are summarized in Table 2. This table reveals that each stakeholder has different interests and levels of influence concerning the mangrove area. The degree of influence reflects each stakeholder's ability to affect the success of mangrove ecosystem management in Jakarta Bay.

Based on Table 2, each stakeholder has varying interests and influences on the mangrove area. This level of influence indicates the ability of stakeholders to determine the success of mangrove ecosystem management in Jakarta Bay. Table 3 is also based on the Decree on the establishment of national and regional mangrove working groups, which is based on the Decree of the Coordinating Minister for Maritime Affairs and Investment No. 88 of 2022 concerning the National Mangrove Ecosystem Management Working Group; Decree of the Governor of Banten No. 522.75.05/Kep. 81-Huk/2019 concerning the Establishment of the Banten Province Mangrove Working Group; Decree of the Governor of DKI Jakarta No. 429 of 2023 concerning the DKI Jakarta Province Mangrove Working Group 2023-2026; and Decree of the Governor of West Java No. 522.4/Kep.293-Rek/2022 concerning Amendments to the Decree of the Governor of West Java No. 522.4/Kep. 594-DISHUT/2013 concerning mangrove and Coastal Ecosystem Management. It's a key policy that impacts mangrove management.

Central government agencies, including the Ministry of Environment and Forestry (KLHK), the Peatland and Mangrove Restoration Agency (BRGM), and BAPPENAS, provide essential frameworks, technical guidance, and funding for mangrove management. However, fragmented coordination among ministries, such as overlapping mandates between KLHK and the Ministry of Marine Affairs and Fisheries (KKP), creates inefficiencies in policy implementation and hinders cross-regional initiatives. Similarly, local governments face the challenge of balancing mangrove conservation with urban development pressures, particularly in rapidly urbanizing areas like DKI Jakarta, where land-use conflicts often arise.

The private sector, such as PT Asianagro Agungjaya, provides resources for mangrove projects but can also contribute to land-use pressures. Community groups, including forest and pond farmers, are vital for local conservation but often lack institutional support and integration into governance frameworks. NGOs and academic institutions, such as LEVA, IPB, and ITB, offer expertise and advocacy but require stronger collaboration with government-led initiatives to ensure their contributions are effectively aligned with broader conservation goals.

The results of the general identification indicate that the mangrove management institutions along the coast of Jakarta Bay include central and regional government organizations, the business and private sectors, local communities, and other stakeholders, totaling 33 institutions. Reed et al. (2009) categorized these institutions into four groups based on their interests and influence: stakeholder subjects, key players, context setters, and crowds. This classification is based on their interest, involvement, and impact on mangrove management in the Jakarta Bay area. The institutions were analyzed and categorized according to the framework of Reed et al. (2009), and their positions were plotted on a quadrant matrix to identify subjects, key players, context setters, and crowds. This matrix helps to identify which institutions can collaborate and which may face challenges in their activities. Figure 2 illustrates the institutional positioning.

In quadrant A (subjects), institutions are characterized by a high level of interest but a low level of influence. These stakeholders may have limited capacity to achieve

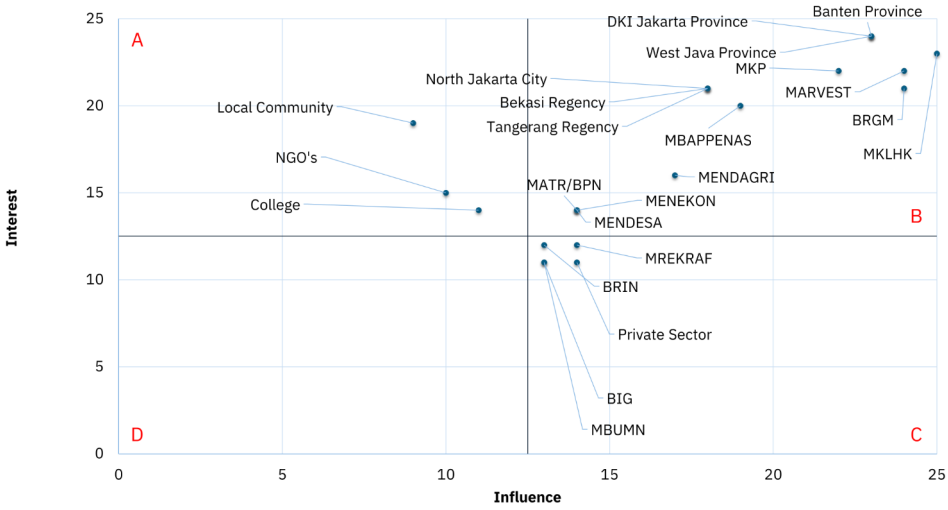


Figure 2. Interest and Influence Matrix

goals but can play a significant role in forming alliances with other stakeholders (Reed et al., 2009). They are often very supportive, necessitating strong relationships with them (Gardner et al., 1986). This quadrant includes local communities, universities, NGOs, and community groups, all significantly impacted. Enhancing their capacity and raising awareness about the importance of the mangrove ecosystem as a vital support system is essential for their involvement in mangrove management in Jakarta Bay. Local communities, which are the focus of mangrove rehabilitation programs, include forest farmer groups, fish farmer groups, and fishermen, coordinated by the village government to implement ecosystem management at the local level. Universities can bolster the efforts of government organizations and communities by providing scientific and technological support for effective mangrove ecosystem management. NGOs and local communities are expected to contribute to the success of rehabilitation programs, aligning with established management objectives and procedures.

Due to their high interest and influence, Quadrant B (key players) comprises central and local governments, the most critical stakeholders. This quadrant includes numerous institutions, such as central ministries and provincial and district/city governments, making them vital for managing the coastal ecosystem of Jakarta Bay. Stakeholders in this quadrant serve as regulators, facilitators for coordination among stakeholders, and implementers at the local level.

Quadrant C (context setters) consists of several central ministries or institutions, such as the Ministry of Tourism and Creative Economy, the Ministry of State-Owned Enterprises, BRIN, and BIG, along with private sector representatives, who have a low level of interest but a high level of influence. While these stakeholders tend to be passive, they can become key players in response to certain events (Gardner et al., 1986). Ministries like the Ministry of Tourism and Creative Economy and others generally provide policy recommendations with supporting data, oversee research, coordinate monitoring and evaluation, update the National Mangrove Map, and establish standards and success indicators for mangrove rehabilitation. Maintaining good relations and ensuring these stakeholders access the necessary information is crucial for their active participation (Nafi'ah, 2022; Wirawan et al., 2018). Quadrant D contains stakeholders with low interest and influence (crowd), but there are currently no stakeholders in this category. While their involvement is not essential for

achieving activity objectives, periodic monitoring and evaluation may be necessary to track any changes in their interests.

## 3.2. Sustainability Status of Mangrove Ecosystem Management Institutions

The MDS analysis results using RAP Mangrove show a sustainability index value of 11.59% for the institutional dimension, which falls under the unsustainable category (Figure 3). Eight indicators were assessed for the sustainability of the institutional dimension, including policies and planning for mangrove ecosystem management, the availability of regulations and roles of non-formal institutions, involvement of community institutions, coordination between institutions or stakeholders, availability of extension workers or field officers, compliance with management rules, sanctions for violators, and monitoring and supervision.

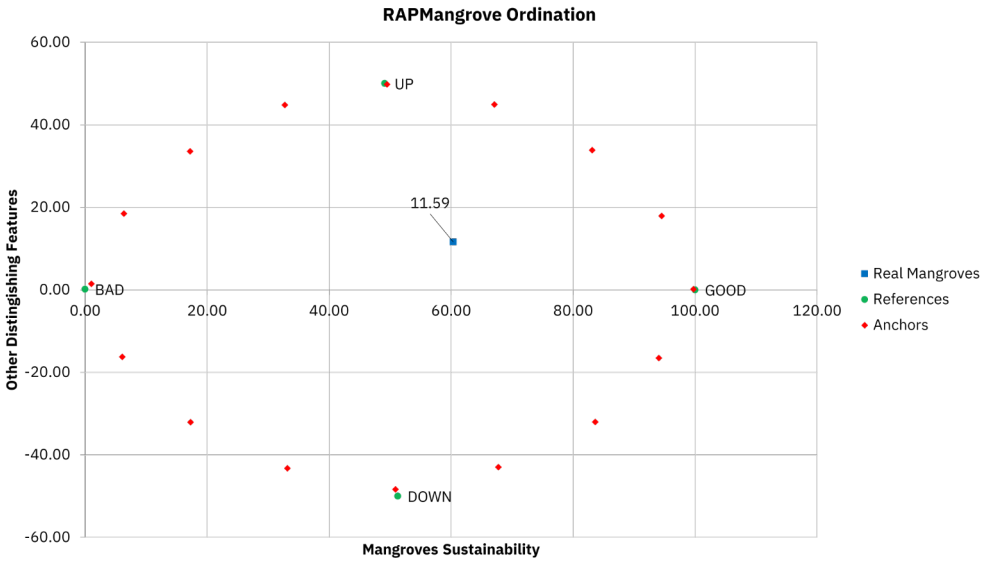


**Figure 3.** Sustainability Index Value of Mangrove Ecosystem Management Institutions

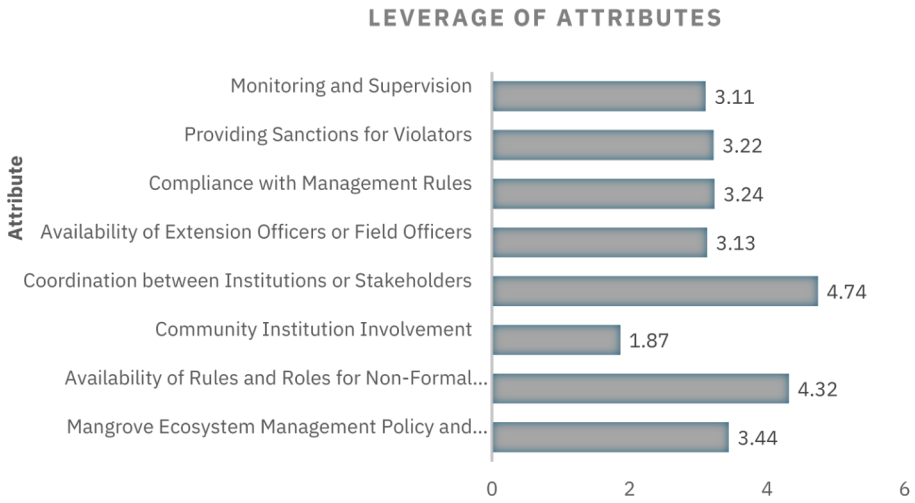


**Figure 4.** The Results of Leverage Analysis in Mangrove Ecosystem Management Institutions

The leverage analysis results on the institutional dimension indicate three attributes that are sensitive to the sustainability index value of this dimension: coordination between institutions or stakeholders, availability of rules and roles of

non-formal institutions, and policies and planning for mangrove ecosystem management (Figure 4). The high leverage of Inter-Institutional Coordination shows that monitoring, supervision, and policy implementation efforts will be hindered without proper coordination. Collaboration allows various parties to align their goals, share information, and coordinate actions necessary for effective mangrove management.

Other attributes, such as compliance with management rules and monitoring and supervision, also have significant leverage. Collaboration among government agencies, law enforcement, and communities is essential to ensure compliance with rules and minimize violations in mangrove ecosystem management. Without strong collaboration, existing regulations can become ineffective. Comprehensive Policy Planning also shows high leverage, underscoring the importance of inclusive and comprehensive policies. In collaboration theory, effective policies are often the result of a collaborative process in which various stakeholders are involved in planning. By involving all stakeholders, the resulting policies are more likely to gain broad support and be more relevant to needs on the ground.

Validation of the RAPMangrove analysis results shows that the RSQ determination coefficient value (R2) obtained is 0.94 with a stress value of 0.15. The analysis results are quite adequate if the stress value is less than 0.25 and the determination coefficient value (R2) approaches the value of 1 (Fauzi & Anna, 2005).

## 3.3. Ideal Condition for Institutional Management of the Mangrove Ecosystem in Jakarta Bay

Based on the findings of the focus group discussions and interviews, three factors were chosen to be evaluated to create the best mangrove ecosystem management institutions in Jakarta Bay. The first element, the fulfillment of enabling conditions, has four sub-elements, and the second element, the implementation of actions, has three sub-elements. Meanwhile, the sustainability strategy has four sub-elements in the third element (Table 3).

Contextual relationships between sub-elements in fulfilling enabling conditions contribute to achieving other sub-elements. Based on analysis using interpretive structural modeling (ISM), the element structure of fulfilling enabling conditions can

**Table 3.** Element and Sub-elements of Mangrove Ecosystem Management

| No. | Element | Code | Sub-element |
|---|---|---|---|
| 1 | Fulfillment of enabling conditions | A1 | Understanding and agreement between institutions in implementation |
| | | A2 | Availability of adequate data and planning for implementation |
| | | A3 | Effective institutions as a forum and means to strengthen regulations, synergistic relationships between institutions, and the smooth implementation of mangrove rehabilitation and management activities at the institutional site level |
| | | A4 | Community empowerment in implementing rehabilitation and management of mangrove ecosystems |
| 2 | Implementation of actions | B1 | Restoration of mangrove ecosystems in damaged conditions |
| | | B2 | Improving the quality of degraded mangrove cover and ponds |
| | | B3 | Saving mangrove ecosystems that are still in good condition and are threatened |
| 3 | Sustainability strategy | C1 | Mangrove rehabilitation at the multi-strata government policy and program level (multisectors-related, regional government, and village government) |
| | | C2 | Mangrove rehabilitation at the forest and land management levels is carried out by those responsible for businesses and activities |
| | | C3 | Development of a silvicultural system for sustainable mangrove forest management within the framework of sustainable forest management |
| | | C4 | Adequate institutions for forest and land management in mangrove ecosystems tend to be open access |

be seen in Figure 5a. The figure explains that the sub-elements of A1 and A2 are the basis for the other two sub-elements. If these two sub-elements are achieved, it is hoped that they can encourage the achievement of the other two sub-elements (A3 and A4). Implementation of action elements is described into three sub-elements, as presented in Table 3.

Interpretation in the form of a hierarchy of ISM analysis results is presented in Figure 5b. The results of these elements consist of two hierarchical levels. The sub-elements B1 and B3 are at level 1 and are the basis of this element. Meanwhile, B2 is at level 2. Interpretation in the form of a hierarchy of ISM analysis results is presented on the sustainability strategy element, which is the last element in the existing institutional model for mangrove ecosystem management (Figure 5c). Level 1, the basis for this element, is occupied by sub-element C1. If viewed according to context, this sub-element certainly plays a very important role in achieving the success of the sustainability strategy element. The figure also explains that sub-element C1 needs to be encouraged and strengthened to support the achievement of sub-elements C2, C4, and C3.


**Figure 5.** Structural Model on Three Elements: a) Fulfillment of Enabling Conditions; b) Implementation of Actions; c) Sustainability Strategy

The classification of sub-elements based on driving power and dependence power values, seen in Figure 6a, places sub-element A2 in the independent quadrant. This shows that sub-element A2 contributes very highly to the element of fulfilling enabling conditions. Sub-elements A1 and A3 occupy the linkage quadrant, indicating that the achievements of other sub-elements greatly influence these sub-elements. Besides that, they also greatly influence the achievements of other sub-elements. Meanwhile, sub-element A4 is in the dependent quadrant, which shows

that the other three sub-elements greatly influence the achievement of this sub-element and have no or little influence on the goals of the other three sub-elements. The results of the sub-element analysis of the element of fulfilling enabling conditions using ISM show that the availability of adequate data and planning for implementing mangrove rehabilitation are the basis for the achievement of other sub-elements.

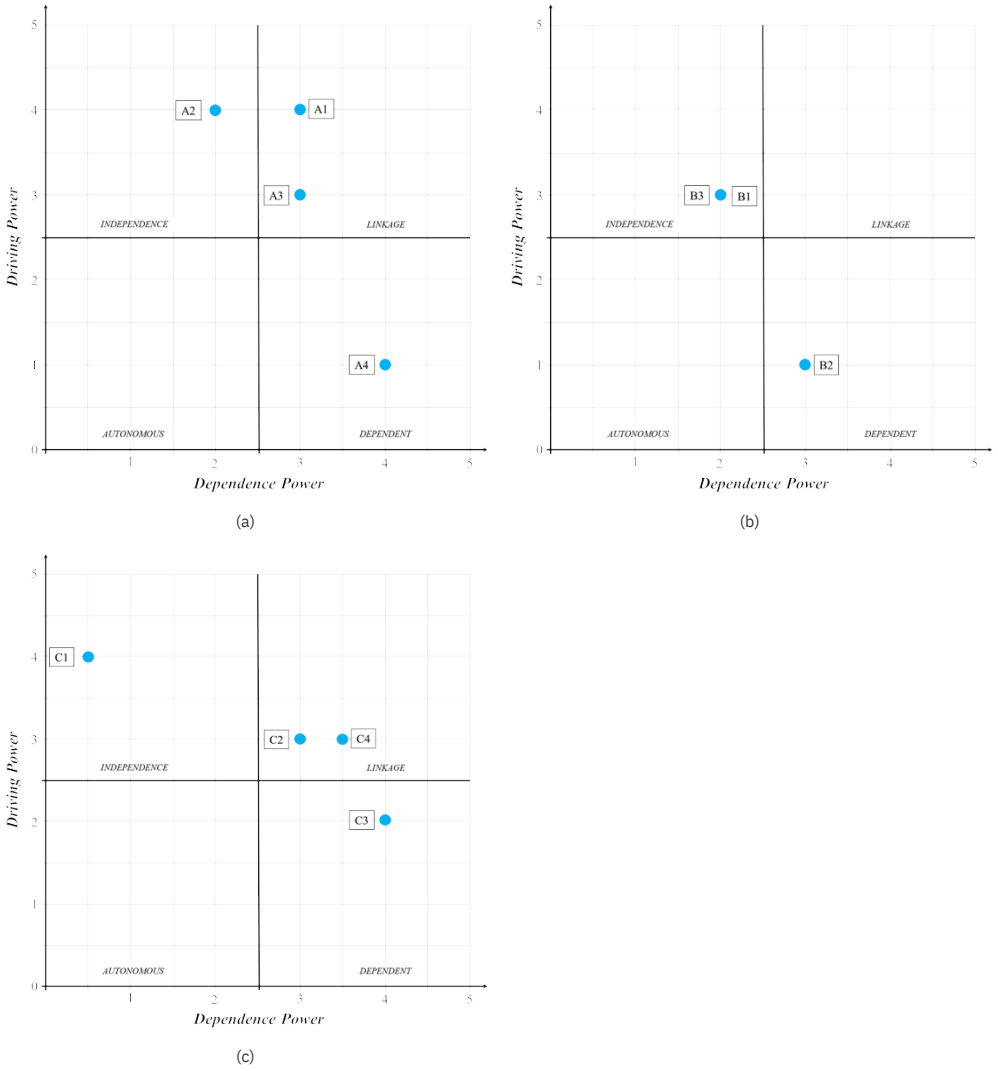


**Figure 6.** Matrix of Driving Power and Dependence Power on Three Elements: a) Fulfillment of Enabling Conditions; b) Implementation of Actions; c) Sustainability Strategy

Grouping sub-elements of action implementation elements into four quadrants: dependent, linkage, independent, and autonomous. In Figure 6b, sub-elements B1 and B3 are in the middle of the y-axis (driving power), which divides the independent and linkage quadrants. This shows that these two sub-elements (B1 and B3) greatly contribute to achieving the action implementation element. Meanwhile, sub-element B2 is in the dependent quadrant, which shows that the other two sub-elements greatly influence the achievement of this sub-element and have no or little influence on the goals of the other two sub-elements. The sub-element analysis of the action implementation element using ISM shows that restoration of mangrove ecosystems in damaged conditions and improving the quality of degraded mangrove cover and ponds are the basis for achieving other sub-elements.

The results of sub-element classification based on driving power and dependence power values can be seen in Figure 6c, which places sub-element C1 in the independent quadrant. This shows that sub-element C1 significantly contributes to achieving the policy strategy element, as shown in Figure 5c. Sub-elements C2 and C4 occupy the linkage quadrant, indicating that the achievements of other sub-elements greatly influence these sub-elements. Besides that, they also greatly influence the achievements of other sub-elements. So, these two sub-elements (C2 and C4) must be carried out seriously and carefully. Meanwhile, sub-element C3 is in the dependent quadrant, which shows that the other three sub-elements greatly influence the achievement of this sub-element and have no or little influence on the goals of the other three sub-elements. The results of the sub-element analysis of the sustainability strategy element using ISM show that mangrove rehabilitation at the multi-strata government policy and program level (multi-related sectors, regional government, and village government) is the basis for the achievement of other sub-elements.

To manage mangrove ecosystems sustainably and improve the welfare of coastal communities, effective policy implementation must be supported by various action plans or strategies formulated based on strategic issues in the concept of sustainable development (Indrawan et al., 2012; Karlina et al., 2016; Kusmana, 2014). Therefore, major challenges in mangrove management must be addressed with specific strategies, and programs must be required as measuring tools to achieve sustainable mangrove management goals.

The successful implementation of strategic decisions is widely considered critical to the achievement of organizational goals and objectives. This applies as much to the public sector as to those in the private sector (Elbanna et al., 2014, 2016). Learning from previous developments in mangrove management regulation in Indonesia, most of the causes of mangrove forest loss can be managed effectively through policy interventions (Friess et al., 2016). Mangrove management policies and regulations have been issued for almost a century. However, these policies and regulations have not been optimally implemented in the field, and mangrove degradation still occurs with little or no compliance with applicable regulations and legislation (Alikodra, 2012; Arifanti et al., 2022; Kordi K., 2012; Salminah & Alviya, 2019). Violations of laws and regulations still occur due to weak law enforcement and inconsistent policies. In addition, unclear policy objectives between government agencies often worsen the situation, resulting in conflicting management decisions. The main challenge lies in the coordination and communication of relevant stakeholders, both those in authority and those affected by the policy (Arifanti et al., 2019; Ilman et al., 2011; Simarmata, 2010).

## 3.4. Inter-Regional Cooperation Regarding Mangrove Ecosystem Management Institutions in Inter-Jurisdictional Areas

Cooperation between regions is important, namely, common interests, where regions with common interests such as natural resources, culture, or economy are more likely to cooperate. Second, there is a desire for mutual benefit, where regional cooperation can benefit all parties involved. Third, the existence of a commitment from the regional government where the elected regional head will bring political promises related to how to develop his region. Fourth, the policy of the central government, where PP No. 28 of 2018 concerning regional cooperation mandates mandatory cooperation and voluntary cooperation (Figure 7).

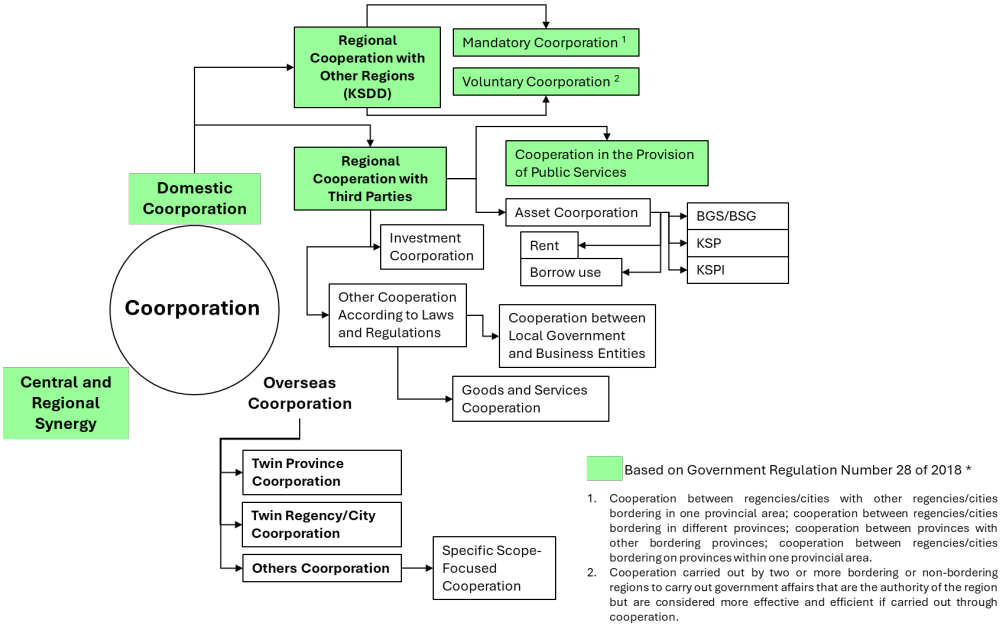


**Figure 7.** Inter-Regional Corporation Based on Government Regulation Number 20 0f 2018

Based on Figure 8, regarding Inter-Regional Cooperation (KSDD), there are two types of cooperation: mandatory and voluntary. In managing mangrove ecosystems in the inter-jurisdictional area of Jakarta Bay, policy instruments for inter-regional cooperation are strategic and crucial. For the mandatory cooperation related to environmental protection, its bordering regions are highly relevant in fulfilling mandatory environmental responsibilities. This includes efforts to protect mangrove ecosystems from degradation and ensure their sustainability through proper management. In this regard, environmental protection becomes a shared responsibility of neighboring regions, requiring synergy between regional governments to effectively and comprehensively implement policies.

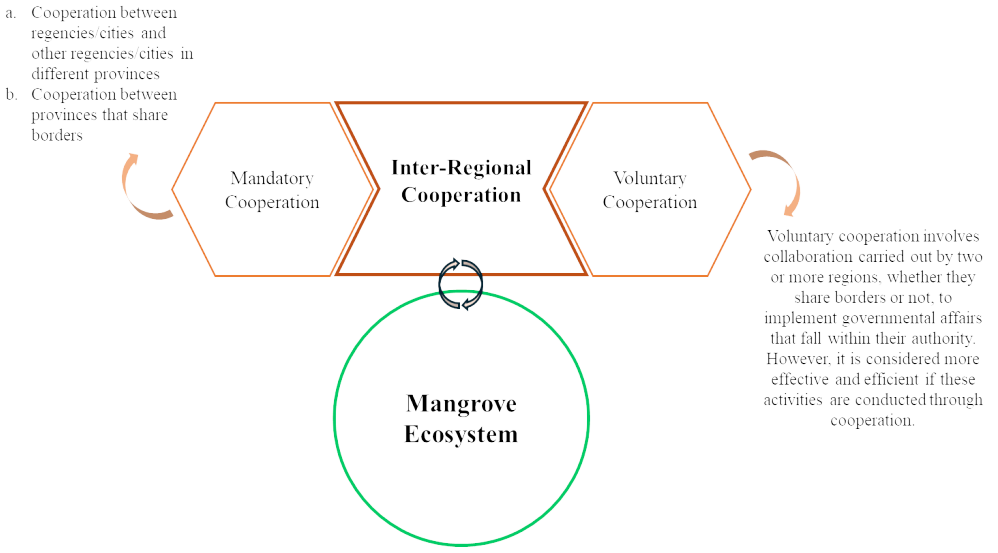


**Figure 8.** Inter-Regional Cooperation (KSDD) in the Context of Managing Mangrove Ecosystems in the Inter-Jurisdictional Area of Jakarta Bay

In Jakarta Bay, the mangrove ecosystem involves several administrative regions (Banten Province, DKI Jakarta, and West Java), each with its respective authority. Inter-regional cooperation in the context of mandatory responsibilities is essential to

maintain an ecological balance that impacts across boundaries, such as pollution control and rehabilitation of degraded mangrove ecosystems.

Voluntary cooperation allows regions, whether bordering or not, to initiate actions to improve and enhance the quality of mangrove ecosystems through activities such as mangrove planting. This authority is considered more effective and efficient when undertaken through inter-regional cooperation, as it involves the combined use of resources, funding, expertise, and technical knowledge. Mangrove planting supports climate change mitigation efforts and strengthens coastal resilience against erosion and flooding, common issues in Jakarta Bay. This voluntary cooperation creates opportunities for regions to innovate and collaborate on a larger scale, ultimately providing ecological and economic benefits to coastal communities.

In addition to mandatory authority related to environmental protection and voluntary authority related to planting, other authorities support the sustainable management of mangrove ecosystems, such as spatial planning, disaster management, and capacity building for local communities. Inter-regional cooperation can help integrate these management aspects to achieve broader goals regarding the sustainability and resilience of mangrove ecosystems. Spatial planning that considers mangrove sustainability and efforts to raise community awareness of the importance of these ecosystems can also be carried out through regional synergy, sharing resources, and information.

Inter-regional cooperation is essential in developing institutional concepts for mangrove ecosystem management. Mangrove ecosystems often cross the administrative boundaries of several regions, so cross-regional coordination is needed. Inter-regional cooperation helps explain how these regions can collectively protect, restore, and manage sustainable ecosystems (Tinambunan, 2022). With inter-regional cooperation, regions can share financial, technical, or human resources to be more efficient in addressing mangrove management challenges. Collaboration allows regions to overcome capacity limitations and create more comprehensive solutions (Harsanto et al., 2015; Nurfindarti, 2019).

Each region may have different policies related to environmental management (Ellison et al., 2020). Inter-regional cooperation emphasizes the importance of policy harmonization so that actions do not conflict and support long-term goals in mangrove ecosystem management (Mahardika et al., 2022). Inter-regional cooperation allows for developing more integrated institutions, which prevent fragmentation in mangrove ecosystem management. A solid institutional mechanism allows coordination between institutions and regions to run more effectively. Effective mangrove management requires an ecosystem-based approach, which includes all areas directly or indirectly affected (Arifanti et al., 2022). The theory of inter-regional cooperation supports this approach by emphasizing the need for holistic management involving all relevant stakeholders.

## 4. Conclusion

This study highlights the critical role of inter-provincial collaboration in managing the mangrove ecosystem in Jakarta Bay, encompassing Banten Province (Tangerang Regency), DKI Jakarta (North Jakarta Administrative City), and West Java Province (Bekasi Regency). The findings reveal that the absence of policy integration across these regions stems from conflicting development priorities, overlapping institutional mandates, and a lack of robust coordination mechanisms. While DKI Jakarta prioritizes urban infrastructure, West Java focuses on aquaculture, and Banten emphasizes tourism, these misaligned objectives have resulted in

fragmented governance, inefficient resource utilization, and inconsistent conservation efforts.

From a theoretical perspective, this research contributes to institutional governance frameworks by emphasizing the importance of ecosystem-based, cross-jurisdictional management for addressing policy fragmentation and enhancing the sustainability of mangrove ecosystems. Practically, the findings underscore the need for harmonized policies, integrated planning, and coordinated budget allocations to align conservation goals across administrative boundaries. Policy implications include the necessity for inclusive frameworks that engage diverse stakeholders, such as government institutions, the private sector, non-governmental organizations (NGOs), academia, and local communities, in a collaborative effort to ensure socio-economic and environmental sustainability.

To improve mangrove management in Jakarta Bay, this study recommends establishing a Regional Mangrove Management Task Force to enhance coordination and accountability among provinces. Key strategies include integrating mangrove management into the RPJMN and RPJMD as performance indicators, developing a unified regional management plan to align conservation with development priorities, and incentivizing collaboration through ecological compensation funds and tax incentives. A centralized monitoring system and co-management frameworks involving local communities are proposed to enhance transparency, enforcement, and stakeholder engagement. These measures aim to create a sustainable, integrated governance model, positioning Jakarta Bay as a benchmark for coastal ecosystem management.

By implementing these targeted strategies, managing mangrove ecosystems in Jakarta Bay can transition toward a more integrated, effective, and sustainable framework. This collaborative approach not only addresses the underlying challenges of policy fragmentation and coordination but also positions Jakarta Bay as a model for sustainable coastal ecosystem governance, contributing to broader environmental preservation and regional development goals.

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