Institutional structure and challenges of internalizing ocean accounting in spatial management at conservation areas

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Abstract. This study examines the institutional structure and challenges of internalizing Ocean Accounting (OA) into Marine Spatial Planning (MSP) within Indonesia's conservation areas, focusing on the interaction between key actors and systemic barriers. Using the Interpretive Structural Modeling (ISM) approach, the research identifies the hierarchical relationships among 13 actor elements and 11 challenge elements derived from expert consultations, policy analysis, and literature review. Results show that national institutions particularly the Ministry of Marine Affairs and Fisheries (KKP), Bappenas, and BPS hold dominant positions as independent drivers, shaping policy direction and data management. However, local agencies, research institutions, and communities remain dependent actors, with limited authority, technical capacity, and access to integrated ocean data systems. The main challenges constraining OA internalization include weak interagency coordination, fragmented data governance, lack of derivative regulations, and low policy literacy regarding OA's application in spatial management. Comparisons with international practices in Australia, the EU, and Norway indicate that successful OA integration depends on synchronized legal mandates, interoperable data frameworks, and institutional incentives for local adoption. The study concludes that effective OA implementation in Indonesia requires phased reforms: strengthening institutional coordination, harmonizing data systems, and embedding OA into marine spatial and fiscal planning frameworks. This research provides a governance roadmap to transform OA from a technical framework into an operational tool for sustainable marine conservation and blue economy development.

Key Words: conservation areas, institutional structure, interpretive structural modeling, marine spatial planning, ocean accounting, policy integration.

Introduction. The management of coastal and marine space in Indonesia remains one of the most complex domains of environmental governance, shaped by overlapping sectoral interests, fragmented authority, and competing socio-economic priorities. Coastal and marine zones are no longer seen merely as ecological frontiers but as strategic economic spaces supporting fisheries, tourism, energy, and maritime transport. This multifunctionality, while offering vast economic potential, also creates institutional and spatial conflicts, particularly in marine conservation areas where ecological sustainability must coexist with economic and community interests. The challenge intensifies as conservation zones are often managed under sectoral mandates with limited coordination mechanisms, leading to fragmented decision-making and inconsistent enforcement (Berkes 2012; Nurhidayah & McIlgorm 2019). Hence,

integrating ecological, social, and economic perspectives through scientifically informed governance frameworks becomes indispensable for ensuring the long-term sustainability of coastal resource use.

Within this context, the Ocean Account (OA) emerges as a transformative approach designed to quantify, value, and monitor the state and use of marine natural capital. OA aligns with the System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA EA) framework promoted by the United Nations, aiming to bridge economic development and ocean sustainability. In Indonesia, however, the OA framework remains at an early stage of institutionalization. While several national initiatives such as Indonesia Ocean Accounts (IOA) and Natural Capital Accounting (NCA) have been piloted by Bappenas, the Ministry of Marine Affairs and Fisheries (KKP), and Statistics Indonesia (BPS), their integration into marine spatial planning (MSP) and conservation management has yet to be achieved (Bappenas 2020; KKP 2021). The current profile of OA in Indonesia reveals fragmented data governance, limited policy adoption, and insufficient cross-sectoral application, especially at subnational levels where marine spatial planns are implemented. This disconnect between accounting frameworks and spatial decision-making represents a significant missed opportunity for evidence-based marine governance.

To dissect the institutional and systemic factors behind these gaps, this research employs the Interpretive Structural Modeling (ISM) approach, an analytical method designed to map interrelationships among complex variables, identify driving and dependent elements, and reveal hierarchical structures within governance systems. ISM is particularly relevant for policy-oriented marine studies because it integrates expert judgment and stakeholder perspectives into a systemic framework that clarifies institutional roles, dependencies, and leverage points. In this study, the ISM approach is combined with expert justification from practitioners, policymakers, and marine governance scholars to identify and structure two key dimensions: (1) the Actor Elements, which define institutional roles, responsibilities, and interactions in the OA internalization process; and (2) the Challenge Elements, which capture structural, technical, financial, and political barriers that inhibit effective OA integration into spatial management of conservation areas (Guerry et al 2015; Cisneros-Montemayor et al 2021). Together, these analytical dimensions illuminate both the institutional architecture and the bottlenecks within Indonesia's ocean governance ecosystem.

The urgency of this research lies in its attempt to systematically connect the emerging OA framework with the operational realities of marine conservation management. While previous studies (Constanza et al 2014; Leenhardt et al 2015; Gentry et al 2017; Asian Develoment Bank 2021; Cisneros-Montemayor et al 2021) have focused on natural capital accounting or marine spatial planning in isolation, few have examined the institutional pathways required to embed OA principles into spatial decision systems (Nurhidayah & McIlgorm 2019). This research thus fills a critical gap by providing an interpretive model that not only identifies who the key actors are but also how their institutional relationships and limitations influence the success of OA internalization. Scientifically, this study contributes to the evolving discourse on blue economy governance, data-driven conservation policy, and sustainable marine resource accounting offering a methodological bridge between environmental economics, governance science, and spatial management.

Accordingly, the main objective of this research is to analyze and structure the institutional elements and challenges influencing the internalization of OA into marine spatial management within Indonesia's conservation areas. Specifically, the study aims to: (1) identify key institutional actors and their hierarchical relationships in OA implementation; (2) examine the critical challenges that impede OA integration across governance levels. By achieving these objectives, the research seeks to provide strategic recommendations for strengthening the institutional foundations of OA implementation ensuring that marine conservation policies in Indonesia are not only ecologically grounded but also economically accountable and institutionally resilient.

Method

Research design. This study adopts a qualitative-systemic research design using the ISM approach to analyze the institutional structure and challenges of internalizing OA into spatial management of conservation areas in Indonesia. The ISM method was chosen because it allows the systematic identification of hierarchical relationships among complex elements in this case, institutional actors and key challenges based on expert knowledge and contextual interpretation (Warfield 1974; Sushil 2012).

ISM serves as both an analytical and a conceptual tool that converts unclear, poorly articulated relationships among system elements into a well-defined, structured model showing how factors influence one another in a multilevel hierarchy. The study is exploratory and interpretive in nature, focusing on the interaction between governance institutions, data systems, and marine conservation policies. It combines literature-based content analysis with structured expert elicitation to capture contextual insights that quantitative datasets alone cannot provide.

Data collection. Primary data were obtained through expert judgment and focus group discussions (FGDs) conducted with stakeholders directly involved in marine spatial planning, conservation management, and OA development in Indonesia. The experts were selected purposively to represent institutional diversity and technical relevance, consisting of:

1. Directorate of Ecosystem Conservation, Directorate General of Marine Management, Ministry of Maritime Affairs and Fisheries;
2. Kupang National Marine Conservation Area Office, as Conservation Area Manager;
3. Provincial Maritime Affairs and Fisheries Service, as Regional Locus and Regional Conservation Manager;
4. Practitioners, who have conducted extensive research related to the OA.

Secondary data were gathered through a comprehensive review of:

1. National policy documents (e.g., National MSP / RTRLN, RPJMN 2020-2024, Ocean Accounts Indonesia reports);
2. Scientific journal articles and international frameworks on OA, blue economy, and ecosystem valuation (Hein et al 2020; World Bank 2021; OECD 2025);
3. Institutional regulations, strategic plans, and governance evaluations relevant to marine spatial planning and conservation area management.

Analytical procedure. The ISM process followed the classic steps proposed by Warfield (1974) and refined by Sushil (2012).

Step 1: element identification. The first stage of ISM involves identifying all relevant elements of the system to be analyzed. In this study, two categories were defined based on literature review and expert consultations:

a. actor elements, which refer to institutions and stakeholders involved in the OA integration process, including ministries, agencies, and community groups; and

b. challenge elements, which represent the key institutional, technical, financial, and political constraints hindering OA internalization.

The elements were finalized through expert consensus to ensure contextual accuracy and policy relevance.

Step 2: establishing contextual relationships. After identifying the elements, experts were asked to define the type of directional relationship between each pair of elements. These relationships were expressed using four symbols: V (element i influences j), A (element j influences i), X (elements influence each other), and O (no relation). The collection of these relationships formed the Structural Self-Interaction Matrix (SSIM). This matrix represents the experts' shared understanding of how each institutional or challenge element affects others, allowing a structured mapping of interdependencies across governance levels.

Step 3: developing the reachability matrix. The SSIM was then converted into a binary reachability matrix, where "1" denotes the presence of influence and "0" its absence. Logical transitivity was applied if element A influences B and B influences C,

then A should logically influence C. This matrix forms the quantitative skeleton of ISM analysis, revealing both direct and indirect relationships among system components. It serves as the foundation for determining each element's driving power (the extent to which it influences others) and dependence (the extent to which it is influenced by others).

Step 4: level partitioning. Once the reachability matrix was established, the elements were grouped into hierarchical levels based on their driving and dependence powers. The partitioning helps interpret systemic roles within the OA governance structure. These relationships are categorized into four quadrants, as summarized in Table 1.

Table 1

Quadrants categories of ISM result relationships

Quadrant	*Characteristics*	*Interpretation in context of ocean accounting internalization*
Quadrant I – autonomous	Elements with weak driving and weak dependence power.	Have little influence and minimal dependence on other factors. Their isolation means they do not significantly affect OA internalization (often technical or local issues).
Quadrant II – dependent	Elements with weak driving but strong dependence power.	Represent outcomes of the system's overall functioning, such as community participation or data adoption rates. Improvements here depend on addressing higher-level drivers.
Quadrant III – linkage	Elements with strong driving and strong dependence power.	These are volatile connectors any change in them affects others and vice versa. They are critical for coordination, requiring integrated multi-sectoral intervention.
Quadrant IV – independent (key drivers)	Elements with strong driving and weak dependence power.	Foundational factors that drive the entire system, such as policy capacity, institutional coordination, and technical understanding. Addressing these is essential to improve overall governance.

Step 5: model construction and interpretation. The next step involved converting the hierarchical relationships into a directed graph (digraph). Each node represents an element, while the connecting arrows indicate influence pathways. For actor elements, the digraph illustrated the flow of coordination from national policy institutions (e.g., KKP, Bappenas) down to local managers, research organizations, and communities. For challenge elements, the model visualized how barriers such as limited technical capacity, overlapping policies, and weak data systems interact within the governance hierarchy. The final ISM diagrams thus revealed the dynamic interplay between institutional structure and systemic constraints in OA integration.

Step 6: expert validation and refinement. Finally, the ISM results were subjected to expert validation to ensure interpretive reliability and contextual coherence. The hierarchical models and quadrant maps were presented to the expert group for feedback through an iterative discussion process. Revisions were made where experts identified inconsistencies or suggested contextual nuances such as local governance capacities or political feasibility. This iterative refinement ensured that the ISM model accurately represents Indonesia's real-world conditions in integrating OA into marine conservation spatial management.

Data interpretation. The completed ISM models comprising both level structuring and quadrant dependence–drive matrices were analyzed to understand the institutional mechanics and strategic leverage points for OA integration. The actor element model revealed the governance hierarchy and interdependence among ministries, data agencies, and field implementers. The challenge element model identified the systemic

constraints, ranging from knowledge deficits (C1) to legal fragmentation (C3), funding gaps (C4), and bureaucratic resistance (C9). By interpreting the quadrant results, the study could distinguish key drivers (Quadrant IV) such as technical capacity and regulation, linkage factors (Quadrant III) like transparency and coordination, and dependent outcomes (Quadrant II) like community involvement and IT accessibility. This structured interpretation provided a scientific foundation for policy recommendations that aim to harmonize institutional functions, enhance data integration, and accelerate the internalization of OA into Indonesia's conservation management systems.

Results

Key institutional actors and their hierarchical relationships in OA implementation. The institutional structure for internalizing OA into spatial management at conservation areas is characterized by a complex network of actors that operate across national, provincial, and local governance levels, each bearing unique mandates and influences (Table 2). At the forefront, the Ministry of Marine Affairs and Fisheries serves as the primary policymaker responsible for embedding OA principles within marine regulations and conservation frameworks (KKP 2021), while conservation area managers such as UPTD and BPSPL translate these policies into on-ground practices that ensure ecological protection (Nurhidayah & McIlgorm 2019). Planning agencies like Bappeda and the Ministry of ATR/BPN play a strategic role in ensuring that OA is incorporated into spatial plans to guide sustainable marine use (Bappenas 2020).

Table 2

Element actor of institutional structure of internalizing ocean accounting into spatial management at conservation areas

No.	*Element*	*Short explanation*	*Relevant citations*
A1	Ministry of Marine Affairs and Fisheries (various Directorates)	Main policymaker at national level	KKP (2021)
A2	Conservation Area Managers (UPTD, partners, BPSPL)	Field implementers of conservation area management	Nurhidayah & McIlgorm (2019)
A3	Planning agencies (Bappeda, Ministry of ATR/BPN)	Planners who must integrate OA into spatial plans	Bappenas (2020)
A4	Ministry of Finance, Directorate General of State Assets	Updating natural resource data, and recording its economic value	Bappenas (2020)
A5	Statistics and geospatial agencies (BPS, BIG)	Providers of official statistical and geospatial data	BPS & KKP (2023)
A6	Provincial/District Marine and Fisheries Agencies	Main technical actors in local implementation	KKP (2021)
A7	Donors and international conservation organizations	Providers of funding and technical support	World Bank (2021)
A8	Academics and marine research institutions	Providers of data, research, and science-based recommendations	Cisneros-Montemayor et al (2021)
A9	Coastal communities and traditional fishers	Directly impacted stakeholders and guardians of traditional practices	Berkes (2012)
A10	Private sector (marine tourism, fisheries, ocean energy)	Primary users of marine space with major impacts	OECD (2020)
A11	Business associations in fisheries and marine sectors (e.g., AP2HI, ASTUIN, GAPPKI)	Forums for business coordination and advocacy	FAO (2020); Gentry et al (2017)
A12	Certification and standardization bodies (eco-labels, MSC, ISO, etc.)	Guarantee sustainability standards for marine products/services	UNEP (2021); OECD (2025)
A13	Public–private partnerships and multi-stakeholder platforms for blue economy	Facilitators of cross-sector collaboration in ocean governance	Hodge & Greve (2017); KKP (2022)

Key supporting actors including the Ministry of Finance facilitate valuation and national asset recording of marine resources (Bappenas 2020), whereas agencies such as BPS and BIG supply standardized data that forms the backbone of OA measurements (BPS & KKP 2023). Implementation success is heavily influenced by provincial and district-level fisheries agencies as local technical operators (KKP 2021), as well as donors and international conservation organizations that provide funding and technical stewardship for innovation in governance (World Bank 2021). Research institutions and academics enrich this governance web through science-based recommendations (Cisneros-Montemayor et al 2021), while coastal communities stand as both key beneficiaries and guardians of traditional practices that must be recognized within accounting systems (Berkes 2012). Private sector actors exert considerable spatial pressure in areas such as tourism and fisheries, requiring careful alignment with sustainability principles (OECD 2020). Business associations complement this by creating platforms for collaborative advocacy and coordination (Gentry et al 2017; FAO 2020). Certification bodies introduce market accountability for sustainability performance (UNEP 2018; OECD 2025), and multi-stakeholder partnerships strengthen integrative governance across sectors (Hodge & Greve 2017; KKP 2022). However, despite this rich institutional mosaic, challenges persist such as uneven authority distribution, fragmented data governance, limited local capacity, and conflicting economic interests, all of which must be reconciled to fully realize OA's potential as a transformative tool for conservation-aligned marine spatial planning.

The institutional structure illustrated in the level hierarchy and the driver-dependence quadrants reveals a governance ecosystem where authority, influence, and operational realities converge to determine the success of internalizing OA into conservation-focused spatial management. As shown in Figure 1 at the top of the hierarchy, the Ministry of Marine Affairs and Fisheries (A1) stands alone in Level 6, symbolizing its overarching regulatory sovereignty and strong driving power with low dependence, placing it in the independent category (Quadrant IV) (Figure 2). This confirms that national policy direction is the single most decisive force shaping OA adoption (KKP 2021). Directly beneath, the Ministry of Finance (A4), statistical agencies (A5), planning agencies (A3), and researchers (A8) operate at Level 5 with high influence on technical standardization, valuation, and scientific legitimacy (Bappenas 2020; Cisneros-Montemayor et al 2021; BPS & KKP 2023). Their placement in Quadrant IV and Quadrant III (linkage) indicates a mix of strong drive and mutual interdependence, reflecting how OA requires coordinated data, valuation methodologies, and spatial policy alignment.

Level 4 hosts the core bridge institutions that translate policy into practice: conservation area managers (A2), provincial/district agencies (A6), donors (A7), and multi-stakeholder platforms (A13). These actors appear in Quadrant III, meaning they hold high drive but also high dependence on policy and data infrastructure. Their interconnectivity highlights the need for stable financial and institutional support to ensure adaptive management in conservation zones (Hodge & Greve 2017; Nurhidayah & McIlgorm 2019; World Bank 2021). Within Level 3, coastal communities (A9) serve as custodians of local knowledge and frontline beneficiaries of marine spatial decisions (Berkes 2012). Their high dependence yet relatively high drive situates them in Quadrant III, reflecting both vulnerability and crucial governance participation needs.

At Levels 2 and 1, the private sector (A10), certification bodies (A12), and business associations (A11) embody market-driven actors that strongly rely on spatial regulations and sustainability legitimacy supplied by the upper tiers (FAO 2020; OECD 2020; UNEP 2018). Their placement in Quadrant II (dependent) underscores the importance of policy coherence and valuation standards to ensure marine use remains compatible with conservation and OA principles.

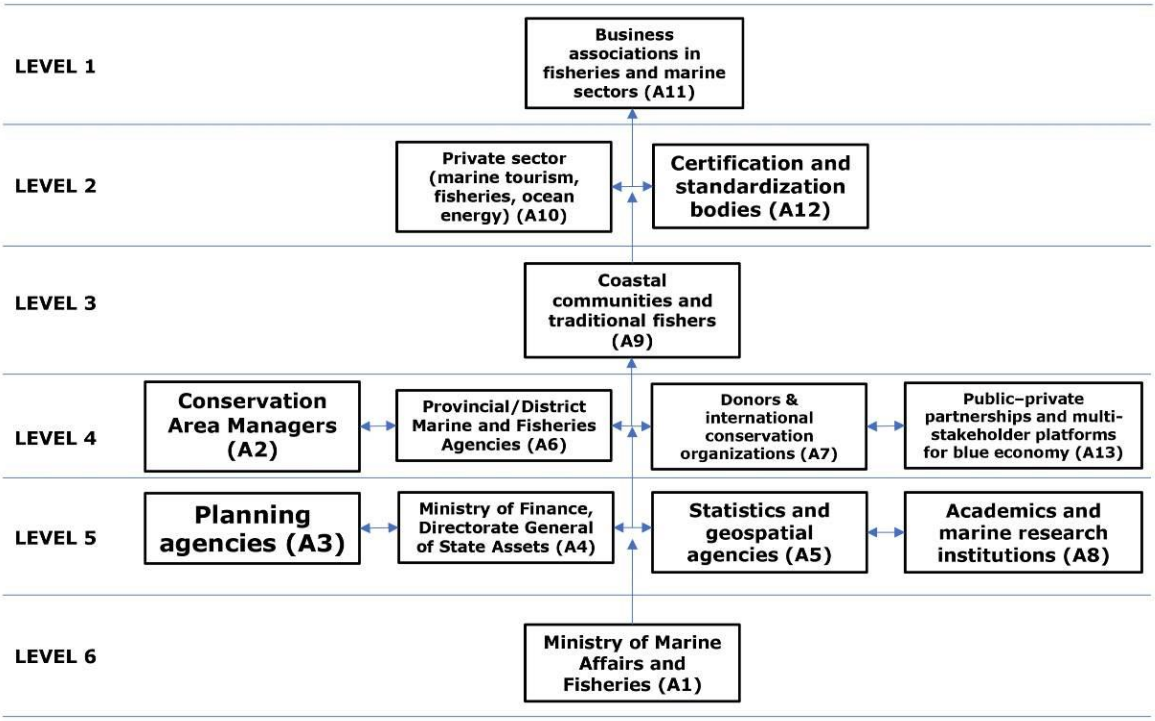

Figure 1. Level structuring of actor in institutional of internalizing structure of ocean accounting into spatial management at conservation areas.

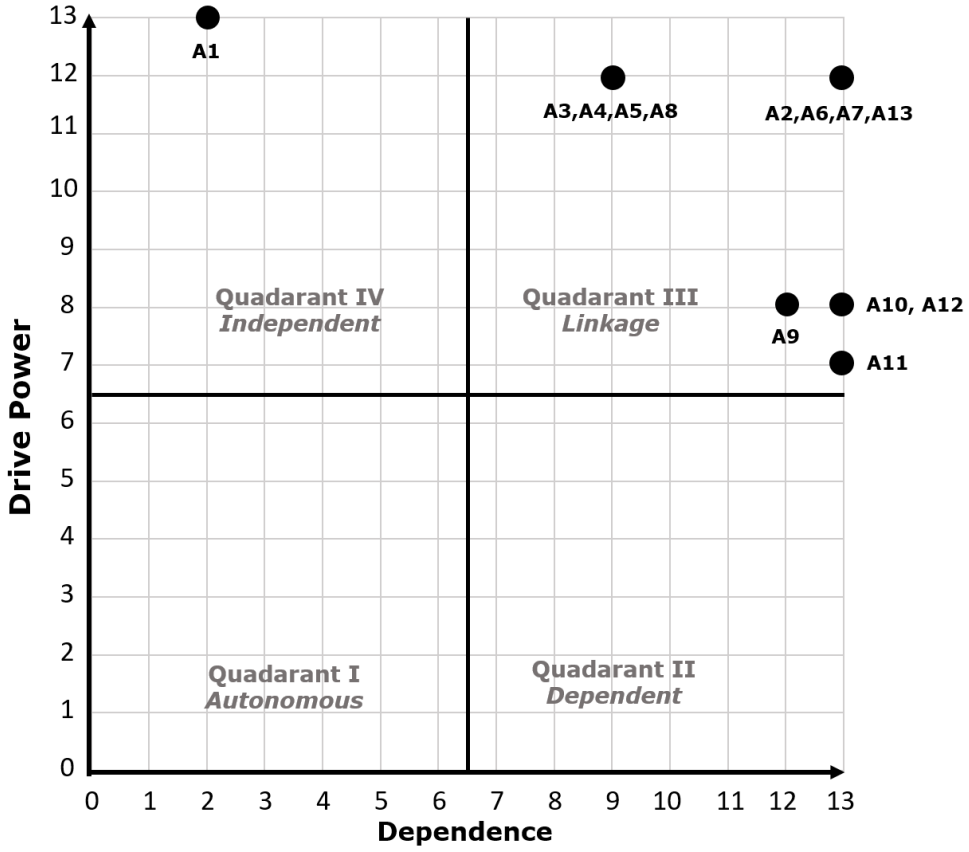

Figure 2. Actor's quadrant interaction in institutional of internalizing structure of ocean accounting into spatial management at conservation areas.

Taken together, the governance architecture resembles an institutional pyramid powered from the top, yet reliant on its middle layers to distribute capacities and engagement.

The central challenge revealed by both diagrams is interdependence without guaranteed cohesion. OA integration demands harmonized data flows, continuous funding, and equitable stakeholder involvement across governance levels but fragmentation, asymmetrical authority, and limited community empowerment remain common barriers (Gentry et al 2017; OECD 2025). Thus, enhancing OA uptake in conservation areas calls for strengthening horizontal coordination among Level 4-5 actors, improving the feedback capacity of communities, and institutionalizing accountability frameworks that align economic incentives with conservation performance. Only through such systemic reinforcement can OA transform spatial management into a tool that not only measures marine wealth but also secures its long-term sustainability.

Critical challenges that impede OA integration across governance levels. Like a complex coral reef society, the institutional landscape for internalizing OA in spatial management of conservation areas is an intricate web of actors, laws, data systems, and interests that does not yet function in full harmony. The elements of the challenges that have been identified in the research are summarized in Table 3. Policy makers often lack sufficient technical understanding of OA, which restricts the translation of data into policy decisions that could strengthen marine governance (Guerry et al 2015). Policy overlaps across marine, forestry, and tourism authorities generate sectoral friction, illustrating that existing regulations have not evolved to legally mandate or operationalize OA integration (Nurhidayah & McIlgorm 2019; KKP 2021). Additionally, resource constraints create delays in data updates and cross-platform system integration, leaving information fragmented across institutions that struggle to synchronize management priorities (OECD 2019; Bappenas 2020).

Table 3

Element challenge of internalizing ocean accounting in spatial management at conservation areas

No.	*Element*	*Short explanation*	*Relevant citations*
C1	Low technical understanding of Ocean Accounts among policymakers	Limits the use of data in policy formulation	Guerry et al (2015)
C2	Overlapping policies among sectors (marine, forestry, tourism)	Causes conflicts in marine spatial use	Nurhidayah & McIlgorm (2019)
C3	Lack of derivative regulations requiring Ocean Account use	Integration is not yet legally binding	KKP (2021)
C4	Limited budget for data updates and system integration	Hampers smooth updates and use of data	OECD (2019)
C5	Minimal community involvement in ocean resource assessments	Reduces legitimacy and sustainability of management	Berkes (2012)
C6	Fragmentation of data across institutions	Makes cross-sector synchronization and integration difficult	Bappenas (2020)
C7	Lack of multidisciplinary experts (ecological-economic-social) for integration	Limits holistic approaches in marine management	Halpern et al (2015)
C8	Dependence on external donors for funding and technical capacity	Makes programs less self-sustainable	Cisneros-Montemayor et al (2021)
C9	Political and bureaucratic resistance to data transparency	Hinders openness and collaboration	Adhuri et al (2019)
C10	Weak economic incentives for the private sector	Decreases business interest in conservation investment	OECD (2025)
C11	Limited IT infrastructure in coastal areas	Hinders equitable access and data utilization	World Bank (2021)

This institutional fragmentation is further amplified by limited engagement of coastal communities in ocean resource assessments, reducing both legitimacy and long-term

sustainability of conservation policies (Berkes 2012). The lack of multidisciplinary experts capable of bridging ecological, economic, and social perspectives reinforces a siloed management culture that hinders holistic integration of OA (Halpern et al 2015). Financial dependency on external donor assistance also threatens continuity and national ownership of marine sustainability initiatives (Cisneros-Montemayor et al 2021). Moreover, political and bureaucratic resistance to data transparency can obstruct collaboration and slow reform progress, while weak economic incentives discourage private-sector participation in conservation-aligned investment (Adhuri et al 2019; OECD 2025). Finally, inadequate IT infrastructure in many coastal regions limits equal access to spatial data and tools necessary for effective marine management (World Bank 2021). Together, these challenges reveal that institutional strengthening, legal harmonization, and cross-sector capacity building are essential to transform OA from an innovative concept into an operational backbone of sustainable spatial planning in marine conservation areas.

The level-structure (Figure 3) and quadrant mapping of challenges (Figure 4) paints a diagnosis of an institutional body suffering from both top-down constraints and cross-sector entanglements. At the base of the causal chain sits low technical understanding among policymakers (C1), which appears as a high-drive but relatively low-dependence challengean "independent" bottleneck that can push decisions but does so without the necessary technical grounding to do so well (Guerry et al 2015). Above this sits limited funding for data updates and system integration (C4), and the core mid-levels (C2, C3, C5) are dominated by overlapping sectoral policies, missing derivative regulations that would legally require OA use, and weak community involvement; these three cluster in the quadrant of high drive and high dependence, meaning they are powerful problems that cannot be solved unilaterally and therefore demand coordinated, multi-actor responses (Berkes 2012; Nurhidayah & McIlgorm 2019; KKP 2021). Fragmentation of data across institutions (C6) sits at the hinge between dependence and drive, signaling that without metadata harmonization and interoperable systems the linkage problems in the mid-levels will persist (Bappenas 2020).

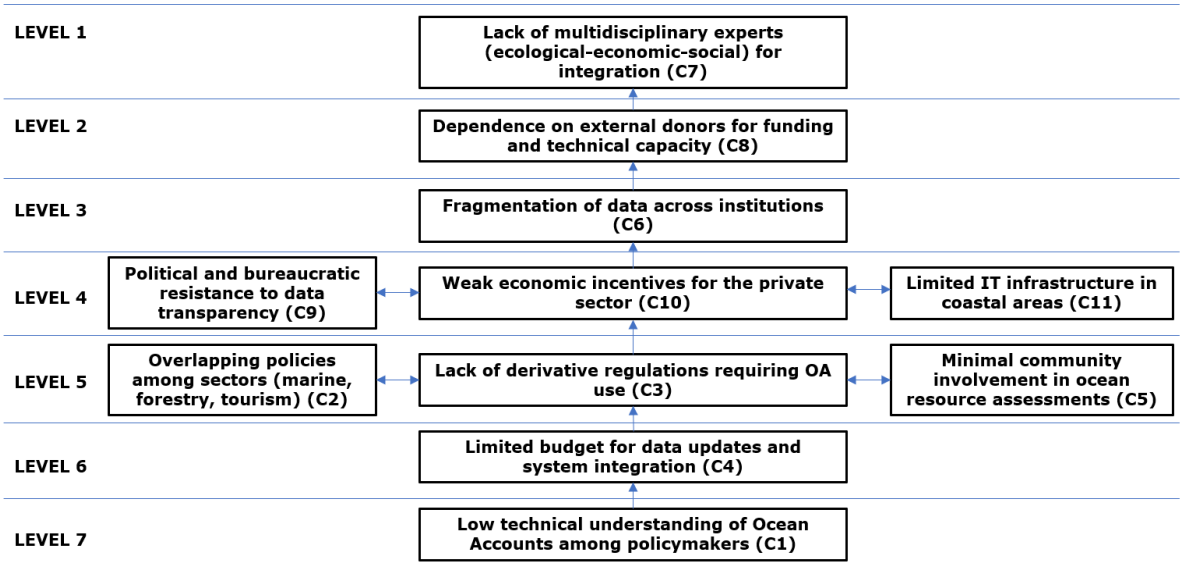

Figure 3. Level structuring of element challenge of internalizing ocean accounting in spatial management at conservation areas.

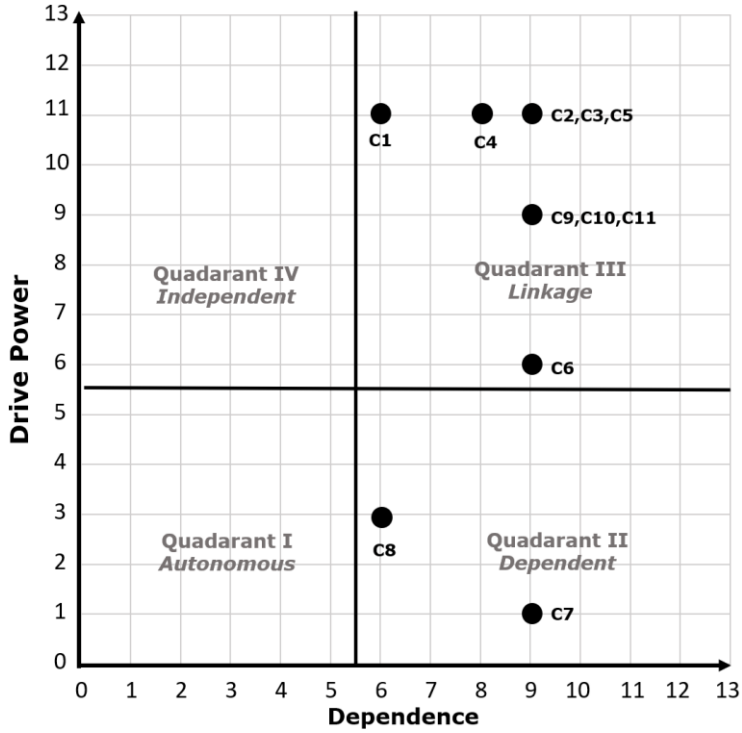

Figure 4. Challenge elements's level structuring of internalizing ocean accounting in spatial management at conservation areas.

The quadrant distribution reinforces a policy message: most critical challenges are linkage problems rather than isolated or purely technical issues. Dependence on external donors (C8) and the scarcity of multidisciplinary experts (C7) fall toward the dependent and low-drive quadrants, indicating vulnerabilities in national ownership and an inability to integrate ecological, economic, and social evidence into unified decisions (Halpern et al 2015; Cisneros-Montemayor et al 2021). Political and bureaucratic resistance to data transparency, weak private-sector incentives, and inadequate IT infrastructure (C9, C10, C11) cluster with high drive and moderate to high dependence, which means reforms on governance, incentive design, and infrastructure must proceed together to be effective (Adhuri et al 2019; World Bank 2021; OECD 2025). In short, the system behaves like a coupled social-ecological network: single fixes such as more data or more funding will underperform unless legal harmonization, capacity building, community participation, and incentives are aligned in an integrated reform pathway (Guerry et al 2015; OECD 2019). Practically, this calls for a prioritized portfolio that first lifts the "independent" technical literacy barrier, then targets the high-drive/high-dependence linkage nodes with coordinated policy instruments and interoperable data architecture, while reducing donor dependency through domestic capacity investment and creating market signals for conservation-compatible business practices (Bappenas 2020; Cisneros-Montemayor et al 2021; World Bank 2021).

Discussion. The results of this study reveal that the institutional structure for internalizing OA into MSP in Indonesia's conservation areas remains highly centralized yet fragmented, marked by overlapping mandates and limited coordination between national and local actors. The ISM analysis showed that the Ministry of Marine Affairs and Fisheries (KKP), Bappenas, and BPS hold dominant positions as independent elements with strong driving power, while local implementing agencies, research institutions, and communities occupy the dependent quadrants. This asymmetrical configuration reflects what Nurhidayah & McIlgorm (2019) and the OECD (2025) describe as a persistent pattern of vertical governance, where authority and resources are concentrated at the center, leaving local agencies operationally constrained. Compared to the Australian Ocean Accounts Framework and the EU's Integrated Marine Data Service (EMODnet), which institutionalized OA through coordinated, cross-sectoral data systems (Hein et al

2015, 2020), Indonesia's actor network remains hierarchical and lacks a binding mechanism for inter-ministerial data sharing or standardized OA application in MSP. Consequently, while Indonesia has formal institutions to support OA, the functional linkages needed for implementation remain weak.

From the perspective of challenges, the ISM findings highlight that the most critical barriers to OA internalization are conceptual and structural rather than technical. Key driver challenges include limited technical understanding among policymakers (C1), the absence of derivative regulations mandating OA use (C3), and fragmented data governance (C6) factors that mirror those found in other developing maritime economies. For instance, the Philippines faced similar limitations when integrating OA into its coastal management system, where policy awareness and valuation capacity lagged behind institutional ambition (SEADS 2021). In contrast, Norway and the United Kingdom successfully embedded OA into MSP by establishing legal mandates and connecting natural capital accounts directly to environmental licensing processes (Costanza et al 2014; Guerry et al 2015). These comparisons indicate that the success of OA internalization depends not only on data availability but also on clear regulatory frameworks and institutional incentives that enable the routine use of accounting information in spatial decisions.

The linkage challenges identified such as interagency coordination gaps, dependence on external donor funding, and limited participation of local stakeholders underscore the transitional stage of OA governance in Indonesia. Similar transitional dynamics were observed in Seychelles and Fiji, where initial OA frameworks relied on donor-funded blue economy programs before institutionalizing them within national planning agencies (World Bank 2021). In Indonesia, although initiatives from Bappenas and the World Bank's PROBLUE program have supported pilot OA efforts, the absence of integrated ocean information systems and weak policy synchronization across ministries limit systemic adoption (OECD 2019). Berkes (2012) argued that adaptive marine governance requires both institutional connectivity and social learning mechanisms, and Indonesia's current OA process still lacks such iterative coordination among actors. Thus, even though the technical foundation for OA exists, its practical integration into MSP remains constrained by bureaucratic inertia and fragmented mandates.

Overall, the ISM results contribute to a broader understanding of OA internalization as a social-ecological governance problem rather than a purely technical innovation. The structured mapping of actors and challenges clarifies that reform efforts should focus first on key driver elements strengthening legal frameworks, harmonizing institutional mandates, and building policymaker capacity before addressing dependent outcomes such as community participation or data access. International experiences confirm this pathway: in New Zealand and the UK, early institutional alignment and standardized data protocols enabled OA to become a strategic instrument for ecosystem valuation within MSP (Costanza et al 2014; UNEP 2018). Hence, Indonesia's pathway toward effective OA internalization must shift from fragmented pilot projects toward an integrated governance framework that links scientific accounting systems with policy implementation. By doing so, OA can evolve from an experimental tool into a decision-support mechanism for balancing conservation imperatives with blue economy development goals in Indonesia's marine spatial planning.

Implication. The findings of this study emphasize that Indonesia's effort to internalize OA into MSP is at a crucial transitional stage. The ISM analysis revealed that while institutional structures exist, the effectiveness of OA integration depends on strengthening the linkages between data systems, legal frameworks, and cross-sectoral coordination mechanisms. Therefore, policy interventions must be phased systematically beginning with foundational reforms that address institutional and regulatory weaknesses, followed by mid-term consolidation of technical systems and capacity, and culminating in long-term mainstreaming within national and regional spatial governance frameworks. Table 4 summarizes the recommended policy directions and their corresponding rationales.

Table 4

Recommended policy directions

Timeframe	*Policy focus*	*Strategic actions*	*Rationale / expected impact*
Short-term (1-2 years)	Institutional strengthening and awareness building	• Establish an inter-ministerial coordination task force involving KKP, Bappenas, BPS, BIG, and local DKP offices to harmonize OA responsibilities; • Conduct national and regional training for policymakers on OA principles, SEEA EA framework, and data use for decision-making; • Integrate OA terminology and indicators into MSP technical guidelines and conservation area management plans.	Builds foundational understanding and shared institutional ownership, reducing policy fragmentation and improving literacy among key actors (Nurhidayah & McIlgorm 2019; OECD 2025).
Medium-term (3-5 years)	Data system integration and legal mandate development	• Develop a unified Ocean Data Integration Platform linking ecological, economic, and social data; • Issue derivative regulations or ministerial decrees mandating OA application in MSP and conservation reporting; • Pilot OA-based decision dashboards in priority marine conservation zones (e.g., Gili Matra, Wakatobi, Raja Ampat).	Enhances interoperability across agencies, ensures legal enforceability, and provides demonstrative proof of OA's utility in spatial planning (Hein et al 2020; KKP 2021).
Long-term (5-10 years)	Mainstreaming and blue economy alignment	• Embed OA within national planning systems (RPJMN and RKPD) and fiscal budgeting frameworks; • Establish public-private partnerships for OA-based environmental monitoring and certification schemes; • Institutionalize periodic OA audits and integrate them into the State Audit Board (BPK) sustainability assessments.	Embeds OA as a permanent governance tool linking marine conservation, fiscal policy, and sustainable development, strengthening Indonesia's position in the global blue economy framework (UNEP 2018; World Bank 2021).

These phased recommendations provide a realistic roadmap for Indonesia's OA internalization, acknowledging both the institutional constraints and political economy realities that shape policy reform. The short-term actions focus on establishing the cognitive and organizational base for OA ensuring that decision-makers and technical personnel share a coherent understanding of the framework. The medium-term priorities target the operational backbone of OA integration through data infrastructure and regulatory harmonization. The long-term strategy, meanwhile, envisions OA as an embedded component of fiscal, environmental, and spatial governance, ensuring the continuity of marine sustainability efforts beyond project cycles.

More broadly, this research implies that Indonesia must transition from project-based OA initiatives to institutionalized governance systems that link marine natural capital to spatial decision-making. International experiences underscore that once OA becomes embedded in national accounts, it strengthens the accountability of marine policies and enhances transparency in conservation investment (Guerry et al 2015; Cisneros-Montemayor et al 2021). Therefore, policy reform should not only focus on data or capacity, but also on creating institutional incentives for local governments, communities, and private sectors to adopt OA as a planning and reporting instrument. This shift would align Indonesia's marine governance with the global move toward sustainable ocean economies, while ensuring that conservation areas function as living laboratories of integrated ecological and economic stewardship.

Conclusions. The results of this study conclude that the internalization of Ocean Accounting (OA) into Marine Spatial Planning (MSP) in Indonesia's conservation areas remains institutionally established but operationally fragmented, driven by a strong central structure yet hindered by weak interagency coordination and regulatory enforcement. The Interpretive Structural Modeling (ISM) analysis revealed that national institutions such as the Ministry of Marine Affairs and Fisheries (KKP), Bappenas, and BPS act as dominant drivers with significant influence but limited horizontal linkages, while regional agencies, research bodies, and communities remain dependent actors constrained by policy direction, technical resources, and funding. This asymmetry explains why OA has not yet been fully embedded in spatial management practices. The study also found that key challenges including limited policymaker understanding, absence of derivative regulations, fragmented data governance, and low institutional collaboration represent systemic barriers that must be addressed before OA can serve as a functional policy instrument. These findings align with global experiences, such as in Australia, the EU, and Norway, where OA integration succeeded only after institutional mandates, legal frameworks, and interoperable data systems were synchronized. Thus, the effective internalization of OA in Indonesia requires a phased reform beginning with institutional harmonization and legal reinforcement, followed by data integration and capacity building, and culminating in mainstreaming OA into fiscal and spatial planning. The study achieves its objectives by identifying actor hierarchies, mapping interdependencies, and diagnosing governance bottlenecks, offering both a conceptual framework and a practical roadmap for policy implementation. Ultimately, this research underscores that OA is not merely a technical accounting tool but a transformative governance mechanism one capable of aligning economic development, marine conservation, and spatial justice within Indonesia's evolving blue economy framework.

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