



**FROM ECOSYSTEM VALUATION TO TRANSFORMATIONAL GOVERNANCE:  
INTERDISCIPLINARY PATHWAYS FOR SUSTAINABLE COASTAL AND MARINE FUTURES**

**DARI PENILAIAN EKOSISTEM KE TATA KELOLA TRANSFORMASIONAL: JALUR  
INTERDISIPLINER UNTUK MASA DEPAN PESISIR DAN LAUT YANG BERKELANJUTAN**

**Yudi Wahyudin\***

Faculty of Agriculture, Universitas Djuanda, Bogor, Indonesia

\*Correspondent author: [yudi.wahyudin@unida.ac.id](mailto:yudi.wahyudin@unida.ac.id) (Y Wahyudin)

Submitted 9 Desember 2025 – Accepted 30 April 2026

**ABSTRACT.** Coastal and marine ecosystems provide critical economic, ecological, and social benefits, yet they continue to experience accelerated degradation driven by sectoral governance, weak enforcement, and persistent environmental conflicts. Over the past decades, ecosystem service valuation has generated substantial evidence on the economic significance of coral reefs, seagrass, mangroves, and fisheries. However, this evidence has rarely been translated into effective policy action, legal enforcement, or preventive governance mechanisms. This paper addresses this gap by examining how ecosystem valuation can evolve from a descriptive economic tool into a foundational element of transformational coastal and marine governance. Using an interdisciplinary policy-oriented approach, this study synthesizes advances in ecosystem valuation, social-ecological systems (SES) analysis, marine audit practices, fisheries bioeconomics beyond maximum sustainable yield (MSY), and ethical governance instruments. Drawing on empirical and policy-relevant experiences from Indonesian coastal and marine contexts, including ecosystem damage claims, zoning violations, fisheries overexploitation, and valuation-based legal processes, the paper demonstrates both the achievements and limitations of valuation in influencing governance outcomes. The results highlight that valuation becomes policy-relevant only when embedded within an integrated governance architecture. Marine audit is identified as a key institutional innovation that operationalizes valuation as an early detection, compliance monitoring, and conflict prevention mechanism. Furthermore, extending fisheries management toward maximum economic yield (MEY), welfare-oriented indicators, and ecosystem approach to fisheries management (EAFM) strengthens the linkage between economic efficiency, social equity, and ecological sustainability. The incorporation of ethical and social finance instruments, such as sharia-based fisheries management, zakat-infaq-shadaqah (ZIS), and waqf-based conservation models, provides long-term financing mechanisms and normative legitimacy for sustainable resource governance. This paper proposes a transformational governance framework built on four integrated pillars: ecosystem valuation, SES-based system understanding, marine audit and legal enforcement, and ethical finance and social innovation. Policy implications emphasize the need for mandatory valuation in marine spatial planning and licensing, institutionalized marine audit systems, valuation-based legal standards, and preventive governance strategies. The framework offers a practical pathway for bridging science and policy, enhancing environmental justice, and achieving sustainable coastal and marine futures in Indonesia and comparable coastal nations.

**Keywords:** Ecosystem service valuation, environmental damage assessment, ethical and bioeconomic resource management, social-ecological systems, transformational marine governance.

**ABSTRAK.** Ekosistem pesisir dan laut memberikan manfaat ekonomi, ekologi, dan sosial yang sangat penting, namun terus mengalami degradasi yang dipercepat akibat tata kelola sektoral, penegakan hukum yang lemah, dan konflik lingkungan yang terus-menerus. Selama beberapa dekade terakhir, valuasi jasa ekosistem telah menghasilkan bukti substansial tentang signifikansi ekonomi terumbu karang, lamun, mangrove, dan perikanan. Namun, bukti ini jarang diterjemahkan ke dalam tindakan kebijakan yang efektif, penegakan hukum, atau mekanisme tata kelola preventif. Artikel ini membahas kesenjangan tersebut dengan meneliti bagaimana valuasi ekosistem dapat berkembang dari alat ekonomi deskriptif menjadi elemen fundamental dari tata kelola pesisir dan laut yang transformatif. Dengan menggunakan pendekatan interdisipliner yang berorientasi pada kebijakan, studi ini mensintesis kemajuan dalam valuasi ekosistem, analisis sistem sosial-ekologis, praktik audit ruang laut, bioekonomi perikanan di luar hasil tangkapan maksimum berkelanjutan, dan instrumen tata kelola etis. Dengan mengacu pada pengalaman empiris dan relevan dengan kebijakan dari konteks pesisir dan laut Indonesia,

termasuk klaim kerusakan ekosistem, pelanggaran zonasi, eksploitasi perikanan yang berlebihan, dan proses hukum berbasis valuasi, artikel ini menunjukkan pencapaian maupun keterbatasan valuasi dalam memengaruhi hasil tata kelola. Hasil penelitian menyoroti bahwa penilaian menjadi relevan dengan kebijakan hanya ketika tertanam dalam arsitektur tata kelola terintegrasi. Audit ruang laut diidentifikasi sebagai inovasi kelembagaan kunci yang mengoperasionalkan penilaian sebagai mekanisme deteksi dini, pemantauan kepatuhan, dan pencegahan konflik. Lebih lanjut, perluasan pengelolaan perikanan menuju hasil ekonomi maksimum, indikator berorientasi kesejahteraan, dan pendekatan ekosistem terhadap pengelolaan perikanan berbasis ekosistem, memperkuat keterkaitan antara efisiensi ekonomi, keadilan sosial, dan keberlanjutan ekologis. Penggabungan instrumen keuangan etis dan sosial, seperti pengelolaan perikanan berbasis syariah, zakat-infaq-shadaqah (ZIS), dan model konservasi berbasis wakaf, menyediakan mekanisme pembiayaan jangka panjang dan legitimasi normatif untuk tata kelola sumber daya yang berkelanjutan. Artikel ini mengusulkan kerangka kerja tata kelola transformasional yang dibangun di atas empat pilar terintegrasi: penilaian ekosistem, pemahaman sistem berbasis sistem sosial-ekologis, audit ruang laut dan penegakan hukum, serta pembiayaan etis dan inovasi sosial. Implikasi kebijakan menekankan perlunya penilaian wajib dalam perencanaan dan perizinan ruang laut, sistem audit kelautan yang terinstitusionalisasi, standar hukum berbasis penilaian, dan strategi tata kelola preventif. Kerangka kerja ini menawarkan jalur praktis untuk menjembatani sains dan kebijakan, meningkatkan keadilan lingkungan, dan mencapai masa depan pesisir dan laut yang berkelanjutan di Indonesia dan negara-negara kepulauan lainnya.

**Kata Kunci:** Valuasi jasa ekosistem, penilaian kerusakan lingkungan, pengelolaan sumberdaya berbasis etika dan bioekonomi, sistem sosial-ekologis, tata kelola laut transformasional.

## 1. Introduction

Coastal and marine systems are among the most productive yet vulnerable social-ecological systems on the planet (Hossain *et al.*, 2020). They provide critical ecosystem services, including food provision, coastal protection, climate regulation, and cultural values, while supporting the livelihoods and well-being of hundreds of millions of people worldwide (Costanza *et al.*, 1997, de Groot *et al.*, 2002, MEA, 2005, de Groot *et al.*, 2012, Costanza *et al.*, 2014, Hernandez-Blanco *et al.*, 2022). However, across many regions, particularly in developing and archipelagic countries, these systems are experiencing accelerating degradation manifested in coral reef decline, seagrass and mangrove loss, and the overexploitation of capture fisheries (Wikinson & Salvat, 2012, Teena-Jayakumar & Sarkar, 2024). These ecological pressures are frequently accompanied by spatial conflicts, zoning violations, and recurrent environmental disputes among competing user groups, reflecting deeper structural weaknesses in coastal and marine governance (Noble *et al.*, 2019, Wu & Wan, 2024).

Over the past three decades, ecosystem service valuation has emerged as a prominent policy-oriented approach to address such challenges. Seminal contributions by Costanza *et al.* (1997) and de Groot *et al.* (2002) laid the conceptual and methodological foundations for quantifying the economic value of ecosystem services, aiming to make the benefits of nature visible within policy and planning processes. Subsequent advances further refined valuation frameworks and emphasized their relevance for sustainability and natural capital accounting (de Groot *et al.*, 2012, Costanza *et al.*, 2014). In coastal and marine contexts, ecosystem valuation has been widely promoted to support conservation prioritization, marine spatial planning, damage assessment, and compensation claims, as well as to strengthen the economic rationale for sustainable coastal management.

In practice, ecosystem valuation has played a particularly important role in informing policy responses to environmental damage in coastal and marine areas (Remoundou *et al.*, 2009, Lopes & Videira *et al.*, 2013, Barbier, 2012, Börger *et al.*, Mehvar *et al.*, 2018). Valuation studies have been used to estimate losses from coral reef destruction, coastal habitat degradation, and pollution-related impacts, providing an empirical basis for liability, compensation, and restoration planning (Bullock & O'Shea, 2016). In Indonesia, for example, valuation approaches have been applied to assess economic losses associated with coastal and marine ecosystem degradation, including coral reef damage caused by vessel grounding and other anthropogenic pressures (Adrianto *et al.*, 2016, Wahyudin, 2020, Wahyudin & Mahipal, 2020, Wahyudin, 2022, Wahyudin *et al.*, 2023a, Wahyudin *et al.*, 2025b). These

applications demonstrate the growing acceptance of ecosystem valuation as a policy-relevant tool in coastal and marine management.

Despite these advances, the translation of ecosystem valuation into effective policy action and governance reform has often remained weak (Liu *et al.*, 2010, Schleyer *et al.*, 2015, Verburg *et al.*, 2016). In many cases, valuation results are acknowledged in reports or legal processes but fail to induce substantive changes in spatial planning decisions, regulatory enforcement, or institutional arrangements (Alexander, 2001, de Groot *et al.*, 2002, 2012). As a result, environmental degradation, zoning violations, and conflicts over marine space tend to recur, even in contexts where scientific evidence and valuation data are readily available (Katsanevakis *et al.*, 2015). This persistent gap highlights a fundamental limitation of treating ecosystem valuation primarily as a technical or informational instrument, rather than as part of a broader governance process (Primmer & Furman, 2012).

The persistence of spatial conflicts and zoning violations in coastal and marine areas illustrates this challenge particularly clearly (Papageorgiu, 2016). Weak coordination across sectors, fragmented authority, and limited enforcement capacity often undermine the effectiveness of marine spatial plans, allowing unsustainable practices to continue despite formal recognition of ecosystem values (Katsanevakis *et al.*, 2011). Recent work has shown that tools such as marine audits can serve as early detection mechanisms for conflicts and zoning violations, revealing how governance failures, not information deficits alone, drive unsustainable outcomes in coastal areas (Wahyudin, 2025). These findings underscore the need to move beyond valuation as an end point and to embed it within governance arrangements capable of addressing power relations, institutional incentives, and accountability mechanisms (Tihanyi *et al.*, 2014).

This article argues that ecosystem valuation can only fulfil its policy potential if it is explicitly linked to transformational governance. Transformational governance goes beyond incremental policy adjustments by enabling fundamental changes in institutions, decision-making structures, and actor relationships that shape coastal and marine resource use. While adaptive governance has emphasized learning and flexibility, transformational governance focuses on addressing entrenched barriers to sustainability, including sectoral silos, short-term economic priorities, and unequal distributions of costs and benefits. In this context, ecosystem valuation should be understood not merely as a method for quantifying environmental benefits or damages, but as a strategic lever that can support institutional reform, legitimacy-building, and policy innovation.

The purpose of this article is to bridge ecosystem valuation and transformational governance through an interdisciplinary, policy-oriented framework for sustainable coastal and marine futures. Drawing on insights from ecological economics, coastal governance, and social-ecological systems research, the article examines why ecosystem valuation has often failed to trigger meaningful governance change and how it can be repositioned to support transformational outcomes. By integrating conceptual advances with case-based insights from coastal and marine management, particularly in developing country contexts, the article seeks to contribute to ongoing policy debates on the governance of ecosystem services, marine spatial planning, and the sustainability of the blue economy.

## **2. Ecosystem Valuation in Coastal and Marine Policy: Achievement, Gaps, and Governance Implications**

### *2.1. From Single-Service Valuation to Integrated Ecosystem Services*

Ecosystem valuation in coastal and marine systems has evolved from narrow, single-service assessments toward integrated valuation frameworks encompassing provisioning, regulating, cultural, and supporting services (Ma *et al.*, 2025). This transition reflects growing recognition that coastal and marine ecosystems, particularly coral reefs, seagrass meadows, and mangrove forests, generate multiple, interdependent benefits critical to human welfare and sustainable development (Costanza *et al.*, 1997, de Groot *et al.*, 2002, 2012, Costanza *et al.*, 2014).

Mangrove and seagrass ecosystems deliver essential regulating services such as coastal protection and wave attenuation, provisioning services through fisheries production, and cultural and supporting services that sustain coastal livelihoods and social resilience (Kumar *et al.*, 2024). Economic valuation of these services has demonstrated its utility in identifying conservation priorities, justifying public investment, and highlighting the welfare consequences of ecosystem degradation (Wahyudin, 2007, Wahyudin & Adrianto, 2012, Wahyudin, 2013, Wahyudin *et al.*, 2016, 2017, 2019a, Wahyudin, 2019, Wahyudin, 2022, Wahyudin *et al.* 2023a, 2025a). By extending valuation beyond market-based outputs, integrated ecosystem service assessment has strengthened the evidence base for policy interventions aimed at ecosystem conservation and sustainable use (Boisvert *et al.*, 2013). Long-term valuation trends further underscore that ecosystem degradation entails cumulative and often irreversible economic losses, reinforcing the importance of preventive governance rather than reactive compensation (Wahyudin *et al.*, 2025b, Mahipal *et al.*, 2025).

## 2.2. *Valuation as Evidence for Environmental Damage Claims and Enforcement*

Beyond planning and prioritization, ecosystem valuation has increasingly been applied in environmental damage assessment and legal processes. Significant economic losses associated with coral reef degradation, particularly from vessel grounding and physical damage, illustrate how valuation can substantiate environmental damage claims and compensation mechanisms. International and domestic flagship cases demonstrate the practical relevance of valuation in enforcement contexts. Incidents involving foreign-flagged vessels, such as the Caledonian Sky grounding in Raja Ampat, alongside domestic cases (MV Lyric, MT Alex, MV Shahraz, MT Edricko, MV Pazifik), reveal how valuation translates ecological damage into legally actionable economic evidence (Wahyudin, 2020, Wahyudin & Mahipal, 2020, Wahyudin *et al.*, 2022, Wahyudin, 2023a, Wahyudin *et al.*, 2025b). These applications reinforce the role of valuation in asserting environmental liability, supporting restoration planning, and strengthening the rule of law in coastal and marine governance (Arkham *et al.*, 2020, Wahyudin *et al.*, 2022, Wahyudin, 2023a). Despite this progress, the use of valuation in legal processes remains limited and uneven (Knez, 2024). Valuation evidence is often mobilized only after severe damage has occurred, and its integration into zoning enforcement, licensing decisions, and compliance monitoring remains weak.

## 2.3. *Coastal and Marine Systems as Social-Ecological Systems (SES)*

Coastal, marine, and fisheries systems function as integrated social-ecological systems composed of ecological, economic, social, and institutional dimensions (Stephenson *et al.*, 2018). Sustainability in such systems requires governance approaches that recognize and manage interactions among these components, rather than treating ecosystems, economic activities, and institutions as separate domains (Plummer & Armitage, 2007, Ostrom, 2009, Heuer, 2011, Glasser & Glaeser, 2014, Bodin, 2017). While valuation has contributed significantly to understanding the economic dimension of ecosystem services, its effectiveness depends on alignment with social realities, institutional capacities, and regulatory frameworks (Adrianto & Wahyudin, 2015). Sectoral management structures continue to dominate coastal and marine governance, resulting in fragmented decision-making, overlapping mandates, and weak enforcement, even when valuation evidence is strong and scientifically credible.

## 2.4. *Persistent Governance Gaps: Why Valuation Rarely Translates into Policy Change*

Several governance gaps constrain the policy impact of ecosystem valuation (Barton *et al.*, 2018). First, valuation results are rarely embedded directly into binding regulations, spatial plans, or licensing frameworks, limiting their influence on day-to-day decision-making (Barton *et al.*, 2024). Second, enforcement mechanisms often lack the institutional capacity or mandate to act on valuation evidence, particularly in cases of zoning violations and cumulative ecosystem degradation (Akhtar-Schuster *et al.*, 2011).

Conflict resolution in coastal and marine areas remains largely reactive, addressing disputes only after environmental damage or spatial conflicts have escalated (Tuda *et al.*, 2014). Valuation is therefore underutilized as a preventive tool that could inform early detection of zoning violations, overlapping sectoral interests, and emerging risks (Droj *et al.*, 2024). These limitations highlight that the primary barrier to sustainable coastal and marine management is no longer methodological uncertainty in valuation, but rather institutional fragmentation and governance inertia.

### 2.5. *Policy Implications: Toward Governance-Embedded Valuation*

The expanded application of ecosystem valuation, from conservation prioritization and welfare analysis to environmental damage claims and enforcement, demonstrates its substantial policy potential (Liu *et al.*, 2010, Bherwani *et al.*, 2020). However, realizing this potential requires repositioning valuation within integrated governance frameworks that explicitly link ecological, economic, social, and institutional dimensions (Rawluk *et al.*, 2019). Embedding valuation into regulatory instruments, zoning enforcement, marine audits, and compliance monitoring would enable a shift from reactive damage assessment toward anticipatory and transformative governance (Kørnøv *et al.*, 2025). The following section builds on this insight by exploring interdisciplinary pathways through which ecosystem valuation can support transformational coastal and marine governance.

## 3. From Valuation Evidence to Transformational Governance Architecture

### 3.1. *Governance Translation Gap: Environmental Conflicts and Legal Challenges in Coastal and Marine Systems*

Despite significant advances in ecosystem service valuation, coastal and marine governance continues to be characterized by persistent environmental conflicts and legal challenges (Mahipal *et al.*, 2025). These include claims for damages to coral reefs, seagrass, and mangrove ecosystems (Wahyudin, 2020, 2023a), widespread coastal zoning violations (Wahyudin, 2025), overlapping sectoral interests among fisheries, shipping, tourism, conservation, and coastal infrastructure (Wahyudin *et al.*, 2023a), and the limited institutional use of valuation evidence in legal and regulatory processes (Mahipal & Wahyudin, 2019, Wahyudin & Mahipal, 2020). In many jurisdictions, valuation results are mobilized primarily after environmental damage has occurred, serving litigation or compensation claims rather than preventive governance functions (Wahyudin, 2020, 2023a).

Although regulatory frameworks, such as Indonesia's environmental damage and loss assessment mechanisms (e.g., PermenLH No. 4/2013), provide legal entry points for ecosystem valuation, their implementation remains uneven and procedurally constrained. Legal analyses demonstrate that while valuation has gained formal recognition within environmental law, its application in coastal and marine cases is often hampered by weak institutional coordination, limited technical capacity, and inconsistent interpretation across enforcement agencies (Mahipal & Wahyudin, 2019). Consequently, ecosystem valuation is rarely embedded within spatial planning, licensing decisions, or routine enforcement, reinforcing reactive governance patterns and prolonging environmental disputes (Tammi *et al.*, 2017).

### 3.2. *Marine Audit as a Governance Innovation: Early Detection, Compliance, and Conflict Prevention*

Marine audit represents a critical governance innovation that operationalizes ecosystem valuation within routine coastal and marine management (Yu *et al.*, 2023, Wahyudin, 2025, Wahyudin *et al.*, 2025c). Unlike conventional assessments that focus on project-level impacts, marine audits function as early detection tools, compliance monitoring instruments, and conflict prevention mechanisms (Prasad, 2025). By systematically examining spatial conformity, ecosystem conditions, and socio-economic pressures, marine audits enable proactive governance before irreversible damage occurs.

Empirical applications demonstrate that marine audits can effectively detect zoning violations, emerging spatial conflicts, and ecosystem degradation in Indonesian coastal areas (Wahyudin, 2025b). Participatory marine spatial audits further enhance governance effectiveness by engaging local

stakeholders, increasing transparency, and strengthening compliance through shared accountability (Wahyudin *et al.*, 2025c). When combined with ecosystem valuation, marine audits transform valuation outputs into actionable governance inputs embedded within monitoring, enforcement, and adaptive management cycles (Schultz *et al.*, 2015). In this context, marine audit bridges the gap between valuation evidence and institutional response, shifting governance from reactive conflict management toward anticipatory and preventive modes.

### 3.3. *From Litigation to Non-Litigation Environmental Dispute Resolution*

The dominance of litigation-based approaches in resolving coastal and marine environmental disputes often undermines efficiency, equity, and trust (Wahyudin, 2023a). Transformational governance therefore requires expanding non-litigation environmental dispute resolution mechanisms that rely on scientific and valuation evidence as shared reference points (Hapsari *et al.*, 2022, Bakhtiari, 2025, Mahipal *et al.*, 2025). Ecosystem valuation provides objective baselines for mediation, negotiation, and administrative settlements by clarifying the magnitude of ecosystem service losses and associated social welfare impacts (Olander *et al.*, 2018). This approach enables faster and more cost-effective conflict resolution while strengthening environmental justice, particularly in coastal communities whose livelihoods depend directly on ecosystem services (Reis-Filho *et al.*, 2024). By reducing information asymmetries among stakeholders, valuation-based non-litigation mechanisms foster transparency and consensus-building rather than adversarial confrontation. Embedding valuation within non-litigation pathways complements formal legal processes and aligns coastal governance with preventive, restorative, and socially inclusive principles.

### 3.4. *Beyond MSY: Fisheries Bioeconomics and Welfare-Oriented Governance*

In fisheries governance, reliance on conventional Maximum Sustainable Yield (MSY) paradigms has proven insufficient to address economic efficiency, social welfare, and ecosystem resilience (Kenny *et al.*, 2018, Stephenson *et al.*, 2018). Transformational governance necessitates a shift toward welfare-oriented bioeconomic frameworks (Hosseini *et al.*, 2025), including Maximum Economic Yield (MEY), sustainability thresholds, and ecosystem-based fisheries management (EAFM). A substantial body of empirical research demonstrates this transition. Early studies on optimal fisheries resource allocation (Wahyudin *et al.*, 2006) laid the foundation for subsequent MEY applications in small pelagic fisheries (Dewantara *et al.*, 2019, 2020). Further work has integrated ecosystem linkages, particularly seagrass-fish interactions, into fisheries bioeconomic analysis, highlighting the dependence of fisheries productivity on coastal ecosystem integrity (Wahyudin, 2018, Wahyudin, 2022, Wahyudin, 2023b). In parallel, social-ecological perspectives have been advanced through the development of fishermen's resilience indices, capturing socio-economic vulnerability and adaptive capacity within fisheries systems (Wahyudin *et al.*, 2019a). Collectively, these studies underscore the limitations of MSY-based management and reinforce the need for governance architectures that integrate economic efficiency, social welfare, and ecosystem sustainability through a social-ecological systems (SES) lens.

### 3.5. *Ethical and Innovative Governance Instruments: Sharia-Based Fisheries Management and ZIS*

Beyond technical bioeconomic optimization, transformational governance increasingly incorporates ethical and normative dimensions. Sharia-based fisheries management (SBFM) represents an innovative governance approach that embeds ethical principles within fisheries bioeconomic models (Wahyudin & Mahipal, 2024a, 2024b). Recent developments demonstrate how zakat, infaq, and shadaqah (ZIS) parameters can be introduced into the Gordon-Schaefer framework, influencing carrying capacity, catchability, and benefit distribution (Wahyudin, 2023b). By integrating ZIS mechanisms, fisheries governance moves beyond profit maximization toward welfare-oriented and distributive objectives (Wahyudin, 2023b). Empirical and conceptual advancements in SBFM illustrate how ethical finance can complement ecosystem valuation, providing moral foundations for sustainability, equity, and

intergenerational responsibility (Wahyudin & Mahipal, 2024a, 2024b). These ethical instruments enrich governance architectures by aligning economic incentives with societal values, thereby strengthening the legitimacy and durability of fisheries management regimes.

### 3.6. *Waqf-Based Governance for Coastal and Marine Conservation*

Waqf-based governance models offer a distinctive institutional pathway for long-term coastal and marine conservation (Wahyudin, 2023b, Wahyudin *et al.*, 2025a). By conceptualizing coastal and marine ecosystems as public resources whose benefits must be sustained over time, waqf governance emphasizes non-transferability, open access, and sustainable benefit generation. These characteristics closely align with the nature of ecosystem services provided by coral reefs, mangroves, and seagrass ecosystems (Ford-Learner *et al.*, 2025).

By Recent applications of waqf models demonstrate their potential to support conservation financing and governance when integrated with ecosystem valuation and adaptive institutional arrangements (Wahyudin *et al.*, 2025a). However, effective implementation requires specialized institutions capable of managing valuation data, monitoring ecosystem conditions, and enforcing governance rules. When properly designed, waqf-based governance strengthens conservation prioritization and reduces dependence on short-term project funding.

### 3.7. *Toward an Integrated Transformational Governance Framework*

Synthesizing these insights, transformational coastal and marine governance can be conceptualized as an integrated framework built upon four interdependent pillars: (1) ecosystem valuation as an economic foundation (Ma *et al.*, 2025), (2) social-ecological systems understanding integrating ecological, economic, and social dimensions (Cinner & Barnes, 2019), (3) marine audit and legal enforcement mechanisms enabling proactive, preventive, and accountable governance (Shih, 2024, Wahyudin, 2025), and (4) ethical finance and social innovation instruments, including ZIS and waqf-based models (Wahyudin, 2023b, Kamaruzzaman & Ishak, 2023, Wahyudin *et al.*, 2025a). Operationalizing this framework requires concrete policy instruments, such as mandatory ecosystem valuation within marine spatial planning and licensing processes, institutionalized marine audit systems, non-litigation dispute resolution mechanisms grounded in scientific evidence, welfare-oriented fisheries governance frameworks, and ethical conservation financing mechanisms (Lehtonen, 2017, Hellström & Jacob, Peters & Fontaine, 2022, Bandelow *et al.*, 2025). Together, these elements reposition ecosystem valuation from supporting evidence to a core component of governance architecture, enabling proactive, equitable, and sustainable coastal and marine stewardship (Williams *et al.*, 2021).

## 4. **From Valuation Evidence to Transformational Governance Architecture**

### 4.1 *Repositioning Ecosystem Valuation as a Core Policy Instrument*

A central policy implication of this study is the need to reposition ecosystem valuation from a supporting analytical tool to a core policy instrument within coastal and marine governance (Luisetti *et al.*, 2011; Pacifico *et al.*, 2025). While valuation has demonstrated its capacity to quantify ecosystem service benefits and losses, its impact remains limited when confined to project-based assessments or post-damage claims (Wahyudin, 2020; Wahyudin & Mahipal, 2020; Wahyudin *et al.*, 2022; Wahyudin *et al.*, 2023a; Mahipal *et al.*, 2025). Policymakers should therefore mandate the systematic use of ecosystem valuation in upstream decision-making processes, particularly within marine spatial planning, coastal zoning, and licensing systems (Katsanevakis *et al.*, 2011; Lopes & Videira, 2013; Pacifico *et al.*, 2025). Integrating valuation *ex ante* enables governments to anticipate social and economic consequences of ecosystem degradation, internalize externalities, and justify precautionary regulatory decisions. Such repositioning strengthens policy coherence and enhances the legitimacy of coastal and marine management interventions.

#### 4.2 *Institutionalizing Marine Audit for Proactive Governance*

Marine audit emerges as a strategic governance instrument for translating valuation evidence into actionable policy (Gelicich *et al.*, 2019; Niner & Randalls, 2021). Governments should institutionalize marine audit systems as routine components of coastal and marine governance, linking valuation data with spatial compliance monitoring and early conflict detection (Gacutan *et al.*, 2022). Policy frameworks should formally recognize marine audits as instruments for early detection of zoning violations and ecosystem degradation, compliance monitoring across sectors, and conflict prevention and governance learning (Wahyudin, 2025). Participatory marine audit mechanisms should be encouraged to enhance transparency, stakeholder trust, and local ownership of governance processes (Wahyudin *et al.*, 2025c). Embedding marine audits within regulatory and enforcement institutions shifts governance from reactive responses toward anticipatory and preventive management.

#### 4.3 *Strengthening Legal and Non-Litigation Dispute Resolution Mechanisms*

The limited effectiveness of litigation-based approaches highlights the need for complementary non-litigation environmental dispute resolution mechanisms (Mahipal *et al.*, 2025). Policymakers should promote mediation, administrative settlements, and negotiated agreements that utilize ecosystem valuation as an objective and shared evidence base (Laurans & Mermet, 2014; O'Hagan, 2020). To support this transition, valuation methodologies and damage assessment standards should be harmonized across agencies to ensure legal consistency and procedural clarity (Bekker & Bello, 2021). Strengthening the legal capacity of environmental assessors and auditors is essential to improve the credibility and enforceability of valuation-based decisions, particularly in coastal and marine damage claims.

#### 4.4 *Advancing Welfare-Oriented and Ecosystem-Based Fisheries Governance*

Fisheries policy should move beyond conventional MSY targets toward welfare-oriented and ecosystem-based governance frameworks (Wahyudin, 2023b; Öz *et al.*, 2025). Ecosystem valuation and bioeconomic analysis provide essential tools for integrating economic efficiency (e.g., MEY), social welfare, and ecosystem sustainability within fisheries management (Wahyudin & Mahipal, 2024a; 2024b). Policymakers are encouraged to incorporate socio-economic indicators and resilience metrics into fisheries management plans, adopt EAFM principles supported by valuation-based trade-off analysis, and align fisheries licensing, effort controls, and conservation measures with long-term welfare objectives rather than short-term yield maximization. Such approaches strengthen the adaptive capacity of fisheries governance under ecological uncertainty and socio-economic change.

#### 4.5 *Leveraging Ethical Finance and Social Innovation for Conservation*

Ethical and faith-based financial instruments represent underutilized policy opportunities for coastal and marine conservation. Sharia-based fisheries management, including the integration of Zakat, Infaq, and Shadaqah (ZIS) mechanisms, offers pathways to align economic incentives with social justice and sustainability goals (Wahyudin, 2023b). Similarly, waqf-based governance models provide stable and long-term financing for ecosystem conservation by institutionalizing non-transferability, public benefit, and intergenerational equity (Wahyudin *et al.*, 2025a). Policymakers should explore regulatory and institutional arrangements that enable ethical finance instruments to complement public funding and market-based mechanisms in coastal and marine conservation.

#### 4.6 *Building Integrated Transformational Governance Architectures*

Transformational coastal and marine governance requires integrated architectures that connect ecosystem valuation (Wahyudin, 2019), social-ecological systems understanding (Wahyudin *et al.*, 2018; Wahyudin *et al.*, 2023b), marine audit and legal enforcement (Wahyudin, 2025; Wahyudin *et al.*, 2025c),

and ethical finance innovations (Wahyudin *et al.*, 2025b). Fragmented, sectoral policies must be replaced by coordinated governance frameworks that facilitate cross-sectoral learning, accountability, and adaptive management. Strategic policy actions include mandating ecosystem valuation within marine spatial planning and environmental licensing, institutionalizing marine audit systems across governance levels, embedding valuation evidence within legal and non-litigation dispute resolution processes, and integrating welfare-oriented fisheries governance and ethical financing instruments into national and local policy frameworks.

#### 4.7 Strategic Takeaways for Policymakers

The findings of this study underscore that sustainable coastal and marine futures depend not on the availability of valuation evidence alone, but on the governance systems that mobilize such evidence effectively. Ecosystem valuation must be embedded within institutional routines, legal frameworks, and ethical governance instruments to drive transformative change. By aligning valuation with proactive governance, legal innovation, welfare-oriented bioeconomics, and ethical finance, policymakers can move beyond reactive conflict management toward resilient, equitable, and sustainable coastal and marine governance (Rubio-Mozos *et al.*, 2020; Hosseini *et al.*, 2025; Shurson *et al.*, 2025).

## 5. Conclusion

This paper demonstrates that ecosystem valuation alone is insufficient to address the escalating complexity of coastal and marine governance challenges. While valuation has successfully quantified the economic significance of coral reefs, seagrass, mangroves, and fisheries, its policy impact remains limited when detached from governance architecture, legal mechanisms, and institutional innovation. The central contribution of this study lies in repositioning ecosystem valuation as an enabling instrument within a broader transformational governance framework, rather than as an isolated technical exercise.

By integrating valuation evidence with social-ecological systems (SES) understanding, marine audit mechanisms, fisheries bioeconomic beyond MSY, and ethical governance instruments, this paper advances a coherent pathway from scientific evidence to actionable policy. Marine audit emerges as a critical governance innovation, functioning as an early detection, compliance monitoring, and conflict prevention tool that strengthens preventive governance and reduces reliance on costly post-damage remediation. When combined with valuation-based legal standards and non-litigation dispute resolution, valuation evidence gains regulatory legitimacy and practical enforceability.

This study further highlights that persistent environmental conflicts, ranging from ecosystem damage claims and zoning violations to overlapping sectoral interests, are not primarily caused by data scarcity, but by weak institutional embedding of scientific evidence. The limited use of valuation in legal and regulatory processes reflects a structural disconnect between knowledge production and governance design. Addressing this gap requires policy-usable science that speaks the language of planners, auditors, and legal practitioners, while remaining grounded in robust ecological and economic analysis.

Importantly, the paper extends conventional governance discourse by incorporating ethical and social finance instruments, including sharia-based fisheries management (SBFM), zakat-infaq-shadaqah (ZIS), and waqf-based conservation models. These instruments provide a normative and financial foundation for sustainability, enabling long-term ecosystem stewardship, equitable benefit distribution, and social legitimacy, dimensions often absent from technocratic governance models. Ethical finance thus complements regulatory enforcement by strengthening collective responsibility and intergenerational justice.

From a policy perspective, the findings call for a decisive shift from sectoral, reactive, and remedial governance toward systems-based, preventive, and integrated governance. This shift necessitates mandatory ecosystem valuation in marine spatial planning and licensing, institutionalized marine audit systems, strengthened valuation-based legal frameworks, and the formal recognition of ethical conservation financing. Together, these elements form four interdependent pillars of transformational

coastal and marine governance: ecosystem valuation, SES integration, marine audit and legal enforcement, and ethical finance innovation.

In conclusion, sustainable coastal and marine futures will not be achieved through valuation, conservation, or enforcement in isolation. They require a governance transformation that aligns science, law, institutions, and ethics into a unified policy architecture. The framework proposed in this paper offers a replicable and context-sensitive model for Indonesia and other coastal nations facing similar socio-ecological and governance challenges, positioning ecosystem valuation as a catalyst, not an endpoint, of transformational governance.

## References

- Adrianto, L., & Wahyudin, Y. (2015). Estimating and Measuring of the Value of Pelagic Tourism System - Preliminary Mapping and A Literature and Secondary Reviews. Available at SSRN. <http://dx.doi.org/10.2139/ssrn.2633033>.
- Adrianto, L., Wahyudin, Y., Nurjaya, I.W., Krisanti, M., Yonvitner, Y., & Trihandoyo, T. (2016). Valuasi ekonomi kerusakan ekosistem sumberdaya pesisir dan laut Kota Bontang. Working Paper PKSPL IPB, 7(4), 1-21. <https://www.researchgate.net/publication/322266300>.
- Akhtar-Schuster, M., Thomas, R. J., Stringer, L. C., Chasek, P., & Seely, M. (2011). Improving the enabling environment to combat land degradation: Institutional, financial, legal and science-policy challenges and solutions. *Land Degradation & Development*, 22(2), 299-312.
- Alexander, E.R. (2001). Governance and transaction costs in planning systems: A conceptual framework for institutional analysis of land-use planning and development control - the case of Israel. *Environment and Planning B: Planning and Design*, 28(5), 755-776.
- Arkham, M.N., Wahyudin, Y., Pahlevi, M.R., & Hutapea, Y.F. (2020). Jasa penyedia ekosistem terumbu karang di kawasan Suaka Alam Perairan Kepulauan Raja Ampat dari perspektif valuasi ekonomi. *Jurnal Kelautan*, 13(3), 239-248.
- Bakhtiari, Z. (2025). A review of environmental conflict resolution: Approaches, challenges, and emerging trends. *Discover Global Society*, 3(1), 131.
- Barbier, E.B. (2012). Progress and challenges in valuing coastal and marine ecosystem services. *Review of Environmental Economics and Policy*, 6(1), 1-19. <https://doi.org/10.1093/reep/rer017>.
- Barton, D. N., Kelemen, E., Dick, J., Martin-Lopez, B., Gómez-Baggethun, E., Jacobs, S., Hendriks, C.M.A., Termansen, M., García-Llorente, M., Primmer, E., Dunford, R., Harrison, P.A., Turkelboom, F., Saarikoski, H., van Dijk, J., Rusch, G.M., Palomo, I., Yli-Pelkonen, V.J., Carvalho, L., Baró, F., Langemeyer, J., van der Wal, T., Mederly, P., Priess, J.A., Luque S., Berry, P., Santos, R., Odee, D., Pastur, G.M., Blanco, G., Saarela, S-R., Silaghi, D., Pataki, G., Masi, F., A. Vădineanu, A., Mukhopadhyay, R., & Lapola, D. M. (2018). Disintegrated valuation-assessing the information gaps in ecosystem service appraisals for governance support. *Ecosystem Services*, 29, 529-541. <https://doi.org/10.1016/j.ecoser.2017.10.021>.
- Barton, D.N., Chaplin-Kramer, R., Lazos, E., Van Noordwijk, M., Engel, S., Girvan, A., Hahn, T., Leimona, B., Lele, S., Niamir, A., Özkaynak, B., Pawlowska-Mainville, A., Muradian, R., Ungar, P., Aydin, C., Iranah, P., Nelson, S., CantúFernández, M., and González-Jiménez, D. (2022). Chapter 4: Value expression in decision-making. In: *Methodological Assessment Report on the Diverse Values and Valuation of Nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Balvanera, P., Pascual, U., Christie, M., Baptiste, B., and González-Jiménez, D. (eds). IPBES Secretariat, Bonn, Germany. <https://doi.org/10.5281/zenodo.6522261>.
- Bekker, P., & Bello, F. (2021). Reimagining the damages valuation framework underlying fair and equitable treatment standard violations through a three-stage contextualized approach. *ICSID Review-Foreign Investment Law Journal*, 36(2), 339-365. <https://doi.org/10.1093/icsidreview/siab010>.

- Bherwani, H., Nair, M., Kapley, A., & Kumar, R. (2020). Valuation of ecosystem services and environmental damages: An imperative tool for decision making and sustainability. *European Journal of Sustainable Development Research*, 4(4), em0133.
- Bodin, Ö. (2017). Collaborative environmental governance: Achieving collective action in social-ecological systems. *Science*, 357(6352), eaan1114.
- Boisvert, V., Méral, P., & Froger, G. (2013). Market-based instruments for ecosystem services: Institutional innovation or renovation?. *Society & Natural Resources*, 26(10), 1122-1136.
- Börger, T., Beaumont, N.J., Pendleton, L., Boyle, K.J., Cooper, P., Fletcher, S., Haab, T., Hanemann, M., Hooper, T.L., Hussain, S.S., Portela, R., Stithou, M., Stockill, J., Taylor, T., & Austen, M.C. (2014). Incorporating ecosystem services in marine planning: the role of valuation. *Marine Policy*, 46, 161-170. <https://doi.org/10.1016/j.marpol.2014.01.019>.
- Bullock, C., & O'Shea, R. (2016). Valuing environmental damage remediation and liability using value estimates for ecosystem services. *Journal of Environmental Planning and Management*, 59(9), 1711-1727.
- Cinner, J.E., & Barnes, M. L. (2019). Social dimensions of resilience in social-ecological systems. *One Earth*, 1(1), 51-56.
- Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., Paruelo, J., Raskin R. G., Sutton, P., & van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature*, 387, 253-260. <https://doi.org/10.1038/387253a0>.
- Costanza, R., de Groot, R., Sutton, P., van der Ploeg, S., Anderson, S. J., Kubiszewski, I., Farber, S., & Turner, R.K. (2014). Changes in the global value of ecosystem services. *Global Environmental Change*, 26, 152-158. <https://doi.org/10.1016/j.gloenvcha.2014.04.002>.
- de Groot, R. S., Wilson, M. A., & Boumans, R. M. (2002). A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics*, 41(SI),393-408. [https://doi.org/10.1016/S0921-8009\(02\)00089-7](https://doi.org/10.1016/S0921-8009(02)00089-7).
- de Groot, R., Brander, L., van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., Christie, M., Crossman, N., Ghermandi, A., Hein, L., Hussain, S., Kumar, P., McVittie, A., Portela, R., Rodriguez, L.C., ten Brink, P., & van Beukering, P. (2012). Global estimates of the value of ecosystems and their services in monetary units. *Ecosystem Services*, 1, 50-61. <http://dx.doi.org/10.1016/j.ecoser.2012.07.005>.
- Dewantara, E.C., Fahrudin, A., & Wahyudin, Y. (2019). Maximum economic yield (MEY) of *Stolephorus* Sp fisheries in the area of fisheries sanctuary of Karang Jeruk, Tegal regency. *Journal on Marine and Fisheries Social Ecological System (JoMFISES)*, 1(1), 29-34. Available at SSRN: <https://ssrn.com/abstract=3457091>.
- Dewantara, E.C., Fahrudin, A., & Wahyudin, Y. (2020). Bioeconomic analysis of *Stolephorus* sp. fisheries in the conservation area of Karang Jeruk waters, Tegal regency, Central Java. *ECOSOFIM: Journal of Economic and Social of Fisheries and Marine*, 8(1), 54-67. <http://dx.doi.org/10.21776/ub.ecsofim.2020.008.01.05>.
- Droj, G., Kwartnik-Pruc, A., & Droj, L. (2024). A comprehensive overview regarding the impact of GIS on property valuation. *ISPRS International Journal of Geo-Information*, 13(6), 175.
- Ford-Learner, M.A., Addison, J., & Cumming, G.S. (2025). A review of ecosystem service supply in tropical marine ecosystems and its relationship to habitats in the Great Barrier Reef. *Ecosystems and People*, 21(1), 2425816.
- Gacutan, J., Galparsoro, I., Pınarbaşı, K., Murillas, A., Adewumi, I.J., Praphotjanaporn, T., Johnston, E.L., Findlay, K.P., & Milligan, B.M. (2022). Marine spatial planning and ocean accounting: Synergistic tools enhancing integration in ocean governance. *Marine Policy*, 136, 104936. <https://doi.org/10.1016/j.marpol.2021.104936>.
- Gelcich, S., Reyes-Mendy, F., & Rios, M.A. (2019). Early assessments of marine governance transformations. *Ecology and Society*, 24(1), 12.

- Glaser, M., & Glaeser, B. (2014). Towards a framework for cross-scale and multi-level analysis of coastal and marine social-ecological systems dynamics. *Regional Environmental Change*, 14(6), 2039-2052.
- Hapsari, D.R.I., Ilmiawan, A.A.S., & Samira, E. (2022). Non-litigation as an environmental dispute resolution mechanism in Indonesia. *Indonesia Law Reform Journal*, 2(1), 55-66.
- Hellström, T., & Jacob, M. (2017). Policy instrument affordances: a framework for analysis. *Policy Studies*, 38(6), 604-621.
- Hernández-Blanco, M., Costanza, R., Chen, H., de Groot, D., Jarvis, D., Kubiszewski, I., Montoya, J., Sangha, K., Stoeckl, N., Turner, K., & van 't Hoff, V. (2022). Ecosystem health, ecosystem services, and the well-being of humans and the rest of nature. *Global Change Biology*, 28(17), 5027-5040.
- Heuer, M. (2011). Ecosystem cross-sector collaboration: conceptualizing an adaptive approach to sustainability governance. *Business Strategy and the Environment*, 20(4), 211-221.
- Hossain, M.S., Gain, A.K., & Rogers, K. G. (2020). Sustainable coastal social-ecological systems: How do we define "coastal"? *International Journal of Sustainable Development & World Ecology*, 27(7), 577-582.
- Hosseini, E., Tsegay, Z.T., Smaoui, S., Elfalleh, W., Antoniadou, M., Varzakas, T., & Caraher, M. (2025). One health approaches to ethical, secure, and sustainable food systems and ecosystems: Plant-based diets and livestock in the African context. *Foods*, 15(1), 85.
- Kamaruzaman, N.R., & Ishak, M.S.I. (2023). Waqf institutions: A systematic literature review on governance, financial models, and socio-economic impact in Islamic social finance. *Advanced International Journal of Business, Entrepreneurship and SMEs*, 5(18), 134-151.
- Katsanevakis, S., Levin, N., Coll, M., Giakoumi, S., Shkedi, D., Mackelworth, P., Levy, R., Adonis Velegrakis, A., Koutsoubas, D., Hrvoje Caric, H., Brokovich, E., Öztürk, B., & Kark, S. (2015). Marine conservation challenges in an era of economic crisis and geopolitical instability: The case of the Mediterranean Sea. *Marine Policy*, 51, 31-39. <https://doi.org/10.1016/j.marpol.2014.07.013>.
- Katsanevakis, S., Stelzenmüller, V., South, A., Sørensen, T.K., Jones, P.J., Kerr, S., Badalamenti, F., Anagnostou, C., Breen, P., Chust, G., D'Anna, G., Duijn, M., Filatova, T., Fiorentino, F., Hulsman, H., Johnson, K., Karageorgis, A.P., Kröncke, I., Mirto, S., Pipitone, C., Portelli, S., Qiu, W., Reiss, H., Sakellariou, D., Salomidi, M., van Hoof, L., Vassilopoulou, V., Fernández, T.V., Vöge, S., Weber, A., Zenetos, A., & ter Hofstede, R. (2011). Ecosystem-based marine spatial management: Review of concepts, policies, tools, and critical issues. *Ocean & Coastal Management*, 54(11), 807-820.
- Kenny, A.J., Campbell, N., Koen-Alonso, M., Pepin, P., & Diz, D. (2018). Delivering sustainable fisheries through adoption of a risk-based framework as part of an ecosystem approach to fisheries management. *Marine Policy*, 93, 232-240.
- Knez, K. (2024). Uneven development, choice of technique, and generalized worldwide law of value. *Review of Radical Political Economics*, 56(3), 405-426.
- Kørnø, L., Boess, E.R., Eliassen, S.Q., Larsen, S.V., Locher-Krause, K.E., Zhu, Y., Wittmer, H., Laporta, L.B., Geneletti, D., Monteiro, M.B., & Partidario, M.R. (2025). Beyond compliance: Enhancing biodiversity through transformative mitigation strategies in spatial planning related SEAs and EIAs. *Environmental Impact Assessment Review*, 114, 107960. <https://doi.org/10.1016/j.eiar.2025.107960>.
- Kumar, P., Das, B., Majik, S., & Bhattacharjee, S. (2024). Coastal ecosystem services: Valuation, threats, and sustainable way forward. *Journal of Agricultural Physics*, 24, 123-134.
- Laurans, Y., & Mermet, L. (2014). Ecosystem services economic valuation, decision-support system or advocacy?. *Ecosystem Services*, 7, 98-105. <https://doi.org/10.1016/j.ecoser.2013.10.002>.
- Lehtonen, M. (2017). Operationalizing information: Measures and indicators in policy formulation. In *Handbook of policy formulation* (pp. 161-181). Edward Elgar Publishing.

- Liu, S., Costanza, R., Farber, S., & Troy, A. (2010). Valuing ecosystem services: Theory, practice, and the need for a transdisciplinary synthesis. *Annals of the New York Academy of Sciences*, 1185(1), 54-78.
- Lopes, R., & Videira, N. (2013). Valuing marine and coastal ecosystem services: An integrated participatory framework. *Ocean & Coastal Management*, 84, 153-162.
- Lopes, R., & Videira, N. (2013). Valuing marine and coastal ecosystem services: An integrated participatory framework. *Ocean & Coastal Management*, 84, 153-162.
- Luisetti, T., Turner, R.K., Bateman, I.J., Morse-Jones, S., Adams, C., & Fonseca, L. (2011). Coastal and marine ecosystem services valuation for policy and management: Managed realignment case studies in England. *Ocean & Coastal Management*, 54(3), 212-224.
- Ma, L., Hong, L., & Liang, X. (2025). Integrating ecological and economic approaches for ecosystem services and biodiversity conservation: Challenges and opportunities. *Ecologies*, 6(4), 70. <https://doi.org/10.3390/ecologies6040070>.
- Mahipal, M., & Wahyudin, Y. (2019). Law study on the application of environmental loss assessment in the coastal zone of Indonesia. *Jurnal Cendekia Ihya*, 2(1), 43-55. <https://ssrn.com/abstract=3432085>.
- Mahipal, M., Wahyudin, M.N.H., Wahyudin, M.Y., Arkham, M.N., Riadi, S., Dewantara, E.C., & Wahyudin, Y. (2025). The effectiveness of environmental dispute resolution through non-litigation in the territorial waters and jurisdictional waters of the Republic of Indonesia. *Jurnal Segara*, 20(1), 15-26.
- Mehvar, S., Filatova, T., Dastgheib, A., de Ruyter van Steveninck, E., & Ranasinghe, R. (2018). Quantifying economic value of coastal ecosystem services: A review. *Journal of Marine Science and Engineering*, 6(1), 5. <https://doi.org/10.3390/jmse6010005>.
- Millennium Ecosystem Assessment [MEA]. (2005). *Ecosystems and human well-being*. Washington, DC: Island Press. Vol.5, p. 563.
- Niner, H.J., & Randalls, S. (2021). Good enough for governance? Audit and marine biodiversity offsetting in Australia. *Geoforum*, 120, 38-4.
- Noble, M. M., Harasti, D., Pittock, J., & Doran, B. (2019). Understanding the spatial diversity of social uses, dynamics, and conflicts in marine spatial planning. *Journal of Environmental Management*, 246, 929-940.
- O'Hagan, A.M. (2020). Ecosystem-based management (EBM) and ecosystem services in EU law, policy and governance. In *Ecosystem-based management, ecosystem services and aquatic biodiversity: Theory, tools and applications* (pp. 353-372). Cham: Springer International Publishing.
- Olander, L.P., Johnston, R.J., Tallis, H., Kagan, J., Maguire, L.A., Polasky, S., Urban, D.L., Boyd, J., Wainger, L., & Palmer, M. (2018). Benefit relevant indicators: Ecosystem services measures that link ecological and social outcomes. *Ecological Indicators*, 85, 1262-1272. <https://doi.org/10.1016/j.ecolind.2017.12.001>.
- Ostrom, E. (2009). A general framework for analyzing sustainability of social-ecological systems. *Science*, 325(5939), 419-422.
- Öz, M., Üstüner, E., Çifci, S., Budak, F., İleri, E., & Dikel, S. (2025). Artificial intelligence for fish disease diagnosis and management: innovations, challenges, and One Health implications. *Aquaculture International*, 33(7), 1-36.
- Pacifico, A.M., Mulazzani, L., & Malorgio, G. (2025). Are the economic valuations of marine and coastal ecosystem services supporting policymakers? A systematic review and remaining gaps and challenges. *Frontiers in Marine Science*, 11, 1501812.
- Papageorgiou, M. (2016). Coastal and marine tourism: A challenging factor in marine spatial planning. *Ocean & Coastal Management*, 129, 44-48.
- Peters, B.G., & Fontaine, G. (2022). Introduction to the research handbook of policy design: Operationalizing the policy design framework. In *Research Handbook of Policy Design* (pp. 1-38). Edward Elgar Publishing.

- Plummer, R., & Armitage, D. (2007). A resilience-based framework for evaluating adaptive co-management: Linking ecology, economics and society in a complex world. *Ecological Economics*, 61(1), 62-74.
- Prasad, A. (2025). Effective strategies in monitoring, control, commissioning, and handover. In *Handbook of Construction Project Management* (pp. 749-785). Singapore: Springer Nature Singapore.
- Primmer, E., & Furman, E. (2012). Operationalising ecosystem service approaches for governance: Do measuring, mapping and valuing integrate sector-specific knowledge systems?. *Ecosystem Services*, 1(1), 85-92.
- Rawluk, A., Ford, R., Anderson, N., & Williams, K. (2019). Exploring multiple dimensions of values and valuing: a conceptual framework for mapping and translating values for social-ecological research and practice. *Sustainability Science*, 14(5), 1187-1200.
- Reis-Filho, J.A., Hatje, V., & Barros, F. (2024). Navigating blue justice: Policy gaps and conflicts in coastal development from small-scale fisher perspectives. *One Earth*, 7(10), 1786-1802.
- Remoundou, K., Koundouri, P., Kontogianni, A., Nunes, P. A., & Skourtos, M. (2009). Valuation of natural marine ecosystems: an economic perspective. *Environmental Science & Policy*, 12(7), 1040-1051.
- Rubio-Mozos, E., García-Muiña, F. E., & Fuentes-Moraleda, L. (2020). Sustainable strategic management model for hotel companies: A multi-stakeholder proposal to “walk the talk” toward SDGS. *Sustainability*, 12(20), 8652.
- Schleyer, C., Görg, C., Hauck, J., & Winkler, K.J. (2015). Opportunities and challenges for mainstreaming the ecosystem services concept in the multi-level policy-making within the EU. *Ecosystem Services*, 16, 174-181.
- Schultz, L., Folke, C., Österblom, H., & Olsson, P. (2015). Adaptive governance, ecosystem management, and natural capital. *Proceedings of the National Academy of Sciences*, 112(24), 7369-7374.
- Shih, Y.C. (2024). Ocean governance in practice: A study of the application of marine science and technology research techniques to maritime law enforcement in Taiwan. *Marine Policy*, 163, 106081.
- Shurson, G. (2025). Sustainable transformation of intensive livestock production systems is not a return to “Old McDonald’s Farm”. In *Intensive Livestock Production in Transition: Analyses, Concepts and Strategies for Sustainability Transformation of the Livestock Value Chain* (pp. 509-530). Cham: Springer Nature Switzerland.
- Stephenson, R.L., Paul, S., Wiber, M., Angel, E., Benson, A J., Charles, A., Chouinard, O., Clemens, M., Edwards, D., Foley, P., Jennings, L., Jones, O., Lane, D., Mclsaac, J., Mussells, C., Neis, B., Nordstrom, B., Parlee, C., Pinkerton, E., Saunders, M., Squires, K., & Sumaila, U.R. (2018). Evaluating and implementing social-ecological systems: A comprehensive approach to sustainable fisheries. *Fish and Fisheries*, 19(5), 853-873. <https://doi.org/10.1111/faf.12296>.
- Tammi, I., Mustajärvi, K., & Rasinmäki, J. (2017). Integrating spatial valuation of ecosystem services into regional planning and development. *Ecosystem Services*, 26, 329-344.
- Teena Jayakumar, T.K., & Sarkar, U.K. (2024). Habitat degradation in coral reef ecosystems and mangroves: Current status and management measures. In *Sustainable Management of Fish Genetic Resources* (pp. 111-149). Singapore: Springer Nature Singapore.
- Tihanyi, L., Graffin, S., & George, G. (2014). Rethinking governance in management research. *Academy of Management Journal*, 57(6), 1535-1543.
- Tuda, A. O., Stevens, T. F., & Rodwell, L. D. (2014). Resolving coastal conflicts using marine spatial planning. *Journal of Environmental Management*, 133, 59-68.
- Verburg, R., Selnes, T., & Verweij, P. (2016). Governing ecosystem services: National and local lessons from policy appraisal and implementation. *Ecosystem Services*, 18, 186-197.
- Wahyudin, Y. (2007). An economic value of the natural seaweed resources. Available at SSRN. <http://dx.doi.org/10.2139/ssrn.1678973>.

- Wahyudin, Y. (2013). The socio-economics value of seaweed: Case study of south Tanimbar and Selaru subdistrict, West Maluku Tenggara district, Maluku province. *Majalah Ilmiah Globe*, 15(1), 77-85. <https://ssrn.com/abstract=2407287>.
- Wahyudin, Y. (2022). Analisis ekonomi keterkaitan ekosistem lamun dan sumberdaya ikan di kawasan konservasi padang lamun Pulau Bintan. *Jurnal Akuatika Indonesia*, 7(2), 42-49. <https://doi.org/10.24198/jaki.v7i2.35874>.
- Wahyudin, Y. (2023a). Penilaian klaim kerugian lingkungan hidup akibat rusaknya terumbu karang di perairan Batu Berhanti Kecamatan Belakang Padang Kota Batam Provinsi Kepulauan Riau. *Prosiding Forum Ahli Penegakan Hukum Lingkungan Hidup KLHK*, 220-233.
- Wahyudin, Y. (2025). Marine audit as an early detection tool for conflicts and zoning violations in Indonesian coastal areas. *Jurnal Segara*, 20(1), 27-40.
- Wahyudin, Y. (2018). Analisis bioekonomi perikanan lamun di wilayah pesisir timur Pulau Bintan. *Jurnal Mina Sains*, 4(1), 17-25.
- Wahyudin, Y. (2019). Small islands resources economic valuation. *Researcher's Association on Marine and Fisheries Social Ecological System (RAMFiSES)*. Available at SSRN. <https://dx.doi.org/10.2139/ssrn.3685943>.
- Wahyudin, Y. (2020). Study of claims for compensation of damage to coral reef ecosystem due to vessel grounded in the waters area of Cilik island, Karimunjawa subdistrict, Jepara regency, Central Java province. *Indonesian Journal of Social Research (IJSR)*, 2(1), 111-118. <https://doi.org/10.30997/ijsr.v2i1.27>.
- Wahyudin, Y. (2023b). Introduction of zakat-infaq-shadaqah (ZIS) parameters in the Gordon-Schaefer fisheries bioeconomic model. *Journal of Engineering Science and Technology*, 18(6), 1-8.
- Wahyudin, Y., Mahipal, M., Lesmana, D., Farizal, F., & Hultera, H. (2023). Feasibility and suitability assessment model for small island development sites based social-ecological systems approach: Mapping the most influenced factors and interest of three pillar partnership. *Journal of Engineering Science and Technology*, 18(3), 41-48.
- Wahyudin, Y., & Adrianto, L. (2012). Economic analysis of natural resources and environment in Lombok strait. *PKSPL-IPB Working Paper*, 3(1). 1-36. <http://dx.doi.org/10.2139/ssrn.2166187>.
- Wahyudin, Y., & Mahipal, M. (2020). Lesson learned on coral reef ecosystem services valuation damage due to vessel grounded in Indonesia. *IOP Conference Series: Earth and Environmental Science*, 414(1), 012030. <https://dx.doi.org/10.1088/1755-1315/414/1/012030>.
- Wahyudin, Y., & Mahipal. (2024a). Developing model of sharia-based fisheries management (SBFM). *Journal of Fisheriescience.com*, 19(4), 1-5.
- Wahyudin, Y., & Mahipal. (2024b). Pengelolaan perikanan berkelanjutan berbasis bioekonomi syariah. *Jurnal Segara*, 19(2), 147-58.
- Wahyudin, Y., Kusumastanto, T., & Sobari, M.P. (2006). Optimum fisheries resources allocation at the waters of Palabuhanratu bay: Demersal fisheries resources. *Jurnal Pesisir dan Lautan*, 7(2), 1-23. <http://dx.doi.org/10.2139/ssrn.1677443>.
- Wahyudin, Y., Kusumastanto, T., Adrianto, L., & Wardiatno, Y. (2016). Jasa ekosistem lamun bagi kesejahteraan manusia. *Omni-Akuatika*, 12(3), 29-46. <http://dx.doi.org/10.20884/1.oa.2016.12.3.122>.
- Wahyudin, Y., Mahipal, M., Arkham, M.N., & Solihin, A. (2019a). Development on the fishermen's resilience index modeling in Indonesia. *Journal on Marine and Social Ecological System (JoMFiSES)*, 1(1), 76-91. <https://ssrn.com/abstract=3479711>.
- Wahyudin, Y., Mahipal, M., Arkham, M.N., Riadi, S., & Lesmana, D. (2022). Potensi nilai kehilangan jasa ekosistem terumbu karang Pulau Pari, Kepulauan Seribu, DKI Jakarta. *Aurelia Journal*, 4(2), 251-264.
- Wahyudin, Y., Mahipal, M., Lesmana, D., Wahyudin, M.Y., & Wahyudin, M.N.H. (2023a). Neraca aset sumberdaya pesisir dan laut Pulau Panggang dan Pulau Semak Daun Kepulauan Seribu DKI Jakarta. *Jurnal Mina Sains*, 9(2), 92-104. <https://doi.org/10.30997/jmss.v9i2.10156>.

- Wahyudin, Y., Mahipal, M., Riadi, S., Dewantara, E.C., Wahyudin, M.Y., Wahyudin, M.N.H., & Wahyudin, A.A.P. (2025b). Extended valuation of coral reef ecosystem services (2017–2025): Model and policy insight. *Egyptian Journal of Aquatic Biology & Fisheries*, 29(5), 827-844. <https://doi.org/10.21608/ejabf.2025.415203.6425>.
- Wahyudin, Y., Mahipal, M., Wahyudin, M.Y., & Wahyudin, M.N.H. (2025a). Waqf model for mangrove, seagrass, and coral ecosystem services management of coastal and marine resources conservation area for human welfare. *Egyptian Journal of Aquatic Biology & Fisheries*, 29(1), 2203-2242. <https://doi.org/10.21608/ejabf.2025.412258>.
- Wahyudin, Y., Mahipal, M., Yusuf, M.A., Riadi, S., Dewantara, E.C., Wahyudin, M.N.H., Wahyudin, M.Y., & Wahyudin, A.A.P. (2025c). Participatory marine spatial audit lesson from Bekasi Regency. *Jurnal Segara*, 20(2), 203-210.
- Wahyudin, Y., Mulyana, D., Ramli, A., Rikardi, N., Suhartono, D., & Kesewo, A.T. (2019a). Nilai ekonomi keanekaragaman hayati pesisir dan laut Indonesia. *Jurnal Cendekia Ihya*, 2(2), 37-51. <https://ssrn.com/abstract=3527424>.
- Wahyudin, Y., Purnama, H., Teguh, I., Randy, A.F., Trihandoyo, A., Ramli, A., & Arkham, M.N. (2017). Analisis manfaat biaya program orang tua asuh pohon mangrove di wilayah pesisir Karawang. *Jurnal Mina Sains*, 3(2), 23–34.
- Wilkinson, C., & Salvat, B. (2012). Coastal resource degradation in the tropics: Does the tragedy of the commons apply for coral reefs, mangrove forests and seagrass beds. *Marine Pollution Bulletin*, 64(6), 1096-1105.
- Williams, G.D., Andrews, K.S., Brown, J.A., Gove, J.M., Hazen, E.L., Leong, K.M., Montenero, K.A., Moss, J.H., Rosellon-Druker, J.M., Schroeder, I.D., Siddon, E., Szymkowiak, M., Whitehouse, G.A., Zador, S.G., & Harvey, C.J. (2021). Place-based ecosystem management: adapting integrated ecosystem assessment processes for developing scientifically and socially relevant indicator portfolios. *Coastal Management*, 49(1), 46-71. <https://doi.org/10.1080/08920753.2021.1846154>.
- Wu, W., & Wan, L. (2024). Coastal ecological and environmental management under multiple anthropogenic pressures: A review of theory and evaluation methods. *Current Trends in Estuarine and Coastal Dynamics*, 385-415.
- Yu, Y., Bao, Y., Zhang, Q., Shen, P., Yang, H., & Xu, Z. (2023). Evaluation of marine resources environmental responsibility audit based on PSR framework. *Ocean & Coastal Management*, 245, 106742.