



When the Sea Becomes an Extraction Zone: Mining, Sedimentation, and the Future of Coastal Fishers in Indonesia

Andi Muhammad Hanafi*

Universitas Muhammadiyah Makassar, Makassar, Indonesia

hanafi_andi@gmail.com

DOI: <https://doi.org/10.65815/0sycg504>

Submitted: 18-01-20256

Revised: 29-03-2026, 18-06-2026

Accepted: 22-07-2026

*Corresponding Author

Abstract

Indonesia's coastal and marine spaces are increasingly subject to competing demands for extraction, infrastructure, conservation, transportation, fisheries, and industrial development. The expansion of marine mining and sand extraction raises fundamental questions about who has the authority to determine the use of coastal space and who bears the ecological consequences. This article examines conflicts surrounding marine extraction, with particular attention to sedimentation, coastal ecosystem degradation, fishing grounds, and the rights of traditional fishers. It argues that the transformation of marine space into an extraction zone can undermine livelihoods that depend on relatively stable coastal ecosystems while concentrating economic benefits among industrial and commercial actors. Sedimentation and habitat alteration may affect fisheries, mangroves, seagrass, and coral-associated ecosystems, creating cumulative impacts that are difficult to capture through conventional project-based environmental assessments. Drawing on marine political ecology and environmental-justice perspectives, the article investigates the distribution of benefits, risks, and decision-making power in coastal development. It emphasizes that traditional fishers should not be treated merely as stakeholders to be consulted after development decisions have been made. Their livelihoods and territorial relationships with the sea require substantive recognition within marine spatial planning. The article concludes that sustainable coastal governance must prioritize ecological integrity, livelihood security, participatory decision-making, and equitable access to marine resources.

[Ruang pesisir dan laut Indonesia semakin menjadi sasaran persaingan tuntutan untuk ekstraksi, infrastruktur, konservasi, transportasi, perikanan, dan pembangunan industri. Ekspansi penambangan laut dan ekstraksi pasir menimbulkan pertanyaan mendasar tentang siapa yang berwenang menentukan penggunaan ruang pesisir dan siapa yang menanggung konsekuensi ekologisnya. Artikel ini mengkaji konflik seputar ekstraksi laut, dengan perhatian khusus pada sedimentasi, degradasi ekosistem pesisir, lahan penangkapan ikan, dan hak-hak nelayan tradisional. Artikel ini



berpendapat bahwa transformasi ruang laut menjadi zona ekstraksi dapat merusak mata pencaharian yang bergantung pada ekosistem pesisir yang relatif stabil, sementara keuntungan ekonomi terkonsentrasi di antara pelaku industri dan komersial. Sedimentasi dan perubahan habitat dapat memengaruhi perikanan, hutan mangrove, lamun, dan ekosistem yang terkait dengan terumbu karang, menciptakan dampak kumulatif yang sulit ditangkap melalui penilaian lingkungan berbasis proyek konvensional. Dengan mengacu pada ekologi politik kelautan dan perspektif keadilan lingkungan, artikel ini menyelidiki distribusi manfaat, risiko, dan kekuatan pengambilan keputusan dalam pembangunan pesisir. Artikel ini menekankan bahwa nelayan tradisional tidak boleh hanya diperlakukan sebagai pemangku kepentingan yang dikonsultasikan setelah keputusan pembangunan dibuat. Mata pencaharian dan hubungan teritorial mereka dengan laut memerlukan pengakuan substantif dalam perencanaan tata ruang laut. Artikel ini menyimpulkan bahwa tata kelola pesisir yang berkelanjutan harus memprioritaskan integritas ekologis, keamanan mata pencaharian, pengambilan keputusan partisipatif, dan akses yang adil terhadap sumber daya laut.]

Keywords: marine extraction, coastal justice, sedimentation, traditional fishers, marine political ecology

Introduction

Indonesia's coastal and marine spaces are increasingly becoming arenas of competing claims over fisheries, conservation, infrastructure, transportation, tourism, mining, and other forms of industrial development. This transformation is significant because coastal environments function simultaneously as ecological systems, economic resources, and livelihood territories. For small-scale fishers, access to productive marine areas is directly connected to household income, food security, and social reproduction. The expansion of industrial activities therefore raises a question that cannot be answered solely through the language of economic development: who has the authority to determine the use of marine space, whose interests are prioritized, and who bears the ecological costs of that allocation? These questions are particularly important in Indonesia because the state possesses extensive regulatory authority over coastal and marine resources, while communities have long developed social and economic relationships with particular fishing grounds and coastal ecosystems. The resulting tension is not simply between development and conservation but between competing claims over marine space, access, livelihood, and authority.

The concept of ocean grabbing provides an important analytical entry point for understanding this transformation. Bennett, Govan, and Satterfield (2015) explain that ocean grabbing involves processes through which marine resources or spaces are appropriated or reallocated in ways that can undermine the access, control,

livelihoods, or well-being of small-scale fishing communities. The concept is particularly useful because it directs attention beyond the formal legality of an individual development project. A project may possess a government-issued license and still generate socially unjust consequences if the allocation of marine space systematically reduces the ability of fishing communities to access resources upon which they depend. Ocean grabbing therefore concerns not merely exclusion from a physical area but changes in the distribution of rights, access, benefits, risks, and decision-making power.

In the Indonesian context, this issue is closely connected to the legal status of coastal and marine resources. Law No. 27 of 2007 concerning the Management of Coastal Areas and Small Islands establishes that coastal and small-island resources constitute natural wealth controlled by the state and must be managed sustainably for the greatest prosperity of the people. Importantly, the law also recognizes the importance of community aspirations and participation in coastal management. The statute has subsequently been amended, including through Law No. 1 of 2014 and later legislation associated with the Job Creation framework. The legal framework consequently creates a dual obligation: the state has authority to regulate marine resources, but that authority must be exercised consistently with sustainability and the interests and participation of coastal communities. The central legal question is therefore not whether the state may regulate marine space, but how that authority should be exercised when industrial allocation conflicts with established fishing livelihoods and ecological functions.

The protection of fishers is reinforced by Law No. 7 of 2016 concerning the Protection and Empowerment of Fishers, Fish Farmers, and Salt Farmers. The statute explicitly recognizes the dependence of fishers upon fish resources, environmental conditions, infrastructure, business certainty, capital, technology, and information. It consequently establishes protection and empowerment as state responsibilities rather than treating fishing communities merely as beneficiaries of economic policy. This legal recognition is important because environmental degradation can affect fishers without directly removing them from their homes or formally prohibiting access to the sea. When ecological changes reduce fish abundance, increase travel distances, or make fishing less economically viable, the resulting harm can occur through the gradual erosion of livelihood conditions. The legal concept of protection must therefore be understood substantively: protecting fishers requires protecting the ecological conditions that make fishing livelihoods possible.

One of the most important pathways through which extraction can affect those conditions is sedimentation. Sedimentation is not merely a physical process involving the accumulation of suspended materials. Excessive sediment loads can alter water quality and coastal habitats and may affect ecosystems that support fisheries. For fishing communities, these ecological changes can translate into declining catches, altered fishing grounds, longer travel distances, increased fuel costs, and greater livelihood uncertainty. The significance of sedimentation therefore lies in its capacity to connect industrial transformation with social

consequences. A community may remain physically present and legally entitled to fish while experiencing a progressive deterioration in the ecological productivity of the waters on which its livelihood depends. This constitutes a form of functional dispossession, in which nominal access remains but the ecological value of that access is progressively diminished.

The issue becomes more difficult when marine development is assessed primarily through individual projects. Marine ecosystems are spatially connected, while sediment, pollutants, and ecological disturbances can move beyond the geographical boundaries of a single concession or project. Consequently, the effects of extraction may extend to fishing grounds, mangroves, seagrass ecosystems, coral-associated habitats, and other areas that are economically important to communities. Project-by-project assessment can therefore underestimate cumulative impacts when several activities occur within the same coastal system. The problem is not necessarily that individual projects have no environmental safeguards; rather, the regulatory unit may be too narrow to capture the ecological system within which those projects operate. This raises an important question concerning whether existing environmental governance adequately accounts for cumulative, spatially distributed, and socially differentiated environmental impacts.

Marine spatial planning is intended, in part, to address precisely this problem by coordinating competing uses of marine space. Indonesia has increasingly adopted marine spatial planning as a mechanism for organizing fisheries, conservation, infrastructure, transportation, and other marine activities. However, Wen et al. (2022) identify significant challenges in implementing marine spatial planning in Indonesia, including institutional coordination, data availability, legalization, licensing, stakeholder involvement, and competing interests. Their findings demonstrate that spatial planning is not simply a technical exercise of drawing boundaries on a map. It is also a governance process through which competing interests acquire institutional recognition and access to marine space. Consequently, the existence of a marine spatial plan does not automatically guarantee a fair distribution of marine resources or environmental burdens.

The problem is particularly acute when traditional fishers are treated merely as stakeholders rather than as communities whose livelihoods depend upon continued access to functioning marine ecosystems. Consultation can satisfy a procedural requirement without necessarily altering the substantive decision. A community may be invited to express concerns about a proposed extraction activity while the basic allocation of marine space has already been determined. In such circumstances, participation risks becoming a mechanism for legitimizing decisions rather than a means of redistributing decision-making power. This distinction is important for evaluating the adequacy of marine governance because genuine participation requires more than information sharing or consultation; it requires opportunities for affected communities to influence decisions concerning activities that may fundamentally alter their livelihood territories.

The Indonesian legal framework provides a basis for demanding such protection. Law No. 27 of 2007 emphasizes sustainable management and community participation, while Law No. 7 of 2016 establishes a specific framework for protecting and empowering fishers. At the constitutional level, Article 33(3) of the 1945 Constitution establishes state control over natural resources for the greatest prosperity of the people. These provisions should not be interpreted independently. State control over natural resources creates a public responsibility to ensure that resource allocation does not merely maximize commercial value but also protects the public interest, ecological sustainability, and livelihood security. The legal challenge emerges when the state simultaneously acts as regulator, allocator, and promoter of investment. Such institutional convergence can create tensions between developmental objectives and the protection of communities whose livelihoods depend on the resources being allocated.

This tension was also addressed by the Constitutional Court in Decision No. 3/PUU-VIII/2010, which concerned provisions of the Coastal Areas and Small Islands Management Law. The Court's consideration is particularly important because the case involved the relationship between state authority over coastal resources and the rights and interests of coastal communities. The existence of this constitutional litigation demonstrates that the allocation of coastal space is not merely an administrative or economic issue; it can raise fundamental questions concerning constitutional rights, public control over natural resources, and the protection of communities dependent on coastal environments. The fact that Law No. 27 of 2007 records this constitutional review in its regulatory history further confirms the importance of the decision in understanding Indonesia's coastal governance framework.

The resulting problem can therefore be understood as a question of distribution and institutional power. Industrial extraction can generate substantial economic benefits through investment, employment, downstream processing, taxation, and export revenues. Yet the ecological risks associated with extraction may be concentrated geographically among communities living closest to the affected marine ecosystems. Small-scale fishers may bear reduced catches, higher operating costs, loss of productive fishing grounds, and increased environmental uncertainty, while the economic benefits are distributed across companies, investors, workers, consumers, and government institutions. This geographical separation between beneficiaries and risk-bearers makes marine extraction an important case of environmental distribution. The question is consequently not whether extraction produces economic benefits, but how those benefits and ecological costs are distributed and whether the distribution is institutionally justifiable.

The concept of ocean grabbing reinforces this argument by emphasizing that changes in marine resource allocation should be evaluated according to their effects on governance, human security, and social-ecological well-being (Bennett, Govan, and Satterfield 2015). From this perspective, a legally authorized extraction project should not automatically be considered socially legitimate. Its legitimacy

should also be assessed according to whether the allocation process adequately recognizes affected communities, whether environmental risks are appropriately assessed, whether participation is meaningful, and whether livelihood impacts are fairly addressed. Such an approach does not imply that all marine extraction must be prohibited. Rather, it establishes a higher threshold for determining when development can be considered compatible with coastal justice.

Against this background, this article argues that the transformation of Indonesian coastal waters into extraction zones represents not merely a conflict between economic development and environmental conservation but a deeper struggle over marine territory, ecological integrity, livelihood security, and decision-making authority. Sedimentation is examined as one pathway through which extraction can alter the ecological foundations of coastal fisheries and redistribute environmental risks toward traditional fishing communities. The article further argues that fishers should not be positioned merely as stakeholders whose opinions are collected after development priorities have been established. Their livelihood dependence, legal status, and relationship with marine ecosystems require substantive consideration within marine spatial planning and environmental decision-making. Sustainable coastal governance therefore requires more than balancing competing economic activities; it requires institutional arrangements capable of ensuring that marine development does not systematically transfer ecological and livelihood costs to communities with the least power to influence the decisions that produce those costs.

Previous Studies and Theoretical Framework

1. From Coastal Development to Marine Extraction

Research on coastal development increasingly demonstrates that the expansion of industrial and commercial activities can transform the ecological and socioeconomic foundations of small-scale fisheries. Rather than viewing the coast as a collection of independent sectors—fisheries, ports, tourism, conservation, and industry—recent scholarship emphasizes the cumulative effects produced when multiple forms of development occupy the same marine space. In Southeast Asia, for example, the expansion of aquaculture, land reclamation, industrial zones, tourism, and other maritime developments has contributed to environmental degradation, declining access to fishing grounds, and an increasingly intense “coastal squeeze” experienced by small-scale fishing communities (Fabinyi et al. 2022). This perspective is particularly relevant to Indonesia, where coastal development frequently occurs in areas already intensively used by fishing communities.

The Indonesian experience also demonstrates that contemporary marine conflicts are connected to longer institutional histories. A historical analysis of Indonesian marine governance shows that marine institutions have been shaped over centuries by economic interests and state practices that have frequently treated the sea as a source of revenue and economic development (Campbell et al. 2022).

The persistence of these institutional arrangements helps explain why contemporary efforts to create more inclusive and sustainable marine governance encounter significant resistance. Marine governance is therefore not simply a technical process of allocating space among competing activities; it is an institutional process shaped by historical patterns of authority, economic interests, and political power.

This historical perspective is important for understanding marine extraction. When a coastal area is designated for mining, industrial infrastructure, port development, or other investment, the decision may appear to concern only the future use of a particular geographic area. In practice, however, it can alter pre-existing relationships between communities and marine ecosystems. Recent research in Jakarta, for instance, found that three decades of coastal development—including port expansion, property development, and beach reclamation—were associated with reductions in mangroves, ponds, and fishing grounds, while industrial areas expanded. The study further identified significant relationships between ecosystem conditions, fishing effort, catches, and fishing income (Rachman, Huang, and Suadi 2025). Such evidence demonstrates that changes in marine space can ultimately become changes in household economic security.

The vulnerability of Indonesian small-scale fisheries is particularly significant because fisheries-dependent households already face substantial socioeconomic and environmental pressures. Research published in *Marine Policy* estimates that approximately 2.5 million Indonesian households are involved in small-scale fisheries and emphasizes their vulnerability to poverty, declining ecosystem health, and climate-related pressures (Sharma et al. 2021). The study also finds that livelihood interventions are more likely to produce positive outcomes when they are inclusive, participatory, locally situated, and implemented through collaboration among communities, government, and other actors. Consequently, policies that reduce access to productive marine environments can have effects extending well beyond the immediate loss of fishing space.

2. Ocean Grabbing and the Redistribution of Marine Space

The concept of ocean grabbing provides a more specific theoretical framework for examining these transformations. Bennett, Govan, and Satterfield (2015) argue that ocean grabbing involves the appropriation or dispossession of marine resources and spaces in ways that deprive small-scale fishers and coastal communities of use, control, or access. Importantly, they emphasize that ocean grabbing should be assessed through governance, human security, and social-ecological well-being rather than solely through the formal legality of resource allocation.

This distinction is particularly important for the analysis of marine mining. A fishing community does not necessarily need to be formally expelled from a coastal area to experience dispossession. Restrictions on navigation, deterioration of fishing grounds, declining catches, increased operating costs, or reduced access to productive habitats may produce similar livelihood consequences. Ocean grabbing

therefore allows the analysis to move beyond physical displacement toward the broader question of whether communities retain effective access and control over the ecological resources necessary for their livelihoods.

Research on small-scale fisheries has increasingly connected ocean grabbing with broader forms of blue injustice. Bennett et al. (2019), for example, identify dispossession, environmental degradation, livelihood impacts, loss of access to marine resources, inequitable distribution of economic benefits, and exclusion from governance as interconnected risks associated with blue growth. These problems demonstrate that the language of the “blue economy” can obscure significant distributive and procedural questions when economic growth becomes the dominant objective of ocean governance. The critical issue is therefore not whether marine development is labeled sustainable or blue, but whether its benefits and burdens are distributed equitably.

More recent research strengthens this argument through the concept of blue justice. Blue justice challenges ocean-development models that prioritize economic growth while marginalizing the interests and knowledge of small-scale fishing communities. Jentoft et al. (2022) argue that blue justice requires attention to the different forms of injustice experienced by small-scale fisheries communities, including the appropriation of customary fishing grounds and the failure to recognize fishers as legitimate knowledge holders. Justice therefore involves not only the final distribution of resources but also the ability of communities to explain, articulate, and have recognized their own experiences of environmental change.

3. Blue Justice: Distribution, Recognition, and Participation

The blue-justice framework is particularly useful because it incorporates three interconnected dimensions of environmental justice: distributional, procedural, and recognitional justice. Distributional justice concerns who receives benefits and who bears environmental costs. Procedural justice concerns who participates in decision-making and whether participation can actually influence outcomes. Recognitional justice concerns whether particular communities, identities, knowledge systems, and relationships with nature are treated as legitimate within governance institutions.

These dimensions are particularly relevant to small-scale fisheries because marine governance decisions can produce unequal consequences even when formal consultation procedures are followed. Gustavsson et al. (2021), for example, demonstrate that procedural inequalities in fisheries governance can influence distributive outcomes, while marginalized groups may remain underrepresented in decision-making. Although their study emphasizes gender, its broader conceptual contribution is important for the present research: participation cannot be separated from power. A community may technically participate in a consultation while possessing little capacity to influence the allocation of marine space.

This issue is further demonstrated by research on coastal development and blue justice. A recent study using participatory mapping, fisher narratives, and remote

sensing found that coastal development can generate multiple conflicts involving marine traffic, industrial activities, ports, pollution, and loss of fishing access. The authors argue that incorporating small-scale fishers' perspectives is essential for equitable coastal development (2024). This finding reinforces the importance of treating fishers not merely as recipients of policy but as knowledge holders and political actors whose understanding of fishing grounds and ecological change can contribute directly to marine governance.

The Indonesian context provides particularly strong support for this approach. Research on traditional fisheries management demonstrates that institutions such as *petuanan laut* and *sasi laut* have historically functioned as systems for regulating marine access and resource use. These arrangements can potentially be transformed into contemporary territorial-based fisheries management rights (2020). Their significance extends beyond cultural heritage. They demonstrate that marine governance can be based upon territorial relationships and locally recognized rules rather than exclusively upon centralized state licensing.

4. Marine Spatial Planning and the Politics of Allocation

Marine Spatial Planning (MSP) is frequently presented as a solution to conflicts among competing marine uses. Its basic objective is to coordinate different activities spatially while protecting ecological functions and promoting sustainable development. However, MSP is itself a political process because spatial allocation determines which activities receive priority and which activities are restricted.

In Indonesia, the implementation of MSP has encountered institutional and political difficulties. Wen et al. (2022) identify problems involving coordination, data, legalization, licensing, and stakeholder engagement. These difficulties suggest that the effectiveness of MSP cannot be measured simply by the existence of formal spatial plans. The critical question is whether spatial planning can actually overcome the historical fragmentation and unequal power relations embedded within marine governance.

Campbell et al. (2022) reach a similar conclusion from a historical-institutional perspective. Their analysis shows that contemporary Indonesian marine governance is constrained by institutional trajectories in which marine spaces have historically been governed in ways that facilitate economic extraction. This path dependence means that introducing new concepts such as marine spatial planning does not necessarily transform the underlying political economy of marine governance. Existing institutions, interests, and administrative practices may continue to shape how spatial plans are interpreted and implemented.

This creates a significant analytical problem for coastal fishers. If marine spatial planning allocates a fishing ground to industrial extraction, the resulting conflict cannot be understood simply as an incompatibility between two activities. The allocation itself represents a political decision about whose use of marine space receives institutional priority. Consequently, MSP should be evaluated not only according to whether different sectors have been spatially separated but also

according to whether the allocation process satisfies principles of fairness, recognition, participation, and ecological sustainability.

5. Sedimentation and Ecological Foundations of Fishing Livelihoods

Within this broader framework, sedimentation becomes an important mechanism linking marine extraction to environmental justice. The significance of sedimentation lies in its ability to transform ecological conditions without necessarily producing immediate or visible physical displacement. A fishing community may remain in the same village and continue to possess nominal access to the sea while the ecological productivity of its fishing grounds gradually declines.

This distinction is important because small-scale fisheries depend strongly upon ecosystem conditions. Rachman, Huang, and Suadi (2025) found that ecosystem conditions in Jakarta's coastal waters were positively associated with fishing effort, total catch, and fishing income. Their mapping also documented declining fishing grounds alongside the expansion of industrial areas over a thirty-year period. These findings provide empirical support for treating ecological degradation not as an isolated environmental problem but as a direct livelihood issue.

The relationship between environmental conditions and livelihood security also appears in broader Indonesian fisheries research. Sharma et al. (2021) emphasize that fishing households are particularly vulnerable to environmental degradation and that successful livelihood interventions require approaches that combine ecological, socioeconomic, and institutional dimensions. Consequently, environmental assessment that focuses narrowly on whether a particular pollutant remains below a regulatory threshold may fail to capture the wider socioeconomic consequences of ecological change.

This is where the concept of cumulative impacts becomes especially important. Marine extraction rarely occurs in an ecological vacuum. Mining, ports, shipping, reclamation, aquaculture, tourism, and other activities can occupy interconnected coastal systems. The resulting environmental pressures may interact even when each individual project has been assessed separately. From an environmental-justice perspective, cumulative impacts are significant because the same communities may repeatedly absorb the environmental consequences of multiple development decisions while the economic benefits remain dispersed across broader regional or national economies.

Marine Extraction, Sedimentation, and Coastal Justice in Indonesia

1. Extraction as a Transformation of Coastal Space

Marine extraction should not be understood simply as the removal of minerals or other resources from the seabed. It is also a process through which the physical, ecological, and socioeconomic functions of coastal space are reorganized. When a marine area is allocated for extraction, the consequences may extend beyond the immediate boundaries of the mining operation because fishing grounds, sediment transport, coral reefs, seagrass meadows, and coastal settlements are

interconnected. The central issue is therefore not merely whether extraction generates economic value, but whether the transformation of marine space redistributes access to resources and environmental risks between industrial actors and coastal communities.

Evidence from Indonesia illustrates this transformation particularly clearly. Research on coastal tin mining in Bangka Island found that the expansion of large- and small-scale tin mining was perceived by local communities as a major driver of changes in coastal ecosystems and land-tenure arrangements. These changes contributed to greater income uncertainty, while fishers experienced continuing declines in fish yields associated with coastal mining activities (Rosyida et al. 2019). The significance of this finding extends beyond tin mining. It demonstrates how extractive activities can transform an ecological system that functions simultaneously as a source of food, income, and social identity.

The consequences are particularly serious for households with limited capacity to diversify their livelihoods. Rosyida et al. (2019) found that limited capital, skills, and educational opportunities constrained the ability of affected households to move into alternative income-generating activities. Fishers were especially vulnerable because their livelihoods were directly dependent on the ecological productivity of coastal waters. In this context, the proposition that communities can simply “adapt” to environmental transformation becomes problematic. Adaptation requires resources, opportunities, and institutional support. Where these are absent, environmental degradation can instead deepen pre-existing socioeconomic inequalities.

2. Sedimentation as an Invisible Form of Dispossession

One of the most important pathways connecting marine extraction to livelihood impacts is sedimentation. Sedimentation can alter water quality, reduce habitat suitability, and affect organisms that form the ecological foundation of fisheries. Its significance for environmental justice lies partly in its ability to produce harm without necessarily producing immediate physical displacement. A fishing community may remain in its village and retain formal access to the sea while the ecological productivity of its fishing grounds gradually deteriorates.

Evidence from Bangka Island provides a particularly relevant example. Research on coastal tin mining has documented sedimentation as one of the environmental consequences associated with suction dredging, alongside coral-reef damage, coastal erosion, and water contamination (Rosyida, Sasaoka, and Saito 2018). The environmental effects therefore extend beyond the mining site itself. Sediment transported through coastal waters can affect ecosystems that are not directly occupied by mining infrastructure but remain ecologically connected to the extraction area.

Recent research provides additional evidence of ecological degradation around sea-based mining. Adi et al. (2024), examining seagrass ecosystems around sea-based tin-mining areas in the Bangka Belitung Islands, found significant habitat loss

and lower species diversity in seagrass meadows affected by mining activities. The study concluded that ecological conditions of seagrass ecosystems declined in areas influenced by sea-based tin mining. These findings are important because seagrass ecosystems provide habitat and nursery functions for marine organisms and are therefore connected to fisheries productivity.

The relationship between sediment and ecological degradation is also visible in other Indonesian coastal mining contexts. Male et al. (2024), studying informal coastal cinnabar mining on Seram Island, found elevated mercury concentrations in coastal sediments extending at least 14 kilometers along the coastline. The study also identified substantial bioavailable mercury in affected sediments, demonstrating that mining-related contamination can travel beyond the immediate location of extraction. Although mercury contamination differs from sedimentation associated with tin or nickel mining, the case demonstrates a broader principle: the ecological footprint of coastal extraction can be spatially larger than the geographical footprint of the mining operation itself.

This distinction is critical for environmental assessment. If environmental impacts are assessed primarily within the physical boundary of a concession, the assessment may fail to capture ecological processes that operate across larger coastal systems. Sediment transport, contaminant dispersion, habitat connectivity, and fish movement do not necessarily respect administrative boundaries. Consequently, the environmental consequences experienced by fishers may occur outside the area officially classified as the “impact zone.”

3. From Ecological Change to Livelihood Insecurity

Environmental degradation becomes an environmental-justice issue when ecological changes translate into unequal social and economic consequences. Small-scale fishers are particularly exposed because their livelihoods depend directly on natural-resource productivity. Research in Jakarta Bay and the Thousand Islands demonstrates this dependency clearly: local livelihoods remain strongly connected to fisheries resources despite extensive pollution and ecological degradation, while fishers with fewer alternative livelihood opportunities experience greater vulnerability (Amri et al. 2016).

This relationship means that the environmental consequences of extraction cannot be evaluated solely through ecological indicators. A reduction in habitat quality may eventually become a reduction in household income. Declining fish availability may produce increased fuel costs because fishers must travel farther from shore. Changes in species composition may require new equipment or fishing techniques. Reduced catches may increase household debt or encourage participation in alternative activities that themselves carry environmental or economic risks.

The Bangka Island case illustrates this process particularly well. Rosyida et al. (2019) found that coastal mining contributed to ecological and socioeconomic changes while households struggled to diversify their livelihoods. The implication

is important: the environmental burden of extraction is not distributed independently of social class and livelihood structure. Households with capital, alternative employment, and stronger political connections may have greater capacity to absorb or avoid environmental losses, whereas resource-dependent fishers may have few alternatives.

The resulting inequality is therefore cumulative. First, extraction alters ecological conditions. Second, ecological degradation affects fisheries. Third, declining fisheries productivity affects household income. Finally, households with limited alternative resources become more vulnerable to poverty and economic dependency. The environmental impact consequently becomes a mechanism through which existing socioeconomic inequalities can be reproduced.

4. The Politics of Consent and Compensation

The distribution of environmental risks is closely connected to the political process through which extraction is authorized. Research on coastal tin mining in Indonesia provides strong evidence that formal consultation does not necessarily produce meaningful participation. In Bangka Island, Rosyida et al. (2018) found that community acceptance of suction dredging was influenced by compensation and local political dynamics, while many fishers opposed the activity because of perceived resource depletion, declining fish quantities and prices, and limited alternative livelihoods.

This finding complicates the idea that compensation is sufficient to establish social legitimacy. Compensation can provide short-term economic benefits, but it does not necessarily compensate for ecological changes that continue to affect a community over time. Nor can financial compensation necessarily replace the cultural, social, and ecological value of a fishing ground.

The problem becomes even clearer when the decision-making process itself is unequal. Another study of coastal tin mining found that villagers initially accepted suction-dredging operations partly because they lacked information concerning potential impacts. Public consultation meetings did not necessarily guarantee active participation in decision-making, and communities did not receive equal access to the benefits generated by mining (Rosyida, Sasaoka, and Saito 2018). The issue, therefore, is not simply whether communities were “consulted,” but whether they possessed sufficient information, bargaining power, and institutional capacity to influence the decision. From a blue-justice perspective, this represents a procedural injustice. A decision may be formally participatory while substantively favoring actors with greater economic and political power. Consultation can therefore become a procedural mechanism that legitimizes predetermined development priorities rather than a genuine redistribution of decision-making authority.

5. The Unequal Geography of Benefits and Risks

Marine extraction creates a distinctive geographical distribution of economic benefits and environmental costs. Investment, mining revenues, industrial

processing, employment, and government revenues can be distributed across regional, national, and international economic networks. Environmental risks, however, are often concentrated around the extraction site and surrounding coastal communities.

This geographical asymmetry is evident in the Bangka tin-mining case. While mining generates economic opportunities, the communities closest to coastal extraction experience ecological degradation and livelihood pressures. Rosyida et al. (2019) demonstrate that fishers can become increasingly marginalized because the same ecological resources that previously supported fishing livelihoods are transformed by mining.

The issue is particularly important because fishers do not necessarily receive benefits proportional to the risks they bear. A fisher may lose access to productive waters without becoming an employee of the mining industry. A household may experience declining catches without receiving compensation. A community may face ecological degradation without possessing effective legal or political mechanisms to influence the activity responsible.

This creates what can be described as an ecological subsidy: coastal communities effectively absorb part of the environmental cost of economic activities whose benefits extend beyond the communities themselves. The concept is consistent with the environmental-justice literature, in which environmental burdens are frequently concentrated among groups possessing relatively limited political and economic power.

6. Nickel and the Emerging Coastal-Extraction Frontier

Although much of the Indonesian evidence on marine extraction has historically focused on tin mining, the expansion of nickel-related industrial development introduces a new dimension to this problem. Nickel has become strategically important to global energy-transition industries because of its role in battery supply chains. Indonesia's position as a major nickel producer has consequently encouraged rapid expansion of mining and downstream processing.

This development creates an important paradox. Nickel is associated with the global transition toward lower-carbon technologies, yet the extraction and processing of nickel can generate substantial local environmental pressures. Research examining nickel-contaminated suspended sediment has demonstrated the potential for nickel exposure to affect marine organisms. Experimental work on *Acropora muricata* found that high concentrations of dissolved nickel and laboratory-spiked nickel sediment could cause coral bleaching and nickel accumulation in coral tissue (Croteau et al. 2020).

The implication is not that all nickel mining inevitably produces identical ecological outcomes. Rather, the evidence demonstrates why the environmental consequences of nickel development need to be assessed at the level of specific ecosystems, exposure pathways, and local communities. A climate-oriented

industrial policy cannot assume that a mineral associated with clean-energy technologies is automatically environmentally benign at the extraction site.

This issue becomes particularly significant in coastal regions where nickel mining, processing, ports, and shipping infrastructure interact with marine ecosystems. The environmental risks may arise not from a single activity but from the combination of land clearing, runoff, sediment transport, industrial discharge, dredging, and increased maritime traffic. Such cumulative processes reinforce the argument that coastal extraction requires ecosystem-scale assessment rather than narrow project-level analysis.

7. Toward a Coastal Justice Framework

The evidence discussed above suggests that marine extraction should be analyzed through four interconnected questions. First, who controls marine space? Formal state authority over coastal resources does not eliminate the existence of historically established livelihood relationships. The allocation of marine space therefore involves a political decision concerning which forms of use receive institutional priority. Second, who bears ecological risk? Sedimentation, habitat loss, pollution, and ecological degradation can be concentrated around communities whose livelihoods depend directly on coastal resources. Environmental risk therefore follows existing patterns of socioeconomic vulnerability. Third, who receives the benefits? Mining and other forms of marine extraction can generate substantial economic value, but the distribution of those benefits may be geographically and socially separated from the communities experiencing environmental costs. Fourth, who participates in decision-making? The existence of consultation does not necessarily establish meaningful participation. As the Indonesian tin-mining literature demonstrates, communities can participate formally while remaining politically marginalized in decisions concerning extraction licenses (Rosyida et al. 2018).

Taken together, these questions suggest that coastal justice requires more than environmental mitigation. It requires a governance system capable of addressing distributional, procedural, and recognitional dimensions of justice simultaneously. Environmental protection must therefore be connected to livelihood protection, and participation must be connected to actual decision-making authority.

Governance, Law, and the Rights of Traditional Fishers

The ecological consequences of marine extraction cannot be separated from the legal and institutional arrangements through which coastal space is allocated. In Indonesia, the state possesses extensive authority over natural resources, including coastal and marine resources, but this authority is accompanied by constitutional and statutory obligations concerning public welfare, environmental protection, and the interests of communities whose livelihoods depend upon natural resources. The central governance question is therefore not whether the state may authorize marine extraction, but how state authority should be exercised

when economic development conflicts with ecological sustainability and the livelihood rights of traditional fishers.

1. State Control and the Constitutional Dimension

Article 33 paragraph (3) of the 1945 Constitution of the Republic of Indonesia establishes that land, water, and the natural resources contained therein are controlled by the state and used for the greatest prosperity of the people. This provision provides the constitutional foundation for state regulation of natural resources, but it does not establish an unlimited governmental power to allocate resources for commercial exploitation. State control carries a public-interest obligation: natural resources must be managed in a manner consistent with collective welfare.

The Constitutional Court's jurisprudence has been particularly important in interpreting this principle. In Constitutional Court Decision No. 3/PUU-VIII/2010, concerning the Coastal Areas and Small Islands Management Law, the Court examined the constitutional implications of granting rights over coastal and small-island areas. The decision emphasized the relationship between state control, public access, and the protection of communities dependent upon coastal resources. This jurisprudence is significant because it establishes that coastal-resource governance cannot be reduced to an ordinary licensing relationship between the government and private investors. The exercise of state authority remains subject to constitutional principles concerning public welfare and the rights of citizens.

This constitutional perspective changes how marine extraction should be understood. If state control exists for the greatest prosperity of the people, an extractive project cannot be justified solely because it generates investment, export revenue, or regional economic growth. The state must also consider whether the project produces disproportionate ecological costs for communities whose livelihoods depend upon the affected ecosystem. The constitutional concept of public prosperity therefore provides a normative basis for asking whether economic benefits and environmental burdens are distributed fairly.

2. Coastal Management and Community Participation

The principal statutory framework is Law No. 27 of 2007 concerning the Management of Coastal Areas and Small Islands, as amended by Law No. 1 of 2014. The legislation establishes principles of sustainable coastal management while providing a legal basis for the involvement of communities and recognition of their interests in coastal-resource governance. The importance of this framework lies in its rejection of an exclusively sectoral understanding of the coast. Coastal areas are simultaneously ecological, economic, social, and cultural spaces. Consequently, decisions concerning coastal development cannot reasonably be based only on the interests of a single economic sector.

Law No. 1 of 2014 was particularly important because it revised provisions concerning coastal and small-island utilization rights following the Constitutional Court's earlier intervention. The amendment reinforced the importance of community rights and participation in coastal governance. In principle, therefore, the Indonesian legal system recognizes that coastal development should not proceed through an exclusively investor-centered allocation model.

However, the existence of statutory recognition does not automatically produce substantive participation. The implementation problem remains significant because licensing and spatial-planning decisions may involve multiple government institutions operating under different sectoral mandates. This institutional fragmentation can create situations in which communities are formally recognized by one regulatory instrument while their interests are simultaneously weakened by another.

3. Protection of Fishers as a Legal Obligation

The legal position of traditional fishers is further strengthened by Law No. 7 of 2016 concerning the Protection and Empowerment of Fishers, Fish Farmers, and Salt Farmers. The law recognizes fishers as a social and economic group requiring protection and empowerment rather than simply as participants in a market economy.

This distinction is important in the context of marine extraction. If environmental degradation reduces catches, increases fishing costs, or destroys fishing grounds, the consequences cannot be treated merely as ordinary business risks. For fishing households with limited alternatives, ecological degradation can directly threaten income, food security, and social welfare. The statute therefore establishes a broader conception of protection. Government policy should provide protection against risks associated with natural-resource use and environmental change while also strengthening fishers' capacity to maintain and improve their livelihoods. In the context of marine extraction, this implies that compensation after ecological damage occurs should not be regarded as a complete substitute for preventive environmental protection.

The distinction between compensation and protection is particularly important. Compensation is generally retrospective: it attempts to address a loss after the relevant decision has been made or damage has occurred. Protection, by contrast, is preventive. It seeks to prevent environmental transformation from producing disproportionate harm in the first place. For fishing communities, preventive protection is often more important because ecological systems and fishing livelihoods cannot necessarily be restored through monetary payment.

4. Environmental Law and the Precautionary Dimension

Law No. 32 of 2009 concerning Environmental Protection and Management provides another important component of the legal framework. The law establishes principles of environmental protection and sustainable development, including

public participation and access to environmental information. These principles are relevant to marine extraction because environmental decision-making must account for ecological consequences before irreversible or difficult-to-reverse damage occurs.

Environmental impact assessment is particularly important in this regard. Industrial activities that may produce significant environmental effects are subject to environmental assessment requirements. Yet the effectiveness of such assessment depends upon the scale at which environmental impacts are understood. A project-level assessment may identify impacts within a defined operational boundary, while marine ecological processes can extend far beyond that boundary. Sediment transport, pollution dispersion, habitat connectivity, and fish movement can connect distant locations. Consequently, environmental assessment needs to account for the ecological system surrounding the project, rather than treating the project boundary as equivalent to the environmental boundary.

This is particularly relevant to marine extraction because ecological impacts may accumulate over time. A single extraction activity might produce relatively limited impacts, while several activities operating within the same coastal system may generate substantially greater cumulative pressures. Environmental governance that evaluates each project independently risks overlooking this cumulative dimension.

5. Marine Spatial Planning as a Legal Governance Mechanism

Marine Spatial Planning has become increasingly important in Indonesian marine governance. The legal framework for marine spatial planning has developed alongside broader reforms of coastal governance and spatial planning. The purpose is to coordinate different activities and establish a spatial framework for the utilization and protection of marine resources. Theoretically, MSP can reduce conflict by identifying areas appropriate for fisheries, conservation, infrastructure, shipping, tourism, and other uses. In practice, however, spatial planning involves choices among competing interests. Deciding that one area is suitable for mining rather than fishing is not simply a technical decision. It determines which economic activity receives institutional priority.

Research by Wen et al. (2022) demonstrates that implementation of MSP in Indonesia faces challenges involving institutional coordination, data availability, licensing, legalization, and stakeholder engagement. These problems are significant because a spatial plan can become ineffective if the institutions responsible for implementation operate according to competing objectives.

The problem is therefore one of institutional coherence. A coastal community may participate in spatial planning while another government agency simultaneously promotes an investment project affecting the same marine environment. Similarly, an environmental regulation may impose safeguards while an investment policy creates pressure for rapid project implementation. Without

effective coordination, the formal existence of multiple protective regulations does not necessarily produce cumulative protection.

6. Recognition of Traditional Knowledge and Territorial Relationships

The legal and institutional problem also involves recognition. Traditional fishers possess forms of ecological knowledge developed through repeated interaction with marine ecosystems. They may know seasonal changes in fishing grounds, sediment movement, spawning areas, currents, and changes in species abundance that are difficult to capture through short-term scientific surveys.

Research on traditional marine management in Indonesia demonstrates the significance of locally embedded institutions such as *sasi laut* and other territorial arrangements. Such institutions provide evidence that coastal communities have historically developed mechanisms for regulating access and resource use. Their existence challenges the assumption that effective marine governance must necessarily originate from centralized state institutions. Recognition, therefore, should not mean simply acknowledging that communities possess “local knowledge.” It should involve incorporating that knowledge into actual decision-making. If fishers report declining catches, changes in sedimentation, or shifts in fishing grounds, these observations should be treated as potentially relevant evidence rather than dismissed because they do not originate from formal scientific monitoring.

This point also relates to procedural justice. Meaningful participation requires access to information and the capacity to contribute knowledge that can affect regulatory decisions. Consultation without recognition can reproduce the same power asymmetries that participation is supposed to address.

7. The Problem of Sectoral Fragmentation

One of the most persistent problems in Indonesian coastal governance is the fragmentation of authority among sectors. Fisheries, mining, environmental protection, transportation, investment, spatial planning, and coastal management may each operate through different legal instruments and administrative institutions. This fragmentation creates what can be described as regulatory compartmentalization. Each institution may perform its own legal mandate correctly while the combined effect of their decisions produces environmental harm that no individual institution considers its responsibility.

For example, a mining authority may focus on the legality of extraction; an environmental authority may assess pollution; a spatial-planning institution may designate the area for industrial use; and a fisheries institution may focus on protecting fishing production. Yet the cumulative effect on a fishing community may include reduced fishing grounds, sedimentation, declining catches, and increased costs.

This institutional fragmentation is consistent with the challenges identified by Wen et al. (2022), who emphasize that effective marine spatial planning requires

coordination among institutions and stakeholders. The problem is therefore not simply the absence of regulation. Indonesia has a relatively extensive legal framework. The deeper problem is whether these legal instruments operate coherently enough to prevent the externalization of environmental costs onto vulnerable communities.

8. Participation versus Consent

The distinction between participation and consent is particularly important for marine extraction. Participation generally means that affected communities are given opportunities to obtain information, express concerns, and provide input. Consent implies a stronger form of decision-making authority. Indonesian law does not establish a universal requirement that all coastal development projects obtain community consent in the same manner as some international Indigenous-rights frameworks. Nevertheless, meaningful participation, environmental information, and protection of community interests are important components of the existing legal framework.

This distinction matters because consultation can occur even when communities have no realistic ability to alter the project. A meeting may be held, objections may be recorded, and compensation may be offered, while the fundamental decision to proceed remains unchanged. From a coastal-justice perspective, participation should therefore be evaluated according to its substantive influence. The relevant question is not simply whether consultation occurred, but whether community concerns could alter the project's location, design, mitigation measures, operational conditions, or even the decision to proceed.

9. Toward Rights-Based Marine Governance

The legal analysis demonstrates that Indonesia already possesses many of the normative principles required for more just marine governance: state responsibility over natural resources, sustainable development, environmental protection, public participation, and protection of fishers. The central difficulty is translating these principles into institutional practice. A rights-based approach would require at least four interconnected measures.

First, fishing livelihoods must be treated as an interest requiring substantive protection, not merely as an economic activity competing with mining. Second, environmental assessment must incorporate cumulative and ecosystem-scale impacts, particularly where sedimentation and other forms of ecological change can extend beyond project boundaries. Third, participation must be meaningful, which requires timely information, access to environmental data, and genuine opportunities to influence decisions. Fourth, marine spatial planning must integrate fisheries protection with industrial development, rather than treating fishing communities as residual users of marine space after industrial priorities have been established.

The central legal argument of this section is therefore that Indonesia's problem is not simply a lack of laws protecting coastal communities. Rather, the challenge lies in the implementation, coordination, and prioritization of existing legal norms. The protection of traditional fishers requires the state to ensure that its authority over marine resources is exercised consistently with environmental sustainability, public welfare, and the rights and livelihood security of communities dependent upon coastal ecosystems.

In this sense, coastal justice is not external to Indonesian environmental law. It is already implicit in the constitutional principle of natural-resource management for public prosperity, the statutory protection of fishers, the requirement of environmental protection, and the legal recognition of community participation. The challenge is to transform these principles from formal legal commitments into effective constraints on environmentally and socially unequal forms of marine extraction.

Discussion: Marine Extraction, Ecological Change, and the Unequal Politics of Coastal Space

1. Marine Extraction and the Transformation of Fishing Space

The expansion of marine extraction in Indonesia represents more than an increase in the intensity of resource utilization. It also changes the social and ecological meaning of coastal space. Areas previously used for fishing, navigation, and other livelihood activities can be incorporated into new arrangements of mining, industrial infrastructure, shipping, and other commercial uses. This transformation is particularly consequential for small-scale fishers because fishing livelihoods depend not only on formal access to the sea but also on the continued ecological productivity of particular fishing grounds. When these spaces are altered, the consequences can extend from ecological degradation to declining catches, increased operating costs, and greater livelihood uncertainty.

Evidence from coastal tin-mining areas in Bangka demonstrates this relationship. Rosyida et al. (2019) found that the expansion of coastal mining was associated with environmental and socioeconomic changes that affected local livelihoods, particularly those of fishers who depended directly on coastal resources. The study also showed that limited access to capital, education, and alternative employment constrained the ability of affected households to adapt to these changes. The significance of this finding lies in the unequal capacity to respond to environmental transformation. Mining may create new economic opportunities, but the people who previously depended on the same coastal ecosystem are not necessarily positioned to benefit from those opportunities to the same extent.

This situation illustrates a central contradiction in the governance of marine resources. The conversion of fishing space into extractive space is often presented as a reallocation of economic opportunity, but for resource-dependent communities it can simultaneously represent a loss of livelihood security. The two

processes occur within the same geographical area but are experienced differently by different social groups. Industrial actors may perceive the marine area primarily as a site of investment and resource extraction, while fishers perceive it as a productive and socially meaningful livelihood territory. The conflict is therefore not simply a conflict between two economic activities; it is a conflict between different ways of valuing and using marine space.

Bennett, Govan, and Satterfield (2015) describe this type of process through the concept of *ocean grabbing*, emphasizing that the appropriation of marine space can reduce the access, control, and security of small-scale fishing communities. Their argument is important because it shifts the analysis away from the narrow question of whether an extraction activity is legally authorized. A project may comply with formal licensing requirements while nevertheless producing a substantial redistribution of access and control over marine resources. In this sense, the central issue is not simply whether fishers are physically removed from the sea but whether they retain effective access to an ecologically productive marine environment.

2. Sedimentation and the Production of Ecological Insecurity

Sedimentation provides an important mechanism through which this transformation becomes environmentally and socially consequential. Unlike physical displacement, sedimentation may not immediately produce a visible boundary between the industrial zone and the affected community. Its effects can instead accumulate through changes in water quality, seabed conditions, habitat structure, and ecological productivity. This makes sedimentation particularly important for understanding forms of environmental harm that are gradual, spatially dispersed, and difficult to attribute to a single event.

Research on coastal tin mining in Bangka has documented sedimentation alongside coral-reef degradation, coastal erosion, and other environmental changes associated with mining activities (Rosyida, Sasaoka, and Saito 2018). Subsequent research has also identified degradation of seagrass ecosystems around sea-based tin-mining areas, including reductions in habitat condition and species diversity (Adi et al. 2024). These findings indicate that the ecological effects of marine extraction can extend beyond the physical location of mining infrastructure. The relevant environmental unit is therefore not necessarily the concession itself but the interconnected coastal ecosystem within which sediment, water, organisms, and human activities move.

This has an important implication for environmental assessment. If assessment is organized primarily around the boundaries of an individual project, ecological processes that operate across those boundaries may be underestimated. Sediment can move through coastal waters; fish can move between habitats; and changes in one ecosystem can influence the productivity of another. The environmental impact experienced by fishers may therefore occur some distance from the original source of disturbance.

The social consequence is a form of ecological insecurity. Fishers may continue to possess formal access to the sea, but the value of that access may decline as ecological conditions deteriorate. In practical terms, a fisher may need to travel farther to obtain the same quantity of fish, spend more on fuel, change fishing equipment, or accept lower and less predictable income. What appears administratively as continued access can therefore become economically ineffective access.

This distinction is analytically important. Dispossession does not always require the removal of people from their territory; it can also occur through the degradation of the ecological conditions that make territorial access meaningful. In the case of coastal fisheries, environmental degradation can consequently function as an indirect mechanism of displacement even when communities remain physically present.

3. From Environmental Degradation to Unequal Livelihood Costs

The economic consequences of ecological degradation are not distributed evenly. Households with diversified income sources, financial capital, education, or access to alternative employment may have greater capacity to absorb environmental shocks. Fishing households that depend almost entirely on daily catches have considerably fewer options.

This vulnerability has been documented in research on Indonesian small-scale fisheries. Sharma et al. (2021) emphasize that millions of Indonesian households depend on small-scale fisheries and that these communities face overlapping ecological, economic, and institutional vulnerabilities. Their research also shows that livelihood interventions are more effective when they are locally grounded, participatory, and capable of addressing multiple dimensions of vulnerability simultaneously.

The Bangka case provides a more concrete illustration. Rosyida et al. (2019) found that coastal mining was associated with declining fisheries conditions and livelihood uncertainty, while affected households faced difficulties in diversifying their sources of income. This means that the economic cost of extraction cannot be calculated simply by comparing the value of mining output with the monetary value of environmental mitigation. Such a calculation risks ignoring the distribution of costs across different groups.

The relevant question is instead who absorbs the residual environmental cost after mitigation and compensation have been applied. For an industrial company, a decline in local fish populations may represent an external environmental effect. For a fishing household, the same decline may represent the loss of daily income. For a government, it may appear as a manageable environmental-management problem. These different perspectives demonstrate that environmental impacts acquire different economic meanings depending on the position of the actor within the resource economy.

This is why the language of environmental justice is analytically useful. It makes visible a distributional relationship that conventional economic assessments can obscure. Economic benefits generated by extraction may circulate through companies, investors, workers, government revenues, and downstream industries, whereas environmental costs may become concentrated among communities living closest to the affected ecosystem. The central injustice therefore lies not simply in the existence of environmental damage but in the unequal social capacity to absorb that damage.

4. Compensation, Participation, and the Limits of Procedural Legitimacy

The politics surrounding coastal extraction also demonstrate that compensation cannot automatically resolve environmental conflict. Research on Bangka's coastal tin mining found that compensation and local political dynamics influenced community responses to mining, while fishers expressed concerns regarding resource depletion, declining catches, and limited alternative livelihoods (Rosyida et al. 2018). This finding suggests that apparent community acceptance may have multiple meanings and cannot necessarily be interpreted as evidence of substantive agreement with the underlying development model.

The distinction between acceptance and consent is therefore important. A household may accept compensation because it needs immediate income even though it remains concerned about the long-term ecological consequences of extraction. Similarly, a community may participate in consultation because participation is required procedurally while possessing little ability to change the fundamental decision.

This problem reflects a broader limitation of participatory environmental governance. Participation can provide information and create opportunities for affected communities to express concerns, but it does not automatically redistribute decision-making power. Wen et al. (2022), in their analysis of marine spatial planning in Indonesia, identify institutional coordination, stakeholder involvement, legalization, data, and licensing as important challenges. Their findings indicate that participation occurs within institutional structures that already contain competing mandates and unequal capacities.

The problem can therefore be framed as a distinction between participation as inclusion and participation as influence. Inclusion means that fishers are present in meetings, consultations, or planning processes. Influence means that their knowledge and interests can alter the substantive outcome. The latter is much more demanding.

This distinction matters particularly when decisions concern the conversion of fishing grounds into extractive zones. If the basic allocation decision has already been made before community participation occurs, consultation can only influence secondary issues such as compensation or mitigation. The fundamental question—whether the area should be allocated for extraction in the first place—has effectively been removed from the participatory process.

Consequently, a more meaningful model of participation requires affected communities to become involved before rather than after the fundamental allocation of marine space has been determined.

5. Marine Spatial Planning and the Politics of Allocation

Marine Spatial Planning is frequently presented as a mechanism for reducing conflicts among different marine uses. In principle, this is reasonable: spatial planning can identify areas for fisheries, conservation, transportation, tourism, infrastructure, and extraction while attempting to minimize incompatibilities.

The difficulty is that spatial planning does not eliminate political choices. It institutionalizes them. When a planning authority identifies a particular marine area as suitable for industrial extraction rather than fisheries, it effectively establishes a hierarchy among competing uses. The map may present this decision as a technical allocation, but the consequences are social and political. One group receives greater institutional access to marine space while another may experience restrictions or declining ecological productivity.

Research on Indonesian marine spatial planning demonstrates that these institutional challenges are substantial. Wen et al. (2022) show that the implementation of MSP is affected by coordination problems, licensing arrangements, stakeholder engagement, and institutional fragmentation. Campbell et al. (2022) further demonstrate that contemporary marine governance in Indonesia is influenced by historical institutional trajectories. These findings suggest that spatial planning cannot be separated from the political and administrative structures within which it operates.

This is particularly important because different actors do not enter the planning process with equivalent resources. Industrial investors may have access to technical consultants, legal expertise, financial resources, and institutional networks. Small-scale fishers may possess extensive ecological knowledge but limited administrative and technical capacity to translate that knowledge into the language of formal planning.

The result is an asymmetry between knowledge and institutional power. Fishers may know where fish aggregate, how sediment has changed, or which areas are important for particular seasons, yet their knowledge may carry less institutional weight than technical reports commissioned by economically powerful actors. A just marine spatial-planning system must therefore address not only the spatial distribution of activities but also the unequal capacity of different groups to shape the spatial plan itself.

6. Recognition: Fishers as Knowledge Holders and Rights-Holders

The recognition dimension is particularly important because small-scale fishers possess knowledge generated through long-term interaction with marine ecosystems. Such knowledge includes observations of seasonal currents, fish

migration, spawning areas, sediment changes, water conditions, and changes in fishing productivity.

Research on Indonesian coastal governance indicates that traditional marine institutions such as *sasi laut* and *petuanan laut* demonstrate the existence of locally embedded systems for regulating marine-resource use. These institutions challenge the assumption that sustainable marine governance must be created exclusively through centralized state regulation.

Recognition of traditional fishers should therefore go beyond acknowledging them as “stakeholders.” The stakeholder concept treats fishers primarily as one interest group among many. A rights-based perspective recognizes that the protection of livelihood and participation in environmental decisions can generate corresponding obligations for public institutions. This distinction becomes particularly important when fishing communities have long-established relationships with particular marine areas. If those relationships are ignored in spatial planning, the resulting allocation may be formally neutral but substantively unequal. The argument here is not that traditional use should automatically prohibit all forms of development. Rather, existing livelihood relationships should constitute relevant evidence in determining whether, where, and under what conditions development should occur. Recognition therefore becomes a substantive component of environmental decision-making rather than a symbolic gesture.

7. The Emerging Nickel Frontier and the Paradox of Low-Carbon Extraction

The contemporary expansion of nickel extraction adds another layer to the discussion. Nickel has become strategically important to global battery and energy-transition industries, making Indonesia a central actor in the emerging low-carbon mineral economy. This creates an important paradox: a mineral used in technologies associated with decarbonization can simultaneously generate significant environmental pressures at the extraction and processing stages.

The paradox should not be interpreted as evidence that renewable-energy technologies are inherently environmentally harmful. Rather, it demonstrates that decarbonization does not automatically eliminate extractive inequalities. A transition away from fossil fuels can still depend upon mining systems that produce ecological and social costs in resource-producing regions.

The environmental implications of nickel exposure are documented in marine ecological research. Croteau et al. (2020), for example, found that nickel-contaminated sediment and elevated nickel exposure could affect coral physiology and contribute to nickel accumulation in coral tissue. The finding is relevant because coral-associated ecosystems are important components of many tropical coastal environments.

This suggests that the environmental legitimacy of the energy transition cannot be evaluated only at the level of emissions reduction. It must also be assessed across the entire material chain connecting extraction, processing, manufacturing, consumption, and waste. For coastal communities, this means that the global

narrative of a “green transition” can appear very different from the local experience of environmental change. An industrial project may contribute to a global decarbonization strategy while simultaneously producing localized sedimentation, habitat degradation, or livelihood disruption. This is why the concept of just transition must be applied not only to workers in fossil-fuel industries but also to communities located at the extraction frontier of low-carbon minerals.

8. Toward a More Substantive Concept of Coastal Justice

The evidence discussed above suggests that coastal justice in Indonesia should be understood through three interconnected dimensions. First is distributive justice. The economic benefits of marine extraction should be considered alongside the ecological and livelihood costs imposed on coastal communities. A project that generates substantial national or regional revenue but imposes concentrated ecological costs on a small fishing population raises a clear distributive question. Second is procedural justice. Affected communities need more than opportunities to attend consultations. They require timely information, access to relevant environmental data, sufficient time to deliberate, and institutional mechanisms through which their concerns can influence decisions. Third is recognition justice. Fishers must be recognized not simply as economic actors but as communities with distinctive ecological knowledge, livelihood dependence, and relationships with marine territories.

These dimensions are mutually dependent. Distributional justice is difficult to achieve when communities lack meaningful participation. Procedural justice is weakened when community knowledge is not recognized as legitimate. Recognition itself becomes ineffective if it does not influence the distribution of marine space and resources. The Indonesian case therefore points toward a broader conceptualization of marine governance. The question is not simply whether extraction is sustainable, but sustainable for whom, decided by whom, and at whose ecological expense.

9. Main Argument of the Discussion

Taken together, the evidence demonstrates that marine extraction can generate a chain of interconnected transformations: *extraction* → *spatial reallocation* → *ecological disturbance* → *sedimentation/habitat degradation* → *reduced fisheries productivity* → *livelihood insecurity* → *unequal distribution of environmental costs*.

This sequence does not occur automatically in every extraction project, and the intensity of each stage depends upon ecological conditions, regulatory safeguards, technology, and local socioeconomic structures. Nevertheless, the Indonesian cases examined in this article demonstrate that the possibility of such a chain cannot be treated as a secondary consideration. The central argument is therefore that marine extraction should be evaluated as a political-ecological process rather than merely as an industrial activity. Its consequences are produced

through the interaction between ecological systems and institutional decisions about who may use marine space, under what conditions, and with what degree of accountability.

From this perspective, the protection of traditional fishers is not an obstacle to economic development. Rather, it is a test of whether marine development is capable of distributing benefits and environmental risks fairly. Where extraction depends upon the degradation of ecosystems that sustain communities with limited political and economic power, the resulting development model risks reproducing precisely the inequalities that environmental governance is supposed to prevent. A genuinely sustainable marine economy therefore requires more than technological improvement or environmental mitigation. It requires institutional restructuring of how marine space is allocated, how ecological risks are assessed, whose knowledge is recognized, and how affected communities participate in decisions. Without these changes, the expansion of the blue economy may reproduce the logic of earlier extractive development—only with the language of sustainability replacing the language of exploitation.

Conclusion

Marine extraction in Indonesia demonstrates that the transformation of coastal space is simultaneously an ecological, economic, and political process. The evidence discussed in this article shows that mining and other extractive activities can affect fishing communities not only through direct occupation of marine space but also through sedimentation, habitat degradation, declining fisheries productivity, and increasing livelihood costs. Research from Bangka and other Indonesian coastal areas illustrates that these environmental changes are experienced most intensely by households whose livelihoods remain directly dependent on coastal ecosystems (Rosyida et al. 2018; Rosyida et al. 2019; Adi et al. 2024). The problem, therefore, is not simply that extraction produces environmental impacts, but that those impacts are distributed unevenly. Economic benefits can circulate through companies, investors, industries, and government revenues, while ecological costs become concentrated among communities with fewer economic and political resources. In this sense, marine extraction can reproduce a form of coastal environmental injustice in which communities retain formal access to marine space but progressively lose the ecological conditions necessary to make that access economically meaningful.

The analysis also demonstrates that the problem cannot be resolved through environmental mitigation or consultation alone. Indonesian law already provides important principles for environmental protection, community participation, sustainable coastal management, and the protection of fishers, while marine spatial planning provides an institutional mechanism for coordinating competing uses of marine space. Yet the effectiveness of these instruments depends upon how they are implemented and whose interests receive substantive consideration. Research on Indonesian marine governance indicates continuing challenges involving

institutional fragmentation, licensing, stakeholder participation, and unequal decision-making capacity (Wen et al. 2022; Campbell et al. 2022). A more just approach therefore requires a shift from treating fishers as stakeholders who are consulted after development priorities have been established toward recognizing them as rights-holders and legitimate producers of ecological knowledge. Distributional, procedural, and recognitional justice need to operate together: environmental costs must be fairly distributed, affected communities must possess meaningful influence over decisions, and their territorial relationships and ecological knowledge must be institutionally recognized.

Ultimately, the future of Indonesia's coastal economy should not be measured solely by the volume of minerals extracted, investment generated, or industrial capacity established. It should also be assessed according to whether development preserves the ecological foundations of coastal livelihoods and whether the communities most exposed to environmental risks possess meaningful power to influence decisions affecting their territories. This is particularly important as Indonesia becomes increasingly integrated into global supply chains for minerals associated with the energy transition. The transition to a lower-carbon economy cannot be considered just if its environmental costs are systematically transferred to communities at the extraction frontier. Coastal justice therefore requires a governance model in which ecological integrity, livelihood security, participation, and accountability are treated as conditions of development rather than costs to be addressed after development has already been authorized. Without such a transformation, the expansion of the blue economy risks reproducing the inequalities of conventional extractive development under a new language of sustainability.

References

- Adi, Wahyu, Agus Hartoko, Pujiono W. Purnomo, Okto Supratman, Delianis Pringgencies, and Udhi E. Hernawan. 2024. "Ecological Condition of Seagrass Meadows around Sea-Based Tin Mining Activities in the Waters of Bangka Belitung Islands, Indonesia." *Marine Pollution Bulletin* 209 (Part A): 117151. <https://doi.org/10.1016/j.marpolbul.2024.117151>.
- Bennett, Nathan James, Hugh Govan, and Terre Satterfield. 2015. "Ocean Grabbing." *Marine Policy* 57: 61–68. <https://doi.org/10.1016/j.marpol.2015.03.026>.
- Baum, Gunilla, Ima Kusumanti, Annette Breckwoldt, Sebastian C. A. Ferse, Marion Glaser, Dwiyoitno, Luky Adrianto, Simon van der Wulp, and Andreas Kunzmann. 2016. "Under Pressure: Investigating Marine Resource-Based Livelihoods in Jakarta Bay and the Thousand Islands." *Marine Pollution Bulletin* 110 (2): 778–789. <https://doi.org/10.1016/j.marpolbul.2016.05.032>.
- Talib, Naimah Lutfi, Ariane Juliana Utomo, Jon Barnett, and Dedi Supriadi Adhuri. 2022. "Three Centuries of Marine Governance in Indonesia: Path

- Dependence Impedes Sustainability." *Marine Policy* 143: 105171. <https://doi.org/10.1016/j.marpol.2022.105171>.
- Gustavsson, Madeleine, Katia Frangoudes, Lars Lindström, María Catalina Blvarez Burgos, and others. 2021. "Gender and Blue Justice in Small-Scale Fisheries Governance." *Marine Policy* 133: 104743. <https://doi.org/10.1016/j.marpol.2021.104743>.
- Male, Yusthinus Tobias, Amanda Reichelt-Brushett, Edward D. Burton, and Alberth Nanlohy. 2024. "Assessment of Mercury Distribution and Bioavailability from Informal Coastal Cinnabar Mining—Risk to the Marine Environment." *Marine Pollution Bulletin* 199: 116047. <https://doi.org/10.1016/j.marpolbul.2024.116047>.
- Rosyida, Isma, Wahidullah Khan, and Masatoshi Sasaoka. 2018. "Marginalization of a Coastal Resource-Dependent Community: A Study on Tin Mining in Indonesia." *The Extractive Industries and Society* 5 (1): 165–176. <https://doi.org/10.1016/j.exis.2017.11.002>.
- Rosyida, Isma, Masatoshi Sasaoka, and Shigeru Saito. 2018. "Local Political Dynamics of Coastal and Marine Resource Governance: A Case Study of Tin Mining at a Coastal Community in Indonesia." *Environmental Development* 26: 12–22. <https://doi.org/10.1016/j.envdev.2018.03.003>.
- Rosyida, Isma, Wahid Ullah, Alfian Helmi, and Masatoshi Sasaoka. 2019. "Adapting Livelihoods to the Impacts of Tin Mining in Indonesia: Options and Constraints." *The Extractive Industries and Society* 6 (4): 1302–1313. <https://doi.org/10.1016/j.exis.2019.10.018>.
- Stacey, Natasha, Emily Gibson, Neil R. Loneragan, Carol Warren, Budy Wiryawan, Dedi S. Adhuri, Dirk J. Steenbergen, and Ria Fitriana. 2021. "Developing Sustainable Small-Scale Fisheries Livelihoods in Indonesia: Trends, Enabling and Constraining Factors, and Future Opportunities." *Marine Policy* 132: 104654. <https://doi.org/10.1016/j.marpol.2021.104654>.
- Talib, Naimah Lutfi, Ariane Juliana Utomo, Jon Barnett, and Dedi Supriadi Adhuri. 2022. "Three Centuries of Marine Governance in Indonesia: Path Dependence Impedes Sustainability." *Marine Policy* 143: 105171. <https://doi.org/10.1016/j.marpol.2022.105171>.
- Wen, Wen, Krishna Samudera, Luky Adrianto, Gabrielle L. Johnson, Mary Sue Brancato, and Alan White. 2022. "Towards Marine Spatial Planning Implementation in Indonesia: Progress and Hindering Factors." *Coastal Management* 50 (6): 469–489. <https://doi.org/10.1080/08920753.2022.2126262>.

Indonesian Legal Sources

Indonesia. The 1945 Constitution of the Republic of Indonesia, especially Article 33(3).

- Indonesia. 2007. Law No. 27 of 2007 concerning the Management of Coastal Areas and Small Islands (Undang-Undang Nomor 27 Tahun 2007 tentang Pengelolaan Wilayah Pesisir dan Pulau-Pulau Kecil). Jakarta: Government of the Republic of Indonesia. The law is listed in the official Indonesian regulatory database.
- Indonesia. 2014. Law No. 1 of 2014 concerning the Amendment to Law No. 27 of 2007 concerning the Management of Coastal Areas and Small Islands (Undang-Undang Nomor 1 Tahun 2014). Jakarta: Government of the Republic of Indonesia.
- Indonesia. 2016. Law No. 7 of 2016 concerning the Protection and Empowerment of Fishers, Fish Farmers, and Salt Farmers (Undang-Undang Nomor 7 Tahun 2016 tentang Perlindungan dan Pemberdayaan Nelayan, Pembudi Daya Ikan, dan Petambak Garam).
- Indonesia. 2009. Law No. 32 of 2009 concerning Environmental Protection and Management (Undang-Undang Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup). Jakarta: Government of the Republic of Indonesia. The law is recorded in the official regulatory database and remains an important statutory basis for environmental protection, subject to subsequent amendments.
- Indonesia. 2023. Law No. 6 of 2023 concerning the Stipulation of Government Regulation in Lieu of Law No. 2 of 2022 concerning Job Creation into Law. Jakarta: Government of the Republic of Indonesia.
- Constitutional Court of the Republic of Indonesia. 2011. Decision No. 3/PUU-VIII/2010, June 16, 2011. *Judicial Review of Law No. 27 of 2007 concerning the Management of Coastal Areas and Small Islands*. The decision invalidated provisions concerning HP-3 (Coastal Water Cultivation Rights) and is directly relevant to the constitutional relationship between state control, private utilization, and coastal communities.

Acknowledgment

None

Funding Information

None

Conflicting Interest Statement

The author states that there is no conflict of interest in the publication of this article.

Publishing Ethical and Originality Statement

All author declared that this work is original and has never been published in any form and in any media, nor is it under consideration for publication in any journal, and all sources cited in this work refer to the basic standards of scientific citation.

Generative AI Statement

The author used generative AI tools to assist with language editing, including correcting minor writing errors, improving sentence clarity, and formatting references. The editor also used generative AI as an editorial aid to identify and correct minor writing and formatting issues. All AI-assisted changes were reviewed by the author and editor, who remain responsible for the accuracy, originality, and final content of the manuscript.