ISSLP
Interdisciplinary Studies in Society, Law and Politics

Original Research

Legal Framework for Responding to Environmental Hazards in Coastal Protected Areas: A Review of Domestic and International Regulations

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Received: 2023-05-24 **Revised:** 2023-08-01 **Accepted:** 2023-08-06 **Published:** 2023-09-01

Given the increasing occurrence of hazards threatening the valuable ecosystems of coastal-marine protected areas, the protection of biodiversity, public health, safety, and sustainable development in these regions has become ever more critical. Despite this, no comprehensive research has yet been conducted on the legal status governing coastal-marine protected areas in Iran. Although numerous studies exist in the transnational scholarly literature, few address a legal model specifically aligned with risk science in relation to these areas. The aim of this article is to, while taking into account the principles of risk science and its underlying preventive approach, analyze existing regulations and propose a differential legal model tailored to the specific needs of coastal-marine protected areas in Iran. These areas face a multitude of hazards threatening their health and safety, and yet coastal protected regions in the north and south of the country—despite their breadth—receive minimal protective attention. The legal framework for protecting coastal areas against hazards necessarily encompasses both terrestrial environmental protection regulations and those governing aquatic zones. Neglect by policymakers and responsible authorities in implementing domestic legal obligations and advanced international guidelines in either of these domains can result in irreparable damage. Leveraging international experience in protecting existing coastal protected areas and transferring such knowledge into national frameworks is essential and may help resolve some of the prevailing issues. Notably, in Iran's domestic law, the prevailing executive-legal approach narrowly focuses on pollution-based threats to coastal-marine protected areas and even that in a fragmented manner. However, many of the hazards that threaten these regions are not limited to pollution alone; legal frameworks have largely overlooked threats to biodiversity and the vital natural resources within these habitats.

Keywords: *risk science, marine coasts, protected areas, legal protection, coastal climate, international regulations.*

How to cite this article:

Rahmati, H., Farshchi, P., & Pournoori, M. (2023). Legal Framework for Responding to Environmental Hazards in Coastal Protected Areas: A Review of Domestic and International Regulations. *Interdisciplinary Studies in Society, Law, and Politics, 2*(3), 112-120. https://doi.org/10.61838/kman.isslp.2.3.13

1. Introduction

Hazard science, despite its endeavor to realize health and safety, does not hold an independent position separate from other sciences. It draws upon interdisciplinary findings to address both the spatial structure of hazardous phenomena and the phenomena themselves, while also considering human beings and their living environment. In addition to conceptual understanding, hazard science refers to the human capacity to transform knowledge into action. In this regard, "the interpretation of hazards and the actions

taken, or the reactions of the public, government, and authorities toward them, all reflect the degree of hazard perception by each party" (Moghimi, 2015). Today, the importance of hazard perception is increasingly recognized in various domains, particularly in environmental matters and, more specifically, in the protection of coastal protected areas. Risk assessment, the study and exploration of appropriate alternatives, and ultimately the selection of optimal responses to hazards form the core approach in hazard science. Three key components influence risk perception: fear, knowledge, and exposure. Presently, numerous behaviors in society place different aspects of human life at risk, most of which require legal responses. Coastal areas, situated between land and sea, benefit from the biodiversity of both ecosystems. However, they are also simultaneously vulnerable to pollutants and destructive agents from both systems. Coastal zones are exposed to direct discharges from rivers, surface runoffs, effluents from remote lands, industrial and domestic outputs, and various other pollutants from maritime vessels. Unique ecosystems in these regions, such as seagrass beds, coral reefs, and mangrove forests, are undergoing degradation due to population pressures and development activities, leading to the depletion of both physical and biological resources. Sustainable resource use requires the preservation of certain areas, particularly notable formations, either in their natural state or with minimal human impact. The conservation of essential habitats for aquatic resources, genetic diversity, prominent landscapes, and full enjoyment of coastal-marine heritage demands the inclusion of these areas under varying protection levels within the International Union for Conservation of Nature (IUCN) classification system.

According to some scholars, comprehensive protection of coastal-marine zones has become an urgent necessity due to the presence of aquatic reserves, biodiversity, increased risk of fuel tanker collisions, overfishing, and oil extraction in these areas (Nichols, 1998).

The definition proposed in 2008 by the International Union for Conservation of Nature for marine-coastal protected areas further reinforces the interdisciplinary necessity of linking hazard science with geography and law. According to this definition, such areas are "clearly defined geographical spaces, recognized, dedicated, and managed through legal or other effective means to achieve long-term conservation of nature with associated ecosystem services and cultural values" (IUCN WCPA, 2008). The emphasis on legal instruments in this definition indicates that without a comprehensive, future-oriented legal framework, effective protection of coastal protected areas cannot be implemented.

2. Method and Discussion Framework

The method employed in this research is descriptive–analytical. On one hand, the authors aim to provide a descriptive review of existing regulations and legal discussions, and on the other hand, after analyzing the legal details and identifying deficiencies, they intend to propose effective orientations for outlining a comprehensive legal model based on hazard science for protection against risks threatening protected areas. Given the inherently predictive and preventive nature of hazard science (Moghimi, 2015), the objective of the approach in the present study is to identify weaknesses in coastal-marine environmental regulations and to propose solutions that could reduce or prevent potential hazards targeting coastal protected areas.

3. Understanding Coastal Protected Areas Through the Lens of Hazard Science

Although the location of coastal areas between land and sea enables them to benefit from the biodiversity of both ecosystems, it also exposes them to pollution and degradation from both terrestrial and marine systems. These regions face direct pollution from rivers, surface runoffs, effluents from remote lands, industrial and domestic discharges, and various marine pollutants. All unique ecosystems in these areas, including seagrass beds, coral reefs, and mangrove forests, are deteriorating under pressure from population growth and development activities. The depletion of their biological and physical resources continues. Sustainable use of these resources requires that specific areas, especially ecologically significant formations, be preserved in their natural or minimally disturbed state. Conservation of critical habitats for fish stocks, genetic diversity, aesthetic landscapes, and the full range of marine-coastal heritage necessitates the classification and management of these areas within various protection levels under IUCN standards (Gashtasb Meigouni, 2012). The process of identifying and selecting coastal-marine protected areas is part of a broader scheme of planning such zones.

Although terrestrial and marine planning processes share similarities, coastal and marine zones—with their extraordinary biodiversity—have long suffered from severe and irreparable neglect in terms of protection. Despite their inclusion in the Rio Agenda 21 as fragile and vulnerable ecosystems, they make up only a small share of the global network of protected areas. Therefore, the establishment of national parks and marine-coastal reserves is essential. In such contexts, the most recommended strategy is the creation of Marine Protected Areas (MPAs). These protected areas can function as nurseries and breeding reserves, ensuring species abundance across large regions. In appropriate sites like coral zones, where external factors such as fishing, environmental degradation, and pollution are absent, aquatic species can grow and reproduce freely, allowing for population size, age, and density to reach natural levels. Especially in the case of pelagic species, MPAs can serve as biomass sources for other marine regions (Rostaei & Rahmanian, 2017). Therefore, establishing protected areas can significantly contribute to the survival and conservation of such species.

The process of identifying and selecting coastal-marine protected areas is part of the broader planning framework for protected zones. Both terrestrial and marine planning follow relatively similar patterns. However, despite their immense and unique biodiversity, coastal and marine ecosystems have been subjected to prolonged and irreparable neglect in conservation efforts. Although these habitats have been described in the Rio Agenda 21 as fragile and vulnerable, they still represent only a minor share of global protected area networks. In regions like coral ecosystems, where external disturbances such as fishing, pollution, or environmental degradation are absent, aquatic species can thrive, reproduce naturally, and achieve appropriate population structures in terms of abundance, average size, and age. Particularly for pelagic species, MPAs can provide vital biomass to neighboring marine regions (Rostaei & Rahmanian, 2017). Thus, the creation of MPAs can play a crucial role in preserving the biodiversity of such species.

By integrating the principles and dimensions of hazard science with the specific characteristics of coastal-marine areas, one can critique and analyze the current state of silence and ambiguity in Iran. Coastal protected areas have been designated in a limited and mostly northern context, while the vital ecological values of southern coastal-marine zones remain overlooked due to inaction. This neglect puts these areas at substantial and irreversible risk.

4. Legal Criteria for the Protection of Coastal Protected Areas

The formulation of criteria for selecting coastal-marine protected areas represents a conventional and rational approach to providing scientific support for the designation of protected zones along the coastal regions of the country. The absence of coastal-marine protected areas within the formal national network of protected zones underscores the need for such criteria, which function like an information model to guide decision-makers in selecting suitable areas. Developing these criteria and applying them through a defined methodology reduces the likelihood of incorrect decisions, removes the process from the hands of non-experts, curbs arbitrary, subjective, and descriptive judgments, and instead places the selection process on a scientific and professional foundation (Danekar & Majnounian, 2004).

Assessments show that the Miankaleh Wildlife Refuge is the most significant coastal protected area in the Caspian Sea basin. The Gorgan Gulf and the Gomishan Wetland in the southeastern Caspian Sea also possess high environmental value and should be granted a more appropriate protection status. For instance, the Boujagh National Coastal Park at the mouth of the Sefidrud River and the Lavandevil Wildlife Refuge currently fall short of the quality required for their designated legal status and must undergo essential improvements, especially in resolving existing conflicts, to be worthy of their official classification.

4.1. Biodiversity Criterion and Legal Protection

Despite their exceptional biodiversity, coastal and marine regions have long suffered from severe neglect in terms of legal protection. Although Agenda 21 from the Rio Summit describes coastal-marine habitats as fragile and vulnerable, they still occupy only a minimal portion of the global network of protected areas. As such, establishing national parks and coastal-marine reserves is deemed necessary, and the creation of Marine Protected Areas (MPAs) is widely recommended. These

protected zones aim to conserve both plant and animal species and can serve as nurseries and spawning grounds, sustaining species abundance over extensive regions.

The Persian Gulf contains sensitive and critical habitats that shelter valuable marine fauna and flora and play a central role in the marine life cycle and fishery resources. Notable ecosystems such as coral reefs, mangrove forests, estuaries, deltas, seagrass beds, tidal zones, coastal wetlands, and sea turtle nesting areas must be protected due to their specific ecological characteristics. Moreover, the Persian Gulf experiences the annual passage of approximately 40,000 ocean-going vessels, around 17,000 of which transport crude oil from the region to global destinations. Combined with widespread offshore oil extraction, this renders the area highly vulnerable to the accumulation and persistence of harmful substances. The ecological conditions of the region highlight the urgency of safeguarding these living ecosystems and habitats. Consequently, the International Maritime Organization (IMO) has designated this sea as a Special Area, and specific pollution-prevention regulations have been enforced accordingly. These measures contribute meaningfully to enhanced environmental protection in this marine zone. It is self-evident that merely identifying and demarcating protected areas is not sufficient to ensure their ongoing protection. Thus, two actions are always emphasized: first, establishing the role and protection of these areas within the national coastal zone management plan; second, benefiting from interagency collaboration among marine organizations and employing expert knowledge and cooperative approaches to design an effective and sustainable protection program (Rasouli, 2015).

4.2. Human Hazards Criterion in Relation to Protected Areas

Many marine protected areas in other countries were designated even before formal legal frameworks were established. Although this is not the case in Iran, various existing legal instruments have enabled partial protection of marine areas. These include the Law on Environmental Protection and Enhancement, the laws on the establishment of the four categories of protected areas, the Law on Protection and Exploitation of Forests and Rangelands, the Law on Preservation of Forest Reserves (applicable to mangrove protection), the Law on Protection and Exploitation of Aquatic Resources, and specific prohibitions set forth by the Iranian Fisheries Organization. These legal tools are typically sector-specific and should only be evaluated within the context of their narrow mandates. They do not correspond with the broader, integrated concept of marine conservation and therefore yield limited effectiveness.

Without solid legal backing, coastal-marine protected areas cannot sustain their existence. Their long-term viability is unfeasible without effective national, regional, and international laws. Global experience shows that no protected area can survive without a robust legal framework and well-established supportive policies, as they will rapidly become subject to human encroachments (Moghimi, 2017).

Conservation encompasses both theoretical and practical components: theoretical protection resides in ideas, cultures, and discourse, while practical protection is realized through applied techniques and modern technologies. Given the climatic conditions and the type and extent of existing coastal-marine protected areas in each country, various theoretical and technological conservation methods have been and continue to be employed. Although progress has been made in Iran regarding the need for protection, there remains substantial room for improvement. By learning from other countries and analyzing the strengths and weaknesses of international legal systems, and considering that legal tools are fundamental mechanisms for advancing conservation, identifying threats and opportunities can significantly enhance the effectiveness of domestic regulations.

Although some studies have explored the application of certain technologies, laws and regulations that support applied technologies, effective theoretical models, participatory conservation methods, and civil society institutions have not been comprehensively examined. Even where studies exist, they are often limited to specific countries or organizations, such as the IUCN. Addressing this issue across broader national or pioneering international contexts could lead to transformative developments in the protection of these areas.

Legal obligations for protecting coastal protected areas against terrestrial hazards represent one of the most serious threats to the geographical and physical values of

these regions. One of the most significant laws in this regard is the Soil Protection Act, passed in 2019. According to Clause (a) of Article 1, the failure to protect soil in various areas, including coastal protected zones, can result in emergency conditions: "when soil pollution leads to contamination of water resources (surface and groundwater) in a manner that seriously threatens human health and the environment." Furthermore, Article 13 of this law stipulates: "Operators of industrial, production, service, and mining units operating in free trade-industrial and special economic zones and industrial parks are required to comply with the provisions of this law." According to Note 1, "Managers of free trade-industrial and special economic zones and industrial parks are obligated, upon being informed of soil pollution or degradation by the relevant organization or ministry, to address the issue within the framework of this law and submit a report of their actions to the respective authority."

5. Instrumental Framework of Legal Measures for the Protection of Coastal Protected Areas

5.1. Criminal Law Instruments in Response to Coastal Hazards

Based on various studies conducted by scholars in the fields of sociology and environmental law, environmental risks are vast in scope, and failure to address them can jeopardize the very security of human life. The risks emerging in nature today are markedly different from those experienced in the past and impact diverse segments of the population (Environmental Education and Sustainable Development Journal, 2017). According to German sociologist Ulrich Beck, fostering a responsive and protective environmental culture requires tangible shifts in environmental values and socio-economic practices. In this context, criminal law is considered one of the essential, effective, and necessary frameworks for safeguarding environmental health. The three major environmental risks of the 21st century are climate change, soil degradation, and the extinction of animal species (Dunn et al., 2014). While these risks are inherently interconnected, governments often address them in isolation. Therefore, in relation to coastal-marine protected areas, it is crucial to determine which of these risks should be addressed through criminal mechanisms.

5.1.1. Criminalization and Sanctions for Offenders Threatening Coastal-Marine Protected Areas

In a comprehensive typology of environmental crimes—considering the nature of the offense and the victim—these can be classified into three main categories. First are crimes affecting human beings, which include two subtypes: some affect all of humanity, such as ozone depletion and air pollution, while others disproportionately impact specific individuals or groups, such as nuclear waste dumping that endangers those living near disposal sites. The second category includes harm to ecosystems and plant species. The third pertains to harm against animal species. Two key points must be emphasized regarding these crimes: first, they are criminalized based on the harm principle; and second, the victims are often diffuse and unidentified (Rostaei & Rahmanian, 2017). As such, the realization of these crimes is probabilistic, and criminalization should be forward-looking and informed by futures studies.

A fundamental characteristic of hazardous behaviors that affect the environmental health of coastal regions is that the outcomes of these actions often remain unknown until they materialize. In other words, it is through the accumulation of minor and repeated actions by individuals that catastrophic outcomes gradually emerge—outcomes that violate environmental integrity and threaten the survival of all individuals in society. As Anthony Giddens emphasizes in *Runaway World*, there are future risks that remain undetected until they reach a tipping point—such as global warming or ozone layer depletion. Environmental risks are categorically distinct from individual risks, such as those arising from tobacco use or speeding, and thus necessitate more robust criminal interventions to mitigate global harm. It is conceivable that the future may witness an era where states bring criminal claims against countries engaging in widespread environmentally harmful practices. All these considerations call for a distinct criminal policy, particularly as environmental degradation may be more destructive and dangerous than pollution, thereby requiring a comprehensive criminal framework.

In Iranian criminal law, although Articles 680, 688, and 689 of the Islamic Penal Code (Book of Discretionary Punishments, 1996) address certain environmental offenses and corresponding sanctions, evidence suggests that even pre-revolution legislators were concerned with environmental protection, as seen in laws related to

forest preservation, water nationalization, and the prevention of pollution in border rivers. The *Law on Protection of the Sea and Border Rivers Against Oil Pollution* (1975) played a critical role in establishing criminal accountability for pollution in Iran's inland, border, and territorial waters, including the Caspian Sea, the Persian Gulf, and the Gulf of Oman. According to Article 2 of this law, polluting these waters with oil or oil mixtures from ships or offshore/onshore oil facilities is prohibited. Offenders are subject to imprisonment, fines, or both. If the pollution results from negligence or recklessness, the offender is liable to a monetary fine only. A key feature of this law is its imposition of sanctions for both intentional and unintentional offenses, consistent with core principles of liability in environmental crimes (Khaleghi & Rashnavadi, 2013).

One of the most devastating hazards to coastal regions is oil pollution, which often extends to the shoreline. This prompted the enactment of the *Law on the Protection of Navigable Seas and Rivers Against Oil Pollution* (2010). The escalating marine oil pollution crisis likely motivated the adoption of this new law, which is similar in structure to the 1975 law. Both laws share a jurisdictional scope encompassing Iran's maritime zones in the Persian Gulf and Gulf of Oman. Article 6, paragraph (g) of the 2010 law defines any environmental pollution of maritime areas in violation of the regulations of the Islamic Republic of Iran as a criminal offense subject to penal and civil liability. An important innovation in this law is the introduction of enforcement guarantees, such as administrative sanctions and fines for government officials who fail to prevent or respond to pollution. Article 15 introduces a three-member expert panel to assess the adequacy of government actions relative to environmental risks, their effectiveness, and potential harm to public health. These assessments, detailed in Article 16, aim to make enforcement decisions more tangible and evidence-based.

Although numerous environmental laws have been enacted, each with specific utility, criticisms persist regarding two key issues: the relatively mild penalties imposed on environmental violators, and the lack of serious enforcement actions. These shortcomings have undermined both legislative and executive effectiveness.

5.1.2. Additional Procedural Measures for Criminal Prosecution of Offenders Against Coastal-Marine Protected Areas

In addition to drafting comprehensive legal provisions that recognize all behaviors threatening protected areas, these regulations must also incorporate procedural mechanisms to enable effective protection.

5.1.2.1 Extension of Statutes of Limitations for Environmental Offenses

Extending the time period for initiating legal action against perpetrators of environmentally harmful behavior serves two purposes. First, it deters individuals from harming the environment. Second, it compels producers to offer safer and higher-quality products and to consider the long-term environmental impacts of their production processes.

5.1.2.2 Establishment of Special Environmental Courts

In the judiciary, one of the responsibilities of the head of the judiciary and provincial judicial administrators is to assign special court branches to handle sensitive matters. Accordingly, judicial actors, especially in coastal provinces and cities, are advised to establish specialized judicial bodies to enable timely and appropriate responses to environmental hazards affecting coastal protected areas.

5.2. Non-Criminal Instruments

5.2.1. Non-Criminal Measures in International Instruments Concerning Threats to Coastal-Marine Protected Areas

International tools aimed at supporting coastal protected areas can be found in declarations, resolutions, conference statements, and the content of various global conferences, most of which emphasize non-criminal protective measures. Over the past fifty years, the number of such non-binding instruments—and occasionally conventions—has increased significantly. These include the *United Nations Convention on the Law of the Sea* (LOSC) (adopted in 1982 and entered into force in 1994), the *United Nations Conference on Environment and Development* (UNCED) (held in 1992 in Brazil), and the *Convention on Biological Diversity* (CBD) (entered into force in 2004).

The LOSC places special emphasis on the control and prevention of pollution in coastal-marine protected areas. However, these areas face more than just pollution; other anthropogenic threats also endanger them in diverse ways.

Generally, the legal regime governing maritime use, including fishing and coastal resource exploitation, was crystallized in the 1982 LOSC, which marked the culmination of the Third UN Conference on the Law of the Sea. This convention holds particular significance for developing countries, as it represents a step toward creating a new international economic and legal order.

Developing coastal states advocated for expanded jurisdiction over their coastal waters and adjacent zones, rooted in the doctrine of preferential rights. According to this theory, these states claimed sovereignty over the resources in their coastal and extended maritime zones, requiring foreign fishing fleets to obtain approval from coastal states before exploiting such resources. However, this preferential rights theory was consistently opposed by states with large fishing fleets, which insisted on the applicability of flag-state jurisdiction and resisted the expansion of coastal state authority.

Today, environmental protection, much like development, is considered a key area of international solidarity and is increasingly integrated into the human rights discourse. The official declaration of the *United Nations Conference on the Human Environment* held in Stockholm in June 1972 introduced the concept of the "right to a healthy environment" as a fundamental human right, alongside liberty and equality.

Currently, it is widely acknowledged that coastal and marine zones—along with associated activities such as fishing—constitute core environmental concerns. The global shift toward higher consumption of aquatic species, particularly marine life, over recent decades has raised serious concerns about overfishing. As a result, the long-term sustainability of marine stocks and the role of fisheries in food security are under severe threat. Conservation of aquatic resources in seas, rivers, and lakes is deeply intertwined with environmental protection. As international environmental law evolves, so too does the body of international law governing the conservation and management of aquatic resources. Given the intrinsic connection between aquatic ecosystem conservation and environmental factors, most of the instruments adopted by the Food and Agriculture Organization (FAO) reflect this integrated approach.

5.2.1.1 The Stockholm Declaration and International Coastal Protection Programs

One of the foundational documents in this domain is the *Stockholm Declaration* of 1972, which emphasized transboundary pollution, environmental rights as human rights, and the sovereign rights of states over their natural resources. This document laid critical groundwork for the development of international legal norms on aquatic biodiversity protection and marine stock management and remains a central focus of FAO and the Committee on Fisheries.

5.2.1.2 The Rio Declaration on Coastal Zones

Another key non-binding international instrument is the *Rio Declaration* of 1992, adopted during the Earth Summit. This declaration, comprised of 27 principles and a six-paragraph preamble, reaffirms the legacy of the Stockholm Conference, promotes equitable global cooperation, and underscores the interconnectedness of environmental protection and economic development. It emphasizes that sustainable development requires integrated management of natural resources and highlights the dependence of environmental preservation on inclusive economic strategies.

5.2.2. Domestic Non-Criminal Measures Addressing Threats to Coastal-Marine Protected Areas

Given the current state of scientific understanding about the protection of coastal-marine environments, the following measures may offer a more comprehensive framework for assessing existing challenges:

5.2.2.1 Participation of NGOs in Legal Protection of Coastal-Marine Protected Areas:

A review of Iran's legal framework reveals that the involvement of non-governmental organizations (NGOs) is sporadically addressed in various legal provisions. There is no comprehensive, independent law supporting participatory prevention, as most preventive programs in Iran are shaped entirely by formal state mechanisms, leaving little room for NGO participation.

5.2.2.2 Interagency Preventive Coordination Among Governmental Institutions:

The fragmented efforts of various governmental bodies in managing coastal-marine environments have led to disjointed and uncoordinated actions, causing serious setbacks in protecting these zones.

5.2.2.3 Public Awareness on the Environmental Value of Coastal-Marine Protected Areas:

Institutional and judicial shortcomings in Iran can be partly attributed to a lack of public information campaigns concerning the environmental value and vulnerability of coastal-marine protected areas.

6. Conclusion

An analysis of the evolution of international instruments reveals that early documents primarily addressed environmental pollution and its prevention. However, especially following the United Nations Conference on Environment and Development, emphasis has increasingly shifted toward the broader impacts of anthropogenic activities. Accordingly, legal responses now prioritize not just pollution control, but also habitat destruction and the erosion of biodiversity in coastal protected areas.

One of the foundational considerations behind this expanded focus is the integration of hazard science, which calls for a comprehensive preventive perspective that addresses the multifaceted nature of specific geographic environments. Despite the growing emphasis in international law, Iranian legal frameworks continue to exhibit both significant implementation gaps—particularly in organizing protected areas in the northern and southern regions—and an outdated reliance on conventional marine pollution doctrines. These frameworks have not kept pace with emerging international standards.

The following recommendations are based on insights from hazard science and the inherent ecological values of coastal-marine protected areas:

- Employ hazard science to identify and prioritize coastal-marine protected areas.
- Utilize hazard science to design culturally and locally relevant preventive measures aimed at protecting biodiversity and habitats.
- Criminalize and impose stringent penalties for behaviors that threaten the safety of coastal protected zones.
- Introduce restorative justice mechanisms whereby individual and corporate offenders are judicially mandated to restore degraded coastal environments to their original state.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

Acknowledgments

We would like to express our gratitude to all individuals helped us to do the project.

Declaration of Interest

The authors report no conflict of interest.

Funding

According to the authors, this article has no financial support.

Ethical Considerations

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were observed.

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