



The Ocean: Sustaining What Sustains Us

***“Interventions on the Occasion of the World Oceans Day 2025 and
the United Nations Oceans Decade”***

Editor

Dr. Tajudeen Sanni

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THE OCEAN: SUSTAINING WHAT SUSTAINS US

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INTRODUCTION

SUSTAINING THE OCEAN THAT SUSTAINS US

As we mark the World Oceans Day 2025 at the UN Ocean Conference (UNOC) in Nice, France, and around the world, this collection of contributions on ocean policy, law, and governance arrives at a psychological moment for the future of our ocean.

This moment stands as a milestone and a fresh start in global ocean governance with international cooperation and events to accelerate action for the conservation and sustainable use of the oceans in line with the agenda of the UN Oceans Decade (2021-2030).

The volume seeks to offer a holistic exploration of the legal and normative frameworks, policy innovations, and governance systems that define the contemporary seascape. It would be left to the readers to decide if it succeeds in this objective, not only through the understanding it cultivates but also the positive action it inspires.

It goes without saying that the ocean is vital to planetary health, providing essential ecosystem services—or, better put, ecosystem support—supporting biodiversity while at the same time underpinning economic and socio-cultural well-being. Yet, it faces unprecedented pressures from climate change, pollution, disruption of indigenous marine culture, overfishing, and illegal and unsustainable economic activities.

Addressing these challenges requires robust international cooperation and effective legal and policy regimes. Central to this is the United Nations Convention on the Law of the Sea (UNCLOS), which establishes the constitutional legal framework for marine rights and responsibilities, marine environmental protection, resource management, and dispute resolution. Another important convention, the Biodiversity Beyond National Jurisdiction (BBNJ) Agreement, also known as the High Seas Treaty, is poised for potential entry into force

at the 2025 UNOC as part of a coordinated global push. Adopted in June 2023, the treaty requires 60 ratifications to take effect.

The contributions from different authors in the volume delves into various critical issues around those conventions and more, touching on themes such as protection of marine environment, marine education, fisheries management, and emerging challenges such as those posed by plastic waste, the digital revolution, and climate change. The role of global and regional institutions and the regulatory tools aimed at safeguarding marine biodiversity and promoting an ecosystem-based approach to ocean governance are highlighted in some contributions.

In yet some others, emphasis was placed on the growing recognition of the links between ocean governance, participatory rights, and blue justice, underscoring the need to combat inequitable activities that threaten marine ecosystems and undermine vulnerable coastal communities, many of who are yet to recover from colonial legacies in the marine space even as they confront current challenges such as climate change and institutional injustice.

Two of the contributions reflect on innovative cooperative initiatives and international partnerships that strengthen governance frameworks, enhance the rule of law, and foster inclusive, sustainable ocean management while highlighting the peculiar position of the Global South.

In bringing together diverse perspectives and expert analyses, the volume seeks to contribute meaningfully to the ongoing dialogue and action needed to secure a healthy, resilient ocean for current and future generations inclusively and effectively. The dialogue must embrace diverse perspectives, including the so-called contrarian voices such as those canvassed by the alternative ocean conference organised by the World Forum of Fishers People in parallel to the United Nations World Oceans Conference on the basis that the voices of the local and indigenous communities are not properly heard and considered in decision-making by the elites who converge in places like Nice, France.

At the end, what matters is for everyone to understand that sustaining our ocean is a shared responsibility demanding coordinated, informed, and sustained efforts across all sectors, societies, and borders so that the ocean can continue to sustain us.

Many thanks to all the contributors, reviewers, and the management of Villa College for the success of this initiative—if this volume contributes to inspiring better understanding and action, the glory would be due to God and them.

Dr Tajudeen Sanni

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PROLOGUE

It is with great honour and profound responsibility that I introduce this volume of scholarly interventions and pieces titled "Ocean: Sustaining What Sustains Us", echoing the theme of the UN World Oceans Day, published by our own Centre for Transformative Environmental and Marine Law at Villa College, Maldives. As the Dean of the Faculty of Shariah and Law, I recognise the critical intersection between legal scholarship and environmental stewardship, particularly in the context of our ocean, which is the lifeblood of our planet and the Maldives' very existence.

The ocean is not merely a vast expanse of water; it is a complex, dynamic system that sustains biodiversity, regulates climate, and supports the livelihoods of millions. It is also a provenance of culture and social well-being. However, we all know that it faces unprecedented threats from pollution, overfishing, climate change, and unsustainable development. This volume arrives at a significant moment when legal frameworks must evolve to meet these challenges, ensuring the protection and sustainable use and governance of marine space for present and future generations.

Our Faculty is committed to nurturing a generation of legal professionals who are not only adept in black letters law but are also deeply aware of their roles in addressing ecological issues of our time. This collection of scholarly articles reflects a multidisciplinary approach, combining legal theory, environmental ethics, and practical policy considerations to advance transformative marine action.

As the UN flags off the Ocean Decade, the Centre for Transformative Environmental and Marine Law seeks to embody Villa College's vision to lead in innovative (legal) education and research that responds to global and local environmental imperatives in realising the

Sustainable Development Goals. By fostering dialogue and knowledge exchange through works such as this, we contribute to shaping a legal and policy landscape that respects ecological interconnectedness and promotes justice for both humanity and nature.

I commend the contributors for their insightful analyses and dedication to sustaining what truly sustains us—the ocean. May this volume inspire policymakers, academics, students, and practitioners alike to engage actively in the stewardship of our marine environment, ensuring its resilience and vitality for generations to come.

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1. FROM MEDITERRANEAN BLISS TO MALDIVIAN REEFS: SWIMMING IN THE SAME PLASTIC SOUP

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INTRODUCTION

Since 2008, the World Oceans Day has been observed annually on 8 June to celebrate the vital role of oceans and seas and to raise awareness of the importance of preserving their invaluable resources. The 2025 theme, ‘Wonder: Sustaining What Sustains Us,’ serves as a powerful reminder of the majesty of the oceans and seas as enduring sources of sustenance, potential, wisdom, and awe.

The 2025 celebration is hosted by the Division for Ocean Affairs and the Law of the Sea of the Office of Legal Affairs of the United Nations, in partnership with Oceanic Global. As highlighted on the official website, the theme was selected to emphasize the ocean as our planet’s greatest wonder(UN World Oceans Day ,2025) in current times, perhaps the greatest wonder lies not in the oceans themselves, but in how human society continues to relate to them.

We have too often treated the oceans as endless storehouses of resources with something to be exploited, consumed, and even neglected. We treat it as a marketplace for goods, a dumping ground for waste, and a silent witness to our out-of-control capitalism sense. We take, often without thought, assuming it will always give. But the evidence is clear: the notion of an oceanic *sold-out* is no longer a distant threat, but it is approaching rapidly (Shaffer et al., 2009).

Alongside the critical challenges that climate change presents to several marine ecosystems, plastic pollution still remains a significant ecological threat. Over 80% of the waste found in the sea and on the coastal areas originates from plastic, translating into a long-term detrimental effect, as the material can persist in the environment for over a thousand years while degrading into smaller and less detectable particles. Although many measures have been taken to reduce plastic waste in the marine environment, the danger it poses persists longer than any effort. Micro- and nano plastics originated by the degradation of big plastic wastes, accumulate in the sediment and in the water column and lastly accumulate in all the trophic levels of marine

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organisms. Marine litter can threaten the marine fauna through ingestion, toxicological effects and bioaccumulation, and entanglement (Baulch and Perry, 2014; Fossi et al., 2018a; Kühn et al., 2015).

The ingestion or absorption of plastic particles is scientifically proven to compromise the health and survival of marine organisms (Oehlmann et al., 2009) and, ultimately, human health (Winiarska et al., 2024). Additionally, as an indirect consequence of the presence of floating plastic waste in the ocean, they may carry allochthonous species, facilitating the introduction of ecologically destructive alien species hitching a ride (Mghili et al., 2023).

This article aims to analyze the current state of scientific knowledge and the applicable legal frameworks addressing plastic pollution, with a focus on two specific regional contexts: Italy within the Mediterranean region and the Maldives within the Indian Ocean. The discussion seeks to inform policy development by highlighting region-specific challenges and regulatory responses.

ITALY–MALDIVES PERSPECTIVES ON PLASTIC POLLUTION

Based on data released by the Superior Institute for Environmental Protection and Research (in Italian: Istituto Superiore per la Protezione e la Ricerca Ambientale, ISPRA), the vast majority of this waste comes from commercial fisheries, including lines, ropes, and nets that are abandoned, lost, or discarded into the sea after use. Plastic material and byproducts, as well as microplastics, constitute a severe threat to both marine habitats and their living organisms. It is estimated that plastic pollution is the cause of death of around 100,000 marine mammals, a million seabirds, and countless fish and pelagic sea turtles each year (Vlachogianni et al., 2018). Several scientific research studies highlight how plastic pollution does not only affect megafauna as we imagine (i.e., mammals, birds, and sea turtles) but also constitutes a severe threat to invertebrates as well (Campani et al., 2013; Bottari et al., 2024). This discovery

emphasized how plastic pollution is now a systematic problem and a serious hazard for all the levels of the marine trophic chain, from top to bottom.



Figure 1: Fishing gear found on the beaches of the Marine Protected Area of Torre Guaceto, Puglia (Italy), during a volunteer-based beach clean-up.

The Mediterranean Sea, although representing only 0.8% of the total ocean and sea surface in the world, accounts for over 2% of the global primary productivity, and it is home to 18% of global marine described species. Being one of the busiest marine areas in the world, its incredible biodiversity is increasingly threatened by waste and litter generated by commercial fishing activities, intense maritime traffic, and dense coastal development (Baudena et al., 2022). Around half a million tonnes of plastic debris reach the Mediterranean waters per year, ranging from tiny particles of microplastic to big chunks of floating litter, polluting the water column from the surface to the seafloor (Hanke et al., 2025). The extent of the harm caused by plastic is still undetermined, as we lack a records database to monitor plastic pollution-induced death of marine mammals and other marine species. In the last 20 years, countless studies have been published reporting the harmful effect on marine fauna both in the Mediterranean area and especially in Italy, which, although being a leader in waste recycling efforts in Europe, still

represents one of the biggest contributors to mismanaged waste among the countries facing the basin (Kaza et al., 2018; Papadimitriou and Allison, 2022). Although still far from reaching this goal, several projects and initiatives have been created and funded (by the Italian Piano Nazionale di Ripresa e Resilienza—PNRR—or other EU programs and by ISPRA) to assess and mitigate the impact of plastic debris.

The collaborative nature of many of these projects, such as *INDICIT (Implementation of Indicators of Marine Litter On Sea Turtles And Biota In Regional Sea Conventions And Marine Strategy Framework Directive Areas)*, *PNRR Marine Ecosystem Restoration (MER)*, and *Plastic Busters MPAs*, fosters international cooperation in the evaluation of the current conditions of the Mediterranean waters while building a common front in the resolution of the issue. The latter in particular stresses the need to consider special management measures for Marine Protected Areas (MPAs) and Specially Protected Areas of Mediterranean Importance (SPAMIs), as they are not exempt from marine pollution and, on the contrary, plastic debris in these areas may cause even more worrisome damages (Fossi et al., 2025). A shared goal for many of the projects conducted on marine pollution is to generate a common standard in terms of marine litter monitoring and provide policy makers with concrete recommendations and strategies for the management of marine plastic waste.

On the other side of the world, another biodiversity hotspot, although very different, is severely threatened by plastic debris and marine pollution: the Maldives. The Maldivian Archipelago is constituted of 26 geographic atolls with a totality of ~1192 low-lying islands, which are latitudinally spread over 870 km in the Indian Ocean north of the equator and host a countless number of marine species and about 3% of the world's coral reefs. Like all marine habitats worldwide, unfortunately this tropical paradise is not untouched by the threat of plastic pollution. The geographic distribution of the islands, the consistency of tourism in resorts, and

the poor or nonexistent waste management of the country make plastic waste a serious problem for marine life. Urban areas, rural areas, and resort islands contribute 10.8 kt, 6.8 kt, and 4.4 kt, respectively, to total plastic waste, with resort islands generating almost twice as much plastic waste per capita compared to Maldivians.

Approximately 1.6 kt of plastic waste (7% of the total plastic waste generated) is estimated to enter the marine environment, with the major leakage source being the national landfill site Thilafushi (62%). 12% of the total plastic waste entering the aquatic environment originates from land-based littering. This percentage comprises the amount of plastic waste littered into the ocean and the amount that occurs in areas with no formal waste management options, particularly in rural islands (Royle et al., 2022).

While in the Mediterranean there is an extensive scientific literature regarding the megafauna and the potential effects of plastic pollution, no studies were conducted in the Maldives. However, this lack of scientific data and research in the area is common to nearly all fields of research compared to other tropical regions where research is broad and covers the majority of marine species.



Figure 2: Plastic material and waste abandoned on the uninhabited island of Adhanga, Faafu atoll (Maldives).

Research institutions and NGOs play a critical role in raising awareness and driving action in both Italian and Maldivian contexts. In the Maldives, organisations such as Zero Waste Maldives and Transparency Maldives have criticized the weak legal framework in managing plastic pollution and donor-funded waste infrastructure for perpetuating technological dependency and undermining local trust in waste management systems (Afrah Ismail and Hamsha Hussain, 2019, and Joint Press Assessment, 2022). Concerns persist over the weak enforcement capacity of national regulatory authorities and the introduction of section 44 of the Waste Management Act, which permits the importation of waste from third countries.

Meanwhile, on the Mediterranean front, Italian NGOs like MareVivo actively support scientific research and attempts to confine plastic pollution damage. Among the numerous initiatives, MareVivo is now in charge of the actualization of the PNRR MER project through the “GhostNets” campaign, a considerable effort that will take place large-scale on the national territory. Like real “ghost busters,” the NGO operators will put into practice activities with the aim of removing ghost nets in various areas, with a “mapping-collecting-restoring” strategy. The involvement of MareVivo allows for a local intervention to reach the project’s goals: restoring and protecting the seabed, enhancing marine and coastal observation systems, and mapping coastal and marine habitats of conservation significance.

In the Mediterranean region, Italy is one of the European coastal states with one of the largest economies in the world. It possesses well-developed infrastructure and faces fewer resource constraints compared to the Maldives, a Small Island Developing State (SIDS) characterized by geographic isolation and an economy in transition. Despite these contrasts, both countries face serious challenges related to marine plastic pollution and demonstrate insufficient political commitment to address it effectively.

In Italy, Article 117 of the Constitution, amended by Constitutional Law No. 3/2001, assigns exclusive legislative competence for environmental protection to the State. Consequently, several national measures have been introduced, including the Plastic Tax under Law No. 160/2019, aimed at reducing single-use plastics and promoting compostable alternatives. However, the tax has been postponed seven times, with the latest implementation date set for July 2026.

As a member country of the European Union (EU), Italy has also transposed the EU Directive 2019/904 on single-use plastics through Legislative Decree No. 196/2021. Nonetheless, the European Commission initiated infringement proceedings in 2024, with a formal note (European Commission, 2024) citing incomplete and incorrect transposition of the EU Directive.

The Maldives has introduced the Waste Management Act No. 24 of 2022, which includes a fee on plastic bags and significant penalties for illegal waste activities. However, an amendment passed in December 2023 permits the import of waste under section 44, a decision that diverges sharply from the trend in many South Asian countries, which have moved to restrict such imports following China's 2018 ban.

As claimed by several Maldivian NGOs and environmental activists (Zero Waste Maldives, 2022), without adequate waste management infrastructure, this policy risks exacerbating environmental harm and echoes broader concerns about 'waste colonialism' enabled by donor-driven infrastructure projects, which have often failed to deliver effective or sustainable results.

At the regional level, both countries participate in multilateral environmental agreements. Italy is a contracting party to the Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona, 1976) and its Protocols, which provide a legally binding framework to

reduce pollution in the Mediterranean. Notable area-based protections in the Barcelona Convention framework include SPAMIs such as the Pelagos Sanctuary.

Four Important Marine Mammal Areas (IMMAs) have been designated under Italian jurisdiction, two of which are shared with neighbouring States, to help protect marine mammals from human-induced pressures, including marine pollution. However, as reported above, the introduction of area-based protection measures seems not suitable for marine plastic pollution (Fossi et al., 2025).

In the Indian Ocean region, under the coordination of the South Asia Co-operative Environment Programme (SACEP), donor-funded initiatives such as the World Bank-supported “Plastic Free Rivers and Seas for South Asia” (PLEASE) project have been launched. However, the region still lacks a robust legal framework for combating marine pollution. In the context of area-based protection measures, no Maldivian marine areas have been designated as IMMAs, although the entire Maldivian marine territory meets the criteria for such designation (IUCN-Marine Mammal Protected Areas Task Force, 2021).

Despite their starkly different socio-economic and geographical contexts, both Italy and the Maldives exemplify the global challenge of marine plastic pollution and the insufficient political prioritization it receives. While Italy possesses a robust legislative framework and greater economic capacity, its delayed implementation of key measures such as the Plastic Tax and incomplete transposition of the EU Single-Use Plastics Directive reflect a lack of urgency. Conversely, the Maldives, although proactive in adopting national waste management laws, faces structural limitations and controversial policy choices that undermine its environmental commitments.

CONCLUSION

Given the transboundary nature of marine plastic pollution, global coordination is essential. The current knowledge about the presence, nature, short- and long-term effects of marine plastic pollution suggests a clear state of emergency worldwide, with a possibly more catastrophic impact on biodiversity hotspots and fragile environments. However, we are still to develop effective tools to generate meaningful actions and enhance constructive international cooperation, as it is clear by now that a common front is needed to face this unprecedented challenge.

Along with NGOs, the scientific community agrees on the urgent need for standardized and harmonised protocol for marine plastic pollution monitoring and implemented international regulations, as it may be the only way to foster better solutions to prevent, avoid, and mitigate the effects of plastic debris in the sea (Panti et al., 2019). In this regard, the development of a legally binding international instrument on plastic pollution, as mandated by the UNEA Resolution 5/14 entitled “End plastic pollution: Towards an international legally binding instrument”, is a significant step forward.

The ongoing Intergovernmental Negotiating Committee to develop an international legally binding instrument on plastic pollution, including in the marine environment, is at its fifth session, and the process represents a crucial opportunity to establish enforceable global standards to address this urgent environmental challenge. In the near future, the second part of the fifth session (INC-5.2) is scheduled to take place in August 2025 in Geneva, Switzerland.

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2. BEYOND THE BENCH—WHAT NEXT AFTER THE ADVISORY OPINIONS ON CLIMATE CHANGE?

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INTRODUCTION

Climate change is one of the most popular subjects of this decade. Backed by science, the impact of climate change on humankind has become real (IPCC, 2023), culminating in several agreements and commitments by States to address the fundamental issues within their respective territories and as a collective.

Despite the intention of States to implement clear resolutions towards achieving reduced emissions and an overall better climate, the most significant question of International Law remained unanswered: how can these commitments be enforced among states?

This question has driven the international community to take steps towards initiating judicial intervention. A total of four advisory opinion requests on climate change have been initiated before different forums – two being requests to the International Tribunal for the Law of the Sea (ITLOS) and the International Court of Justice (ICJ), which are the focus of this

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contribution, while the others have been before regional human rights courts- one before the African Court on Human and Peoples Rights and another before the Inter-American Court of Human Rights.

ADVISORY OPINION BY THE ITLOS

On 12 December 2022, the Commission of Small Island States (COSIS) submitted a request to the ITLOS for an advisory opinion on the specific obligations of States Parties to the United Nations Convention on the Law of the Sea (UNCLOS), including under Part XII (a) to prevent, reduce, and control pollution of the marine environment in relation to the deleterious effects of climate change, including ocean warming and sea level rise, and ocean acidification, which are caused by anthropogenic greenhouse gas emissions into the atmosphere, and (b) to protect and preserve the marine environment in relation to climate change. 53 entities, comprising States, non-governmental organisations and regional organisations participated in the proceedings through written submissions, and the opinion of the tribunal was delivered on 21 May 2024.

For the first time in its opinion, the ITLOS found that the definition of pollution under the UNCLOS in Article 1(1)(4) also included GHG emissions for the reason that such emissions are a) a 'substance or energy' which b) is 'introduced by humans, directly or indirectly, into the marine environment,' and c) causes multiple 'deleterious effects,' such as warming and ocean acidification, as well as harm to living resources and marine life (para. 75).

In addition, the tribunal properly defined the scope of the obligation of States to take 'all necessary measures' to prevent, reduce, and control pollution, noting that the margin of States' discretion should be considered based on objective factors like best available science, international rules and standards, and available means and capabilities (para. 206).

Lastly, due diligence has remained an amorphous obligation in the Law of the Sea, but the ITLOS observed that this obligation should impose more stringent requirements for riskier

activities (para. 239). Accordingly, in relation to marine pollution, the due diligence requirement would not stop at the application of ‘best efforts’ by States but will include specific positive results, including administrative, legislative, and enforcement procedures to achieve its intended objective. Overall, the ITLOS was concerned with giving more definition and force to the loosely-framed wording of the UNCLOS in relation to the protection of the marine environment. It is necessary to add that several commentators found the advisory opinion to be limited as a result of the questions presented before the tribunal, which guided the scope of issues covered in its advisory opinion.

ADVISORY OPINION BEFORE THE ICJ

In line with the procedural requirements for advisory requests before the principal judicial organ of the United Nations, the General Assembly (GA Resolution A/77/L.58) requested the ICJ to render its advisory opinion also on the obligations of States with respect to climate change. At face value, the topic before the ICJ is similar to the ITLOS request. However, a perusal of the specific questions indicates a broader question for consideration before the ICJ.

The Court is requested to advise on (a) the obligation of States to ensure the protection of the climate system and other parts of the environment from emissions of GHGs for present and future generations and (b) the legal consequences under these obligations where States have caused significant harm to the climate system and environment, including small island developing States which are specially affected by the adverse effects of climate change, and the individuals of the present and future generations.

Although the procedures leading to the rendering of the Court’s opinion are ongoing, three aspects of this request justify the expectation of the international community of a more robust and wider-encompassing opinion from the court. First, the court has been invited to comment on States obligations for the ‘present and future generations.’

This phrase invites the court to take a futuristic view on State obligations with respect to climate change, which, as Foster observes, lends credence to the theory of intergenerational equity, which views future generations as having specific international legal interests to be protected (Foster, 2024). Secondly, the request for advice on legal consequences corrects the limitation of the ITLOS request. While obligations are necessary, knowing the responsibility a State may be exposed to under international law for its hazardous act or omission might encourage States to avoid actions which will expose them to responsibility under International Law. Third and importantly, the court is invited to advise on the effect of climate change not only on States but also on peoples and individuals. Although States are the primary rightsholders and duty-bearers under International Law, an extension of the legal consequences of States' actions to individuals will signify the recognition of the impact of climate change on individuals and groups whose considerations are not emphasised in International Law.

WHAT NEXT?

While the recourse to these judicial organs is a laudable move to reinforce States' commitments and interpret aspects of the law, the question remains: what happens after these opinions have been rendered, and what difference will they make to States' current commitments on climate change?

As a background, advisory opinions are just that—opinions. They are not binding, regardless of the widespread participation of States and other stakeholders or the relevance of the topic. As non-binding views of the court, States are not obligated by law to follow the advice, although they can reference it when performing their obligations (Vinuales, Jorge et al., 2021). An additional action by States based on the advisory opinion—whether through a treaty, other

binding agreements, or domestic legislation—is required to give binding force to the judicial conclusions contained in the opinion.

However, advisory opinions are not completely impotent in international law. In the first place, the issuance of an advisory opinion on a particular topic serves as a pointer to the international community regarding the reasoning of judicial bodies on certain matters. It also sheds light on the future direction of international law concerning a subject.

Accordingly, States parties initiating an international claim on the basis of law on related questions can benefit from a previous court or tribunal's advice in their preparation or in formulating their litigation strategy. Moreover, these judicial tribunals have been known to cite earlier advisory opinions in subsequent contentious cases.

For example, ITLOS cited its previous advisory opinion in a previous case as a reference on the elevation of the ILC Draft Articles to customary international law (ITLOS: *MV Virginia G*, 2014; *Ghana v. Cote d'Ivoire*, 2007), and the ICJ cited its advisory opinion in a subsequent contentious case as a well-settled reference for the exercise of the right to self-defense (ICJ: *Oil Platforms Case*, 2003)

Secondly, advisory opinions give the court or tribunal an opportunity to specify the meaning of a provision of law previously undefined in earlier cases. An example from the ITLOS climate change opinion is the definition provided to the obligation of due diligence, which is famed as an ambiguous obligation in international environmental law. Also, an expansion of the meaning of pollution under the UNCLOS to include atmospheric GHG emissions expands the UNCLOS coverage in Part XII, thereby bringing it to contemporary significance.

Thirdly, prior to these advisory requests, States and other stakeholders in protecting the climate have made several commitments which show their interest in responding positively to the

climate emergency, but mostly without further basis under international law. The opinions concretise these commitments, short of creating new obligations, but persuade States to take action based on the interpretation of their obligations by the court.

Fourthly, Sands observed that the involvement of judicial bodies could play a positive role in addressing climate change (Sands, 2016). The advisory opinions could inspire and influence States to not only resume negotiations on an internationally binding agreement in relation to climate change but also open up the ‘hard talk’ that States have delayed for so long regarding consequences for defaulters under international law (Bodansky, 2023).

The current climate change legal regime has been managerial and collaborative, focusing less on enforcement, compliance, and consequences. The UNCLOS and the United Framework Convention on Climate Change repeat vague formulations of due diligence and precautionary principles masked in obligations to ‘protect and preserve’ and to ‘take all necessary measures,’ which are hardly defined by law and subject to different State interpretations.

Moreover, the consideration of socio-economic contexts and capacities inserted into many legal instruments on climate change, though necessary and significant, might provide an excuse for capable polluters to shy away from responsibility. With advisory opinions, States could become prepared to institutionalize certain benchmarks and standards, which, in turn, could drive positive results in the climate ecosystem.

Finally, there are indications that the advisory opinion may serve as useful jurisprudence for domestic courts, arbitral tribunals, and international organizations when addressing matters relating to climate change. For instance, the advisory opinion on human rights and the environment rendered by the Inter-American Court of Human Rights has been invoked by the

UN Committee on the Rights of the Child, notably in the case of *Saachi et al. v. Argentina et al.* (104/2019).

Similarly, the earliest advisory opinion issued by the ICJ (IMCO Advisory Opinion, 1960), which advised that the composition of the Maritime Safety Committee of the International Maritime Organization be drawn from the largest ship-owning nations, was adopted in Article 17(a) of the IMO Convention for election to the Council.

CONCLUSION

There is a long way to go in institutionalizing the obligations and responsibilities of States in relation to climate change, but the international community has made significant progress.

Advisory opinions serve as a tool in the hands of States and other stakeholders to reinforce the global commitment to achieving a climate-resilient environment. This is particularly necessary for the oceans, which are the largest carbon sink.

As we await the advisory opinion by the ICJ, this post has identified essential ways the community of nations can take advantage of advisory opinions, regardless of their non-binding nature.

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3. JOINT DEVELOPMENT AGREEMENTS: A COOPERATIVE PATHWAY TO OCEAN GOVERNANCE IN DISPUTED MARITIME ZONES: LESSONS FROM THE GULF OF GUINEA

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INTRODUCTION

The ocean is a vast body of water surrounded by land masses (Arif, 2017). It plays a significant role in supporting human activities, including trade, transportation, and exploitation of natural resources. Regrettably, maritime zones have been subject to consistent transnational threats, including unlawful activities such as piracy, armed robbery, and human trafficking. These threats have been exacerbated by disputes over boundaries, which have hindered the effective governance of the ocean.

This is particularly evident in regions where overlapping claims intersect with abundant resources, such as oil, gas, and fisheries in areas like the Exclusive Economic Zone and Continental Shelf. One such region is the Gulf of Guinea (GoG), which extends from Angola to Senegal in the Southern Atlantic Ocean along the coastlines of West and Central Africa (Okafor-Yarwood, 2015). The status of the sea's semi-enclosed nature has become a focal point

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of maritime boundary disputes, driven by a complex interplay of geographical features, colonial legacies, and the presence of abundant hydrocarbon deposits (Adusu, 2019).

It has been determined that of the 100 potential maritime boundary disputes that have occurred on the African continent, 32 have been resolved. The remaining 68 have either remained unresolved or been deemed undisputed (Roelf, 2014).

Notwithstanding, the GoG offers an opportunity to explore promising interim, pragmatic, and innovative solutions, such as Joint Development Agreements (JDAs). These agreements are codified under Articles 74(3) and 83(3) of the 1982 United Nations Convention on the Law of the Sea (UNCLOS). They allow cooperation, resource exploitation, and exploration between two or more states while awaiting the final delimitation.

This blog post explores the potential of JDAs to function as a mechanism in the realm of ocean governance. To illustrate this point, the post will draw upon case studies from the GoG and other sources. The key findings indicate the contribution of this instrument in promoting marine justice and sustainable development.

AN EXAMINATION OF THE COMPLEXITY OF MARITIME DISPUTES IN THE GULF OF GUINEA

The GoG states are distinguished by a confluence of intricate geographic characteristics, colonial-era treaties, and the presence of lucrative oil and gas resources. In recent years, these states have experienced an escalation in maritime boundary disputes. It is worth noting that *the 2012 Cameroon/Nigeria maritime boundary dispute* over the Bakassi Peninsula was adjudicated by the International Court of Justice (ICJ).

This judgment signified the inception of a resolution to the dispute, as the court determined that Cameroon possessed sovereignty. Consequently, it emphasizes the preeminence of colonial agreements and protracted court decisions, in conjunction with the absence of

cooperative instruments such as JDAs. In the event that JDA had been pursued, Nigeria would have relinquished its sovereignty over the Bakassi Peninsula. This could have potentially enabled both states to maintain access to shared resources and mitigate tensions without the need for an immediate resolution regarding sovereignty.

Conversely, the consequences of the Berlin Conference of 1884-1885 (Keith, 1919) continue to influence the establishment of arbitrary and artificial maritime boundaries throughout the African continent. This principle of *Uti possidetis*, initially implemented in Latin America and subsequently adopted in the GoG, has been a contributing factor in this ongoing phenomenon. Despite the efforts of regional frameworks such as the African Union Border Programme (AUBP) and the Gulf of Guinea Commission (GGC) to enhance regional stability, the redefinition of African maritime boundaries remains a politically sensitive initiative. In such contexts, JDAs serve as a diplomatic conduit between sovereignty and cooperation in sensitive regions such as the GoG.

JOINT DEVELOPMENT AGREEMENTS AS A LEGAL AND PRAGMATIC INNOVATION

By UNCLOS Articles 74(3) and 83(3), JDAs are defined as provisional arrangements of a practical nature. These arrangements are established for the purpose of joint management of maritime resources pending final delimitation. These agreements mandate that the involved parties engage in negotiations with good faith, strictly prohibit unilateral exploitation, and promote the equitable distribution of benefits. Complimented by Article 123 of the UNCLOS, which encourages semi-enclosed states to cooperate on resource management and environmental protection, JDAs serve as a cooperative legal instrument.

A substantial body of research exists in other regions, comprising numerous international case studies, which collectively demonstrate the potential benefits and pitfalls associated with JDAs.

The *1974 Japan-South Korea* JDA was a bilateral agreement that led to the establishment of a Joint Development Zone (JDZ) in the East China Sea. Notwithstanding the successful implementation and initiation of resource sharing, unresolved sovereignty claims have impeded long-term stability (Miyoshi & Schofield, 1999). Moreover, the *1990 Malaysia/Thailand* agreement permitted the establishment of a joint authority model that continues to oversee a productive development zone in the Gulf of Thailand, illustrating robust institutional design and equitable revenue sharing.

In the GoG, the *2001 Nigeria/Sao Tome and Principe* case established a JDZ and is the first and effective JDA of the region, serving as a regional precedent. Despite its initial success, the zone has faced operational and transparency challenges due to evolving political priorities and governance capacity. Notwithstanding the aforementioned, JDAs provide a legal framework that can be regarded as a paradigm for cooperative governance in contested maritime areas.

The ICJ and the International Tribunal for the Law of the Sea (ITLOS) have been criticized for their inflexible approach, which often results in the imposition of binding decisions that fail to address the dynamic and continually evolving nature of resource management issues (Yiallourides, 2016; Adusu, 2020). Conversely, JDAs have been praised for their ability to offer greater flexibility, a feature that is particularly appealing in the context of rapidly changing environmental circumstances. Consequently, JDAs provide both legal continuity and policy pragmatism.

JOINT DEVELOPMENT AGREEMENTS AND OCEAN GOVERNANCE: LEGAL NORMS VS. POLICY ASPIRATIONS

It is imperative to acknowledge that JDAs straddle the line between binding legal mechanisms and policy instruments for cooperation. From a legal standpoint, they comply with UNCLOS by temporarily suspending sovereignty disputes. From a political standpoint, they enhance

regional integration, strengthen institutional capacity, optimize shared resources, and mitigate tensions. Nonetheless, policy objectives, including but not limited to environmental sustainability, community inclusion, and equity benefit-sharing, are contingent upon the establishment of robust legal commitments.

In light of their paramount importance, JDAs must undergo a comprehensive re-examination and restructuring to align with global environmental standards, such as the Sustainable Development Goals (SDGs), notably the SDG “Life Below Water” (United Nations, 2015). Adequate provisions must be in place to address the pressing issues of marine pollution, impact assessments, and participatory governance involving local communities.

SOVEREIGNTY VS. COOPERATION: CHALLENGES AND THE WAY FORWARD

The global analysis and perception argue that JDAs can be temporary palliatives allowing states to navigate challenging sovereign decisions and reap resource benefits (Smith, 2020; Tanaka, 2018). In the absence of legal clarity, trust, a strong political commitment, equity, fairness in resource sharing, and institutional strength, JDAs could become a temporary solution to unsettled sovereignty claims rather than a permanent solution that fosters global stability. To be more precise, there is a risk that they will devolve into stopgap measures that prevent the escalation of conflicts within the short term. However, this approach may prove ineffective in addressing the underlying tensions that are the true drivers of conflict (Mensah, 2019).

As the GoG moves towards aligning with this global trend, it would be advantageous to draw from the experience of JDAs worldwide and develop regionally adapted models that incorporate robust legal and institutional frameworks. The development of a regional JDA-adapted framework under the auspices of the African Union's 2050 Africa's Integrated Maritime Strategy (AIMS) and the Yaoundé Code of Conduct has the potential to foster consistency, strengthen cooperation, and promote ocean governance (African Union

Commission [AUC], 2012; ICC Yaoundé Architecture, 2013). To achieve a truly transformative outcome, JDAs must be designed not only as legal instruments but also as integrated governance compacts. Such compacts must ensure revenue-sharing equity, involve communities, protect marine ecosystems, and foster trust between negotiating parties (Özçayır, 2021; Akpan, 2017).

The AIMS underscores the significance of Shared Maritime Domain Awareness, underpinned by cross-border unitization. This approach directly contributes to the operationalization of JDAs by facilitating the joint management of offshore resources in disputed maritime areas, such as the GoG (AUC, 2012).

A similar cooperative vision is reinforced by the *African Charter on Maritime Security and Safety and Development in Africa (Lomé Charter)*, adopted in 2016 but not yet in force. Article 13 of the Charter calls upon Member States to demarcate their maritime boundaries in accordance with international law and to develop legal frameworks that promote cooperation and economic growth (African Union, 2016). Upon ratification, the Charter could provide legally binding support for JDAs as mechanisms for managing overlapping maritime claims.

At the regional level, the ECOWAS Integrated Maritime Strategy (EIMS) designates the GoG as a key maritime security and economic hub. It emphasises joint patrols, coordinated governance, and information sharing to complement and reinforce the principles of effective JDAs (ECOWAS, 2014). These provisions contribute to the establishment of a regional environment characterized by trust, shared sovereignty, and collaborative development.

When considered collectively, these continental and regional instruments establish robust policy and normative foundations for the adoption and evolution of JDAs as legitimate, legally supported tools for maritime cooperation and conflict resolution in Africa (Oduntan, 2020; Okafor-Yarwood, 2022).

CONCLUSION

In commemoration of World Ocean Day 2025, it is vital to reaffirm cooperation as the foundational principle of ocean governance. The GoG, characterized by intricate disputes and substantial resources, presents a multifaceted environment that offers challenges and opportunities. The efficacy of JDAs as instruments of cooperation has been demonstrated by their ability to promote equitable resource distribution, foster development, and enhance cooperation.

Nevertheless, the attainment of success is contingent upon factors that extend beyond the realm of legal drafting. The establishment of trust, the presence of political commitment, the implementation of transparent institutions, and the promotion of inclusive governance are all imperative for the realization of this objective. By embracing the legal tools and policy frameworks known as JDAs, GoG states can achieve a balance between sovereignty and solidarity, thereby charting a sustainable path toward maritime peace and prosperity.

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4. MARINE POLLUTION AND ERADICATION OF POVERTY: THE PROSPECTS AND CHALLENGES IN THE NIGER-DELTA AREA

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INTRODUCTION

A nation's natural endowments constitute assets which are expected to be applied for the development of citizens and the state in general. It takes good governance to manage such resources in a profitable way for humanity by way of attainment of development in a satisfactory environment. The paper examines the management prowess of traditional rulers in the pre-colonial communities in Africa and the transition to the present age with arrays of legislation and international instruments. There is then a debate on whether the ancestral stages of the African with simple cultural norms was more pragmatic than and more result-- oriented than now. It is believed in certain quarters that communities in the pre-colonial Africa enjoyed

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primitive innocence and harmony with the environment and that disposition was sustained by norms, taboos, and Aboriginal laws (Rodney, 1972, 68; Olayinka, 2021, 19).

The study considers the indigenous people in the various ways they have been discriminated against under colonization and the post-colonial era owing to their dispossession from ancestral homes, which events equally hinder their pastoral, fishing, and crop farming (ILO Handbook, 2013, 3). Extraction of mineral resources, which was an imposed development, was for public interest. Consequent to extraction businesses is the generation of wastes, pollution of land and oceans, affecting the lives, health, and vocation of the indigenous peoples of oil-producing communities in Nigeria.

Nigeria has enormous natural resources such as crude oil, natural gas, gold, limestone, granite, and coal, among others. This explains the flow of the nation's income, though with accompanying pollution of the safe waters and general environment (Environmental Issues In Africa; Borha and Olujobi, 2023, 3, 5).

There are arrays of legislation and instruments made towards attaining and sustaining a satisfactory environment. However, the Federal Government of Nigeria has been accused of non-commitment to enforcing the rule of law and of failing to sanction oil-producing companies for their role in violating satisfactory environmental standards. This is linked to the immense income generated from that source, which the Government wants to maintain. Legal instruments, however, caution that development should not be made at the expense of environmental violations (Principles 11, 14 Stockholm Declaration, 1972). This explains the citizens' resort to killings, maiming, vandalisation of pipelines, and stealing of crude oil.

The Nigeria's Petroleum Industries Act (PIA) of 2021 is considered in terms of prospects of attaining justice over allegations of violation of dispossession, denial of various entitlements,

and whether the establishment of the Host Communities Development Trust (HCDT) Fund is able to make a difference in their development.

The paper makes recommendations such that can reverse poverty trends in oil-producing communities, giving education and enlightenment on environmental matters and the fact that developing nations should refrain from taking foreign loans with unfavorable conditionality that affect development and satisfactory environments.

The study is divided into six sections, with the first giving the background information and the next section treating indigenous people, ocean pollution, and the state's obligations. The third section throws light on poverty alleviation and the right to development. Section four provides information on climate change and adaptation measures. Section five provides recommendations, while section six provides a conclusion.

INDIGENOUS PEOPLE, OCEAN POLLUTION, AND STATE'S OBLIGATIONS

In the pre-colonial Africa, the indigenous peoples lived in small communities, which now form the modern Africa (Rodney, 1972, 68). The indigenous peoples lived in harmony with nature as everyone was guided by norms, taboos, and Aboriginal laws, which discouraged pollution of the land and the environment (Olayinka, 2021, 19). The *Ogoni* people, for instance, are indigenous people who occupied the north-east plain terraces of the Niger-Delta River in Rivers State. They are mostly farmers and fishermen and have been in occupation of the area for nearly 1,000 years before the British came to Nigeria in 1861 (ACHPR/IWGIA, 2005, 18).

The histories of indigenous peoples, particularly under colonization and the post-colonial era, have victims of circumstances of birth, location and thus are treated by successive administrations as 'less-human' (ILO Handbook, 2013, 3). With colonialism and

westernisation, particularly under the post-colonial administration, indigenous peoples lost the right to determine how natural resources on their ancestral land were used, and the control of their land vested in other interests which are superior to theirs.

The law provides that no one should suffer any deprivation on account of his race, ethnic group, colour, sex, language, religion, political or any other opinion, national and social origin, fortune, birth, or other status (Article 2, African Charter, 1981; Section 42, 1999 Constitution of Nigeria).

Nigeria has numerous extractive resources such as crude oil, natural gas, gold, limestone, granite, and coal, among others. The economy of Nigeria is heavily dependent on its hydrocarbon resources (Borha and Olujobi 2023, 3, 5). In the course of the exploration of crude oil, there is pollution of the safe waters resulting from the transportation of crude oil through the sea route, which results from the improper packaging and transport (Environmental Issues In Africa).

Pollution also occurs at the domestic level, from industrial sources, from agrochemical siltation and sedimentation, from oil pollution, and at the microbial level (Yoromar & Ezugwu, 2024, 66). The effect of marine pollution on water bodies and coastal areas causes degradation to the environment and its ecosystem (Alari, 2019).

Consequently, marine pollution in Nigeria links with human activities such as the rapid expansion of metropolitan areas, extraction of nature's endowment, and industrialization. Attempts at curbing marine environmental pollution, in order to have a dependable environment on the principles that "damage to the marine resources, marine development, and marine environmental quality is damage to mankind" (Umeh et al., 2024: 441; Yoromar & Ezugwu, 2024, 66).

The United Nations Conference on the Human Environment (Stockholm Declaration, 1972) provides the link between human rights and environmental protection. It asserts that man has the fundamental right to adequate conditions of life, with an environment that permits a life of dignity and well-being, with an obligation to explore the environment today without compromising on the best interests of future generations (Principle 1, 2, Stockholm Declaration 1972).

Economic development and climate change are inextricably linked, particularly around poverty, gender equality, and energy. States are obliged to effectively handle climate action and the environment to avoid being enmeshed in poverty (Goal 13 SDG). Nigerian Coastal waters like all coastal and port countries in the world, experience the problem of marine pollution through industrial activity at the ports. And like some other petroleum-producing nations, Nigeria's marine pollution challenge is exacerbated and ignited by oil and gas exploration/flaring and production (Yoromar & Ezugwu, 2024, 67).

States are obliged to take all possible steps to prevent pollution of the seas by substances that are liable to create hazards to human health, to harm living resources and marine life, to damage amenities, or to interfere with other legitimate uses of the sea (Principle 7, Stockholm, 1972).

Marine pollution has a damaging effect on the quality and quantity and the expected economic value of marine resources and benefits to individual stakeholders and a nation. Careless handling of plastic debris most times finds its way to the ocean and being non-biodegradable element, they obstruct the movement of boats and ships, thereby affecting the quality distribution of goods and national productivity. Commercial transport on waterways and submarine trawling operations are adversely affected such that they affect the economic participation of indigenous people and their poverty level. All these are due to the pollutants which have defaced the ocean and marine ecosystems.

Pollution generates heat, a rise in temperature, which in turn leads to ocean acidification and the death of aquatic habitats. Acidic Oceans result from the increased levels of carbon dioxide in the atmosphere due to deforestation and burning fossil fuels, which make oceans more acidic. Since the Industrial Revolution, beaches are already 30 percent more acidic, posing ocean species and ecosystems at extreme risk (Conserve Energy, Yoromar & Ezugwu, 2024, 67).

In the Niger Delta, oil spill is a phenomenon with over 1000 spills per annum from obsolete crude oil pipelines that are corroded and frequently giving way and spewing oil into the rivers, streams, farmlands, and neighbourhoods. Human activities aggravate global climate with implications touching on environmental, social, economic, and political aspects of indigenous people of Africa (Onyeabor 145).

Effective strategies to mitigate the adverse effects of increased ocean acidification are needed to advance the sustainable use of oceans and life below water. The United Nations Convention on the Law of the Sea (UNCLOS) was adopted in 1982 and entered into force in 1994. It regulates all uses of the seas and provides the legal framework for international ocean governance. It is expected to contribute to achieving the United Nations' 'Life Below Water' (Goal 14, Sustainable Development). Goal 14 stresses on preserving aquatic habitats in a manner that conserve and sustainably use the oceans, seas, and marine resources for sustainable development. UNCLOS is also expected to give support efforts to place 30 percent of the world's oceans under protection by 2030 (UN Ocean Treaty, 1994).

In the pre-colonial Africa, the aquatic life such as fish stocks and other marine creatures in rivers and oceans flourished, and there were conducive forests which sustained wildlife (Principle 4, Stockholm; Udok & Akpan, 2017, 25). As such, the indigenous people adopted and used the land and ocean to meet the needs of everyone, including the vulnerable or

marginalised groups, without compromising the future generations' ability to meet their own needs (Principle Stockholm 11 Declaration; McGuire; Tawari & Abowei, 2012, 106-110).

There were lands and oceans protected from degradation and pollution, invoking spiritual colourations. The indigenous people relied on 'taboos' and norms such as branding, as juristic status was conferred on sacred land, rivers, mountains, trees, and forests (Studley, 2020, 2). The state has the legal duty and responsibility to protect the environment, to safeguard the water, air, land, forests, and wildlife of Nigeria. States should protect the environment to meet the needs of every age (Goal 3, SDG; article 24, 30 African Charter, 1981).

States are obliged to seek development by adopting integrated and coordinated development planning, such that developmental steps that are taken do not conflict with the principles of a safe environment (Principles 11, 14 Stockholm Declaration, 1972). As such, the Limburg Principles clearly mandate the states to take all legislative, administrative, judicial, economic, social, and educational measures to fulfill the obligations under the ICESCR (The Limburg Principles; Olayinka, 2019 – AJICL, 571). The obligation of the state to enforce constitutional provisions and to take other measures is now sealed with the State's responsibility to prevent, reduce, and control the risk of environmental harm to its citizens and those of other States.

POVERTY ALLEVIATION AND THE RIGHT TO DEVELOPMENT

Eradication of extreme poverty is the greatest global concern on the path to attaining global sustainable development (Preamble to the SDG). Eradicating of poverty has to do with the provision of certain social services, which also depends on available funding by the state. Developing countries are encouraged to diversify economic activity and develop with required resources to handle environmental demands (Principle 10, Stockholm, 1972).

This may be attained better with diversification of the economy from producer of primary products to manufacturing of goods. Manufacturing of goods contributes as much as 80 percent to gross domestic product, while primary agricultural products contribute as low as 10 percent to the gross domestic product. Thus, it is desirable for a state to diversify from an agrarian mono-economy to manufacturing (SDG 9; Olayinka, 2022).

Since development has to be attained without compromising on the health of the environment, the paper considers the laudable provisions on environmental protection made by the PIA, 2021. A licensee has to certify to appropriate agencies of its resolve to meet environmental demands in its operation (section 102(1) PIA 2021).

Equally, the PIA makes gas flaring an offence but creates certain exceptions, such as those that are explored. Such include in the case of an emergency, pursuant to an exemption granted by the Commission, or as an acceptable safety practice (Section 104(1) PIA 2021). The Nigerian Government condones degradation of the environment as it omits to sanction MNCs that indulge in gas flaring.

Gas flaring makes life unbearable for communities in the Niger Delta area of Nigeria and a conducive environment for development. The African Charter on Human and Peoples' Rights however provides that 'all peoples shall have the right to a general satisfactory environment favourable to their development' (article 24, African Charter).

The African Union (AU) provides that member states should eradicate poverty, generate employment, and observe all other rights, with a view of attaining development in such states (Preamble to the African Charter). The African Charter affords the legal protection of the environment, devoid of human rights violations (Article 24 African Charter; Jegede, 2015). The economic benefit to the Nigerian State explains the Governments blindness to the over

1000 spills per annum from obsolete crude oil pipelines that are corroded and frequently giving way and spewing oil into the rivers, streams, farmlands, and neighbourhoods.

While the state earns more income from oil mining, not minding the reckless manner adopted by the multinational corporations handling the same, the indigenous people suffer the brunt of environmental pollution. Environmental degradation, gas flaring, and deforestation have severe impacts on these communities, leading to the displacement of people from their places of fishing, animal husbandry, forestry, and food cropping, which were very profitable ventures (Omoyefa, 2008; Oruonye, 2012).

It is envisaged that citizens attain development when their means of livelihood are not adversely affected in any way. This laudable goal is not realised with the wilful destruction of the means of livelihood of indigenous people of oil-producing communities who lose their farms to oil spills, which enhances their poverty level. Environmental violations have left people in oil-producing communities susceptible to serious health risks, struggling to access safe drinking water, and unable to earn a living (McGuire; Tawari & Abowei, 2012). Without good health, there cannot be productivity.

The need to strike a balance between environmental protection and development makes the demand of responsible consumption and production relevant (SDG 12). In the circumstances, eco-friendly production methods, which reduce the amount of waste and degradation that follow production, have to be embraced; recycling of waste products is equally encouraged.

CLIMATE CHANGE AND ADAPTATION MEASURES

Adaptation has to do with adopting processes to cope with the “ill-effects of climate change” by way of adjustments to reduce vulnerability or improve flexibility to the observed or expected changes in climate (Springer-Verlag Berlin Heidelberg 2015, 799–822; Jegede, 2015, 803).

Climate change adaptation recognizes the effect of environmental violations on account of human activities, and to be precise, in the advancement of economic exploits.

Marine pollution arising out of petroleum harnessing is a major cause of the social unrest in the Niger Delta area, which has over the years attracted national and international attention. The state's intervention is the promulgation of the PIA and HCDTF, which ensure the construction of infrastructure and development of the area. (Yoromar & Ezugwu, 2024).

The omission of the Federal Government of Nigeria to honour international and regional obligations to protect the environment in the extraction of natural resources makes for resort to litigation to seek remedy for violation of environmental rights.

In *Allar Irou v. Shell BP Development (Nig) Ltd.*,⁸ the court refused to make an order for injunction in favour of the successful claimant whose land and fish pond had been contaminated by the defendant's activities, holding that such an order would disrupt the defendant's business in oil and gas mining, which is the main source of the country's revenue.

In *Oronto Douglas v. Shell*,⁹ in an action against the Shell for its failure to comply with the provisions of the Nigerian Environmental Impact Assessment Act, the court held that the applicant did not have locus standi notwithstanding that the proposed project to which the non-compliance related was to be carried out in the plaintiff's community.

The case of *Gbemre v. Shell Petroleum Development Corporation of Nigeria Ltd. and ors.* (2005) AHRLR 151). The Court found that the gas flaring in the course of oil exploration and production activities in the Applicants' community was a gross violation of their fundamental

⁸ Unreported Suit No. W/89/71, Warri High Court (Judgment delivered on 26th No. 1973); Ugbeta 44.

⁹ Unreported Suit No. FHC/L/CS/573/96; see also Ekhaton (n230) 66. Ugbeta 44

right to a healthy environment, which extends to sustaining their right to life and the right to dignity of the human person as enshrined in sections 33 and 34 of the Constitution of the Federal Republic of Nigeria 1999 (LFN, 2004 as amended). The Government failed and neglected to enforce the judgment, and this violates the requirement of access to justice.

Nigeria's absolute dependence on revenue from oil explains the absence of political will to stop the catastrophic environmental degradation in the Niger Delta area of Nigeria (Ojo 2; Munyai & Agbor, 88). Access to justice challenge, while environmental degradation rages on, causes crises in the Niger Delta. To realize an environment of Peace, devoid of warfare, there has to be justice, tolerance, sacrifice, harmonious co-existence and development, where people are willing to live and work together (Ajiya, 31).

There is a 3% allocation to the host communities and the establishment of trusts for the domicile of companies' contributions to community development for the Host Communities Development Trust (HCDDT) Fund. This is meant to cater for host communities' infrastructure and economic development.

The host communities have criticized the approval of 3 percent as against the 10 percent demanded (Borha and Olujobi, 2023). The PIA has been further criticized for having omitted to make provision on procedure for resolving disputes between the host communities and the MNCs who mine crude oil. This is notwithstanding the fact that the PIA set out to enhance peaceful and harmonious co-existence between MNCs and host communities (Section 234(1) PIA 2021).

RECOMMENDATIONS

States to avoid foreign loans and conditionality

States have been encouraged to aspire towards economic development so that they can better handle environmental demands. Industrialised countries have environmental problems related to industrialization. Nigeria, as a developing country, should pursue development without compromising on having a satisfactory environment for living. Developed nations have equally been advised to recognise the need for equality among nations (Preamble, Paragraph 4, Stockholm Declaration, 1972).

It is observed that if parity between the developed and the developing nations is to be attained, the latter have to be wary of taking foreign loans. The international credit institutions owned by some Western states lure developing states with little or no record of transparency in public governance to take loans. The debtor states are not better for it in the long run, except for the few people in political leadership positions.

Among the conditionality of such a loan are the insistence on withdrawal of public funding of social services, devaluation of local currency, and withdrawal of subsidies on goods that were originally put in place to make them more accessible and affordable to citizens. In May 2023, the Federal Government of Nigeria withdrew in totality the subsidy on fuel, and that was never met with a commensurate increase in wages. Thus, the purchasing power of most citizens has reduced drastically. This adversely affects the management of wastes in households.

Government has withdrawn from the provision of social services, being part of foreign loan conditionality. States have contracted waste disposal services to independent contractors, just as it mandates householders to patronise firms collecting wastes. Foreign loan conditionality has made citizens poorer with little purchasing power to foot the bills for proper disposal of

wastes generated. The consequent careless disposal of wastes finds abode in streams, rivers, and oceans.

In the above circumstances, lending institutions should stop giving facilities to countries whose corruption index are terrible. Such countries may opt to take domestic loans such that they may remain committed to the constitutional duty of affording welfare and security of lives and properties

Recycling of wastes

This is proposed as a measure to reduce generated wastes, such that meets the requirement of responsible production and consumption. The United Nations envisages that by 2030, national recycling rates should increase, as measured in tons of material recycled. As such, States should conceive policies mandating companies to re-inject wastes that are generated into production (Izah, P. P. (1994). Nigeria's resources are expected to be deployed to meet the needs of the nation. It is observed that power generation can be tapped from processes of extraction of crude oil.

Enlightenment campaigns

Governance in most developing nations is not participatory nor responsive. Most citizens are not carried along by the Government on the demands of a satisfactory environment and development, good health, and a long life. The mass media and appropriate state agencies and non-governmental organisations should embark on education on environmental matters.

Poverty Alleviation

The wilful destruction of means of livelihood of indigenous host communities who lose their farms to oil spills enhances poverty in Africa. Environmental violations have left people in host

communities susceptible to serious health risks, struggling to access safe drinking water, and unable to earn a living.

The host communities development was created under section 234.—(1) with the objectives of fostering sustainable prosperity within host communities ; providing direct social and economic benefits from petroleum operations to host communities ; enhancing peaceful and harmonious co-existence between licensees or lessees and host communities ; and creating a framework to support the development of host communities (PIA, 2021).

This aligns with the need to gain lucrative jobs. (Goal 8, SDG). The constitution of the host communities development trust aims to achieve so much but eventually hopes to achieve little, given the fact that 3 percent of MNCs' profit goes into the trust fund, which is a huge setback.

CONCLUSION

This study acknowledged the growing phenomenon in developing states such that the natural resources are being controlled and managed by external interests that opted for profits at the expense of a satisfactory environment. It particularly recognised the peculiar effect of poverty of indigenous people of the Niger Delta on account of crude oil extraction-induced degradation of their environment. Noting particularly the loss of lives, good health, maiming, loss of productivity, and abject poverty.

The paper considered arrays of legislation and instruments that are meant to enforce the rule of law over the violation of rights of indigenous people. Decided cases establish that The State opted not to apply sanctions against MNCs because the flow of national income from ground rent could be disrupted.

Persistent agitation for justice led to the promulgation of the PIA and the establishment of Host Communities Development Trust (HCDDT) Fund to cater for host communities' infrastructure and economic development. The paper found this as a laudable venture, with room for improvement.

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5. DOMESTIC IMPLEMENTATION OF THE ANTI-FOULING SYSTEM CONVENTION AND THE FUTURE OF MARINE SUSTAINABILITY

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INTRODUCTION

The ocean, vast and mysterious, is foundational to life on Earth. Despite covering over 70% of the planet's surface, only a small fraction has been explored (UNESCO Ocean Literacy, n.d.). Yet human activities have already inflicted significant ecological damage. One less conspicuous but equally destructive pollutant is toxic marine paint, used in anti-fouling systems (Callow & Callow, 2002). While enhancing vessel performance, these paints release harmful substances like tributyltin (TBT) into the water, impairing marine biodiversity (Evans et al., 2015). To address this, the International Maritime Organization (IMO) adopted the Anti-Fouling Systems (AFS) Convention in 2001, which entered into force in 2008. However, the Convention's impact varies widely among member states due to disparities in domestic enforcement. This blog post critically examines these legislative gaps and highlights promising

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practices from jurisdictions that have aligned national law with global marine environmental standards.

THE INTERNATIONAL LEGAL FRAMEWORK

The AFS Convention represents a landmark in international marine law. It prohibits the use of harmful substances like TBT and mandates that all ships carry certificates verifying compliance (IMO, 2001). The Convention's annexes specify technical standards, encouraging the adoption of less ecologically damaging alternatives. However, the AFS Convention lacks direct enforcement mechanisms, relying instead on domestic implementation by state parties.

This reliance presents a critical limitation. Without incorporating the Convention's requirements into national law, signatory states cannot penalize non-compliance. Consequently, ships from countries with weaker legislative frameworks can exploit loopholes, undermining global environmental efforts.

EFFECTIVE DOMESTIC ENFORCEMENT: AUSTRALIA AND THE EU

Australia offers a compelling model of successful national implementation. Its *Protection of the Sea (Harmful Anti-Fouling Systems) Act 2006* strictly prohibits TBT, establishes certification systems, and mandates regular inspections. These efforts have yielded tangible results; a 2015 study reported an 85% reduction in TBT levels in Australian marine sediments, particularly benefitting ecosystems like the Great Barrier Reef (Evans et al., 2015).

Similarly, the European Union has harmonized compliance through Regulation (EC) No 782/2003. With guidance from the European Maritime Safety Agency (EMSA), member states have achieved uniformity in certification, inspection, and enforcement protocols. A 2021 study

found a 90% decline in TBT in European coastal waters, attributing this success to coordinated regional governance (Brown & Phillips, 2021).

CHALLENGES IN DEVELOPING STATES

In contrast, several developing countries face structural impediments to effective implementation. Bangladesh, for instance, incorporated anti-fouling provisions into its *Merchant Shipping Act, 2020*. However, limitations in monitoring infrastructure and maritime surveillance impede enforcement. Ships operating under flags of convenience further complicate compliance, as they often bypass stringent regulations by registering in jurisdictions with lax oversight.

This divergence highlights a pressing need for capacity-building. The IMO and international donors must support developing countries through technical assistance, training, and financial aid. Without such support, the risk persists that weak enforcement in a few jurisdictions could undermine the Convention's global objectives.

INNOVATIVE AND HYBRID APPROACHES

Japan demonstrates how blending regulation with industry self-governance can yield sustainable outcomes. While adhering to the AFS Convention, Japan relies on self-regulatory measures by the Japan Paint Manufacturers Association to ensure compliance. This has incentivized innovation, leading to the development of eco-friendly anti-fouling technologies (Japan Paint Manufacturers Association, n.d.). Such hybrid models offer a template for other nations seeking both compliance and innovation.

Economic incentives also show promise. Governments could offer reduced port fees or tax benefits to vessels using environmentally friendly coatings. These measures not only promote

voluntary compliance but also embed sustainability into the commercial logic of the maritime industry.

CONCLUSION

The AFS Convention is a powerful tool for mitigating marine pollution, but its success hinges on domestic implementation. As this blog has shown, countries like Australia, Canada, and EU member states exemplify how strong national legislation can translate international commitments into ecological recovery. Conversely, jurisdictions with weak enforcement pose a challenge to the Convention's effectiveness.

Bridging this gap requires international cooperation, particularly in supporting resource-constrained states. Regional harmonization, public-private partnerships, and economic incentives can further bolster compliance. As marine pollution continues to jeopardize biodiversity and human livelihoods alike, advancing uniform and enforceable national legislation under the AFS Convention becomes not just a legal imperative but a moral one.

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6. THE GREAT PACIFIC GARBAGE PATCH: LEGAL GAPS IN MARINE AREAS BEYOND NATIONAL JURISDICTION

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INTRODUCTION

The 8th of June marks World Ocean Day, not only a day to appreciate our planet's blue heart but also a day to reflect on the current challenges the ocean faces. One of the most environmentally threatening issues is that of plastic pollution. This issue is especially acute in marine Areas Beyond National Jurisdiction (ABNJ), which lie outside the jurisdiction of any state. Marine ABNJ makes up almost half of the surface of our planet and covers more than 64% of the ocean (Spencer et al., 2023).

Enormous quantities of plastic marine debris have been piling up in these areas. The most infamous example is the Great Pacific Garbage Patch (Spencer et al., 2023), which has been described as the largest landfill in the Pacific Ocean (Harse, 2011), a colossal monster with enormous environmental implications (Schroeder, 2010), and strikingly, everyone's responsibility but nobody's problem (Santamaria, 2017). Due to its transboundary impacts, it raises a fundamental question: can existing international law prevent this Sea of Plastic from flooding our future, or is more regulation on this matter needed?

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PLASTIC MARINE DEBRIS

Plastic marine debris is the most common form of marine pollution (Pramudianto, 2019). The current volume of plastic marine debris results from decades of mass plastic consumption, incorrect plastic disposal, and increased fishing activities (Wu, 2022). Every year, more than 4.8 million to 12.7 metric tons of marine plastic debris are disposed of at sea (Jambeck et al., 2015). In 2023, there were 170 trillion particles of marine plastic debris at sea (Eriksen et al., 2023).

The effects of plastic pollution are globally recognised and impact marine species, human health, food safety and quality, coastal tourism, and even climate change. The marine plastic debris does not stop at the ocean's surface but reaches even the depths of the ocean, as a plastic bag was found 36,000 feet below the water surface (Keselica, 2020).

THE GREAT PACIFIC GARBAGE PATCH

More than 50% of all this plastic marine debris is located in the Great Pacific Garbage Patch, despite it only covering around 0.5% of the total surface area of the ocean (The Ocean Cleanup, 2023). Located in the marine ABNJ in the Pacific Ocean, the Great Pacific Garbage Patch is essentially a massive accumulation of plastic marine debris trapped in a gyre, a circular ocean current (Santamaria, 2017). The ocean currents force the marine debris towards the centre of the gyre and trap it there (Schroeder, 2010).

Although its exact size is difficult to pinpoint, estimates suggest that it could be as big as the state of Texas or even that of the entire United States (Coulter, 2020). In 2018, the Great Pacific Garbage Patch was estimated to contain at least 87,000 tons of plastic debris, and this figure has only continued to grow ever since (Keselica, 2020). Approximately 80% of the plastic marine debris comes from land-based sources, especially from the United States, Canada, China, Japan, and Mexico, and the remaining comes from ships (Schroeder, 2010).

Nevertheless, there is no state to be held responsible, and there is no binding international obligation to clean it up. The Great Pacific Garbage Patch thereby exemplifies what is known as the ‘tragedy of the commons.’

THE TRAGEDY OF THE COMMONS

The ‘tragedy of the commons’ is a phenomenon occurring in ABNJ, which means that the lack of state jurisdiction creates a perverse incentive to turn a blind eye to the environmental harms happening in these areas (Napper et al., 2024). There is no economic incentive for states to clean up marine plastic debris that is not located under their jurisdictional control. Consequently, this creates conditions where little is done to combat environmental harms.

Despite the vastness of marine ABNJ, they should still be seen as finite resources that need protection and conservation (Napper et al., 2024). In particular, marine ABNJ include the high seas (the water column) and the Area (the seabed), zones as defined by the *United Nations Convention on the Law of the Sea* (1982) (UNCLOS). The absence of regulatory oversight in these areas contributes to the continuous growth of the Great Pacific Garbage Patch.

THE CONSTITUTION FOR THE OCEANS

The UNCLOS, as the constitution for the oceans, provides the starting point for the obligations of states to tackle the Great Pacific Garbage Patch. As it has been ratified by 170 parties, it represents an almost universal commitment to marine governance. Part XII of the UNCLOS imposes obligations on states to protect and preserve the environment, which is largely regarded to be customary international law.

The general obligation to do this can be found in Article 192 of the UNCLOS, while Article 194(2) of the UNCLOS particularly prohibits states from causing transboundary harm. When it comes to land-based sources as the biggest contributor of plastic marine debris (Schroeder, 2010), and Article 207 of the UNCLOS further requires States to enact regulations to prevent,

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<https://www.intraders.org>

reduce, and control pollution from land-based sources. While these provisions are of great importance, they lack specificity and clear enforcement mechanisms. Consequently, they are often inadequate to motivate states to action, particularly in marine ABNJ.

THE OCEAN CLEANUP

In the absence of state action on cleaning up the Great Pacific Garbage Patch, a Dutch private actor has taken the lead in addressing this. The Ocean Cleanup is a nonprofit organisation targeted at cleaning up rivers and the ocean. It has already removed over 194,000 kilograms of plastic marine debris from the Great Pacific Garbage Patch and aims to remove 90% of the floating plastic marine debris in the ocean by 2040 (The Ocean Cleanup, 2023).

While this initiative has been successful in cleaning up the Great Pacific Garbage Patch, it also raises questions about what the rights and duties are of private parties acting in the marine ABNJ. To ensure that the activities of The Ocean Cleanup align with the duties of the Dutch government under international law, both parties entered into an agreement which ‘translated’ the main responsibilities and liabilities of the Netherlands under UNCLOS into binding obligations of The Ocean Cleanup.

While this is an innovative approach to ensure compliance with international law by private actors in marine ABNJ, the underlying issue remains that there is not enough action taken by states on this issue. Moreover, as this is a transboundary issue, more global cooperation is required in solving this massive issue, in particular from the biggest polluting states to the Great Pacific Garbage Patch. The Ocean Cleanup holds that Article 194 of the UNCLOS does not encourage and motivate states enough to clean up plastic marine debris, particularly in marine ABNJ (The Ocean Cleanup, 2023), which has further been affirmed in academic literature (Santamaria, 2017).

LIMITED IMPACT OF THE EXISTING LEGAL FRAMEWORK

The UNCLOS does not explicitly deal with plastic marine debris (Pramudianto, 2019), but rather functions as an umbrella convention by incorporating, among others, *the International Convention for the Prevention of Pollution from Ships* (1973/1978) (MARPOL).

Annex V of MARPOL bans ships from discharging plastic in any zone of the ocean, whether it is the territorial sea of a State or the marine ABNJ. It is important to note that MARPOL only concerns plastic marine debris coming from ships, which only makes up 20% of the plastic marine debris in the Great Pacific Garbage Patch. Therefore, while it is an effective and clear ban, its actual impact might remain limited.

Similarly, the *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter* (1972) (London Dumping Convention) and its subsequent *Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter* (1996) adopt a very strict approach by prohibiting ships from all kinds of dumping. It is seen as one of the fundamental international norms to prevent dumping waste in the ocean and to protect the marine environment (Wu, 2022), including the marine ABNJ (Harse, 2011). However, it deals again only with sources coming from ships and does not extend to land-based sources, which make up the majority of the plastic of the Great Pacific Garbage Patch.

A more recent development, the *Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction* (2023) (BBNJ Agreement), has the potential to address certain environmental issues in marine ABNJ. While it does address plastic pollution in marine ABNJ has some provisions relevant to this in its preamble, but it does not specifically deal with plastic marine debris. Furthermore, as this treaty has not come into force yet, its impact on the international community remains to be determined.

A CALL TO ACTION

The example of the Great Pacific Patch illustrates a critical legal vacuum surrounding plastic marine debris in marine ABNJ. Despite the foundational framework laid down by the UNCLOS and related instruments like MARPOL and the London Dumping Convention, existing international law falls short in effectively addressing the most significant source of plastic marine debris: land-based sources.

Voluntary private initiatives such as the Dutch The Ocean Cleanup provide hope and demonstrate what can still be achieved. However, one actor is not enough to tackle the pressing environmental threat of plastic marine debris. Instead, effectively combating this issue in marine ABNJ requires concrete, binding, and enforceable legal obligations and international cooperation.

CONCLUSION

The Great Pacific Garbage Patch is more than a collection of waste; it is a striking example of the inadequacy of international law in addressing one of the most pressing environmental concerns: plastic marine pollution. The regulatory gap especially leaves marine ABNJ vulnerable to pollution, where no state bears responsibility, and a perverse incentive is created to undertake action, the so-called ‘tragedy of the commons.’

As we mark World Ocean Day, the urgency of the environmental threat of plastic marine debris cannot be overstated. More awareness needs to be drawn to this issue, and international cooperation and legislation on this should be increased. Without such measures, the Sea of Plastic will continue to grow, bringing irreversible consequences for the marine ecosystems and the global environment. It is time for international law to turn the tide to protect our planet’s blue heart.

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7. CONSERVING OCEAN BIODIVERSITY FOR A BETTER FUTURE

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INTRODUCTION

This contribution explores the current state of ocean biodiversity, the emerging frameworks for sustainable ocean management, and the transformative potential of digital technologies in fostering a resilient and equitable future for marine ecosystems and biodiversity.

BIODIVERSITY FOR A BETTER FUTURE

The ocean covers about 71% of the Earth's surface and is a vast, ever-changing world full of life. It's got amazing biodiversity, from vibrant coral reefs teeming with sea creatures to mysterious deep-sea vents full of strange organisms. This immensely diverse ecosystem is crucial for maintaining a healthy ocean, regulating the climate, and supporting human lives. Coastal habitats like mangroves, seagrasses, and salt marshes are helpful to protect shorelines from erosion, store a lot of carbon, and provide a safe place for marine ecosystems to grow. By doing so, the ocean provides jobs, helps regulate the climate, and offers important resources like food, oxygen, and new medicines (IPBES, 2019).

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Unfortunately, human activities are putting a lot of pressure on this delicate balance. Overfishing, pollution, and habitat loss are causing a rapid decline in ocean biodiversity. Fish populations are dwindling, and plastic waste has reached even the deepest parts of the ocean. Coastal development and harmful fishing methods like bottom trawling have damaged important habitats. Meanwhile, rising ocean temperatures and acidification related to climate change are hurting coral reefs and marine life. A global report in 2019 showed that many coral species and marine mammals are at risk of disappearing forever.

To deal with these problems, marine conservation has become a top priority. The goal is to protect ocean ecosystems while making sure people continue to enjoy the benefits they provide, both now and in the future. Marine Protected Areas (MPAs) are one of the best tools for this. When done right, MPAs can help fish stocks to restore, fix up damaged habitats, and bring in eco-tourism. But, for now, only about 8% of the world's oceans are protected, and even then, enforcement isn't always strong (UNEP-WCMC & IUCN, 2023).

ADVENT OF THE BLUE ECONOMY WITH SUSTAINABILITY

As human impacts on marine environments grow, there is a significant shift in our perception that views the ocean not just as a source of raw materials but as a critical foundation for sustainable development. This new approach, known as the Blue Economy, emphasizes responsible management of ocean assets to promote economic growth, improve social well-being, and maintain the health of the ocean on the long run.

Instead of focusing solely on immediate financial returns, the Blue Economy strives to harmonize economic activities with ecosystem resilience and fairness. It advocates economic progress and improved livelihoods while preserving the ecosystems that support them (High Level Panel for a Sustainable Ocean Economy, 2020; World Bank, 2017). While the Blue

Economy mainly targets the growth of specific ocean-related sectors; the Sustainable Ocean Economy presents a broader, integrated vision that incorporates equity, scientific knowledge, and enduring ocean stewardship. When combined with nature-based strategies, these frameworks support practices like sustainable fisheries management, which involves harvesting marine life within natural replenishment limits.

This ensures food security without compromising biodiversity. Furthermore, it plays a crucial role in the restoration of mangrove forests and coral reefs, safeguarding shorelines, and generating economic benefits through carbon offset markets and eco-tourism opportunities. Ultimately, the rise of the Blue Economy signals a transformative moment where economic advancement and marine conservation are aligned rather than in conflict, offering a promising path forward for both people and the planet.

Around the world, interest in the Blue Economy is expanding quickly. Regions and governments are developing plans, making investments in cutting-edge ocean technologies, and incorporating ocean sustainability into broader development and climate action plans. International institutions like the World Bank and the United Nations have emphasized how the Blue Economy may help achieve global goals, especially Sustainable Development Goal 14, which focuses on protecting life below the ocean.

A DIGITAL ERA

The development of Digital Twins of the Ocean (DTOs) as part of the UN Ocean Decade initiative represents a significant advancement in marine conservation efforts, in addition to creating digital representations of our ocean. The growing global emphasis on DTOs is evident in initiatives such as Destination Earth of EU and the UN Ocean Decade's digital ocean initiative. By developing tools that are accessible to a wide range of users, from fishermen to

finance ministers, they will help make ocean data and information available to all (European Commission, n.d.; United Nations, 2021–2030).

By combining satellite data, ocean sensors, artificial intelligence, and high-resolution models, DTOs create virtual representations of actual marine systems. These resources are powerful tools for decision-making. DTOs empower researchers and decision-makers by allowing them to model various outcomes, such as the potential effects on fish stocks in the event of the establishment of a new MPA.

What impact will ocean warming have on seagrass meadows' ability to sequester carbon? The following resources offer insights into how the ocean state may vary or change under different scenarios, thereby helping to anticipate coastal disasters from extreme events.

CONCLUSION: A SHARED FUTURE

A conservation strategy cannot function without people at its heart. True progress in marine protection requires empowering local communities, elevating indigenous and traditional knowledge systems, and cultivating ocean literacy from classrooms to coastal villages. When young marine stewards are trained, fishers become data collection partners, and women are supported in defining marine governance, long-term change can be expected.

We need tools. The development of digital twins of the ocean is a significant step forward, allowing us to simulate, analyze, and forecast ocean conditions with unparalleled precision. To really serve sustainability, these digital breakthroughs must be founded on the ideals of open data and open knowledge.

The ocean is not merely a resource; it is a lifeline, a legacy, and a living system that supports all of us. Marine conservation encompasses a wide range of initiatives and activities. extending

beyond the maintenance of coral reefs and the protection of endangered species. It is about ensuring food security, livelihoods, cultural identity, and climate stability. We have the potential to shape a fair and successful future for ourselves by leveraging cutting-edge technologies, inclusive policies, and the power of free knowledge.

The concept of open data and knowledge promotes a sustainable blue economy, characterized by the responsible and regenerative use of marine resources. It ensures that innovation is inclusive, that no community is overlooked, and that the benefits of ocean stewardship are shared.

When ocean data is transparent, accessible, and shared across sectors (from scientists and politicians to fishermen and citizen scientists), it promotes informed decision-making and democratic involvement. Open platforms broaden the reach of digital twins, allowing users to explore policy scenarios, monitor ecosystem changes, and collaborate on solutions that balance conservation with economic potential.

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8. POTENTIALS OF BLUE JUSTICE IN PROMOTING EQUITABLE ACCESS TO THE BLUE ECONOMY FOR COASTAL COMMUNITIES IN NIGERIA

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INTRODUCTION

Nigeria's coastal communities have historically played an important role in the socio-economic development of the nation, serving as vital hubs for trade and resource exploitation. From facilitating international trade in the pre-colonial era to becoming central to the oil economy in the Niger Delta, these communities have continuously contributed to regional and national prosperity. However, despite their strategic location and economic importance, coastal communities in Nigeria have often faced marginalisation, environmental degradation, and limited autonomy over the resources and economic activities within their territories. The persistent challenges—from colonial trade imbalances and exploitation to modern-day illegal fishing and environmental pollution—underscore the need for a more equitable and inclusive approach (Esin et al., 2025).

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The emerging concept of Blue Justice offers a promising framework to address these issues by ensuring that coastal communities gain rightful access to the sea and participate meaningfully in the sustainable management and benefits of marine resources.

This contribution briefly appraises the opportunities presented by the Blue Justice approach in guaranteeing equitable access to the sea for Nigeria's coastal communities, highlighting its potential to transform their economic and social realities.

GUARANTEEING ACCESS TO THE SEA FOR COASTAL COMMUNITIES

Nigeria's Coastal communities have been central to economic activities since pre-colonial times. Their crucial position was maintained during the colonial era and in post-independence Nigeria. They have consistently been the hub for the diverse economic and trading activities that have been the mainstay of Nigeria's economy.

These activities cut-across diverse aspects of the economy, such as fishing, tourism, import and export of goods and commodities, as well as the exploration and extraction of crude oil and associated products.

In the pre-colonial era, the coastal region facilitated the international trade between the hinterland and the European traders. This vantage position provided by their proximity to the sea brought great benefits to the coastal communities. The benefits can, however, be regarded as limited because the dynamics of the relationship between the coastal communities and the European traders put them at the mercy of the former. Since they owned the ships through which the products would be taken to the markets, they invariably dictated the pricing of the products, and this was usually done to their advantage. The most important factor that can be blamed for the imbalance in this relationship was technology.

While other coastal communities in other parts of the world were able to take advantage of their proximity to the sea to become sea-faring nations and thus achieve the economic benefits of access to the sea, particularly international trade, Nigeria's coastal communities have had to wait for the trade to be brought to them. Consequently, they have never been able to have full autonomy over the economic activities taking place in their ports.

At the on-set of colonial rule and the abolition of the slave trade, the nature of the maritime trading activities was legitimatised; despite this change, the dynamic of the trading relationship remained the same, and the benefits getting to the coastal communities remained limited when compared to the volume of trading activities that was passing through their ports.

While the economic value of the coastal communities was initially dependent on the International trade in commodities, the discovery of oil within the area brought it again to the epicenter of economic activities. Unfortunately, the dynamics of the new economic activities were also not favourable to them. Environmental pollution arising from the oil exploration created a cascade of ecological challenges, thus creating new economic challenges for coastal communities in terms of the sustainability of their traditional economic activities (Sanni, 2021), especially fishing and farming.

The loss of traditional habitat through pollution of the creeks and rivers around coastal communities, particularly in the Niger Delta, fuelled hostilities between host communities and exploration companies. (Obi, 2010), These hostilities in places where they were not properly managed eventually resulted in violent confrontations such as bombing of oil installations and kidnappings. In some areas in the Niger Delta, the resulting violence was organised and widespread, sometimes reaching the level of insurgencies (Ukeje et al., 2002). (Obi, 2010)

In a bid to address the challenges being experienced by communities in the Niger Delta, including coastal communities, as a result of the negative impact of oil exploration on their

environment and, in particular, their economic livelihoods (Sanni, 2013), the Federal Government established agencies such as the Niger Delta Development Commission (NNDC), which was charged with improving infrastructural development, and the Nigerian Maritime and Administration Safety Agency (NIMASA), which was given the mandate of improving maritime security by combatting new forms of criminality in the coastal regions, such as piracy, kidnapping, and oil theft.

Although many of the negative effects of the oil exploration, such as oil spills, were consequential effects of oil exploration, there were also several incidences of vandalism of oil installations. While some were perpetuated by members of the host communities or with their connivance, the majority of such acts had no local input but were facilitated by local apathy. This can be explained by the fact that the oil installations were viewed as a non-beneficial enterprise, and the natural instinct to protect such facilities was therefore absent.

In the diverse forms in which the economic transformations of the coastal areas of Nigeria have occurred, the most constant factor has been the imbalance in the interactions between the local communities and their partners.

While not fully recovered from the effects of years of degradation of their environment through oil exploration, which has resulted in significant economic challenges, the coastal people have yet had to combat in recent years another round of economic pillaging, this time by illegal fishing by fishing trawlers from Asia and Europe (Jentoft et al., 2022). Although the longtime effect of the activities of these fishing crews are yet to be fully appreciated. The short-term cost to the government has been valued at millions of dollars in lost revenue. coastal communities also suffer direct costs in terms of lost income and degradation of their environment.

GROWING THE BLUE ECONOMY AND THE IMPERATIVE OF JUSTICE AND EQUAL ACCESS

Although the maritime sector has always been a strategic aspect of the Nigerian Economy, there have been increased efforts in recent years to increase its value and harness its untapped potentials in propelling the growth of the Nigerian economy so that the country could also realize the economic benefits that other coastal countries have been able to achieve through the effective development of their blue economy and maritime sector. Towards this end, a new government department charged with the specific mandate of developing the blue economy and regulating the maritime sector was created in 2023.

While this can be regarded as a laudable effort by the Nigerian government, a realisation of the challenges that have accompanied the development of the blue economy in other parts of the world makes a cautious approach imperative (Bennet et al., 2020).

While the official discourse on the development of the blue sectors always focuses on its potentials for spurring economic growth (FMMBE, 2024), its challenges have been left to academic discourse, and these have been well documented by different researchers around the world.

These include dumping of hazardous waste and toxic pollution (Okafor-Yarwood and Adewumi, 2020); pollution and degradation of the environment arising from unsustainable extraction of renewable and non-renewable resources in the coastal areas (Nash et al., 2022); and appropriation of resources, displacement of coastal communities, and ocean grabbing (Fakoya et.al. 2021) All of these challenges have been broadly classified as ‘blue injustices’ (Blythe et al. 2023).

In order to ensure that the development of the blue economy will not be done in a way that will be detrimental to the interests and livelihood of coastal communities, blue justice has been

positioned as a regulatory framework and a counter-narrative to the free-market philosophy of the blue economy developmental model.

Initially the primary objective behind blue justice was the protection of small-scale fishermen in coastal areas from unfair competition from industrial fishing and aquaculture, which are usually detrimental to their own livelihoods, and advocacy for social justice for them. (Isaacs, 2019).

It has now evolved to cover a much wider scope, which includes developing a framework for the blue economy in a way that it would not perpetuate injustices and marginalization of traditional coastal communities and ensure that there is equitable governance of the blue economy (Axon et al., 2022).

POTENTIALS OF BLUE JUSTICE FOR COASTAL COMMUNITIES IN NIGERIA

Beyond the establishment of the Ministry of Marine and Blue Economy, the government has not clearly set out a policy-framework for the development of the sector. It may therefore be difficult to clearly state the philosophy that will shape the development of the sector. Historical antecedents from previous developments in the oil and gas sector may, however, raise the presumption that a free-market model will be adopted.

The implication of this is that multinational companies may be the direct beneficiaries of the new sector. They usually have technological and financial advantages over local companies. It may therefore be expected that the imbalance that has historically shaped the relationship between indigenous businesses and their foreign partners will continue. As reiterated earlier, a major fall-out of the oil and gas industry was massive pollution perpetuated partly because of an ineffective legal framework for holding the multi-national companies liable for environmental degradation arising from their activities (Stevens, 2011-12). Similar situation may likely re-occur in the broader blue economy if there is an insufficient regulatory

framework for ensuring minimal damage and degradation of the environment by companies operating in the blue sector.

A major challenge in the oil and gas sector has been the contending claims over resource ownership and resource control between local communities, state governments, and the Federal Government (Orogun P., 2010). While this claim has consistently been resolved in favour of the Federal Government, this has meant that the local communities do not directly enjoy the benefits of the resources extracted from their communities.

In a bid to address some of the grievances of these communities, remedial solutions such as the introduction of a special revenue allocation structure for oil-producing states, i.e., derivative revenue, and the creation of special agencies to address infrastructural gaps had been in place.

It is, however, contended that none of these can be as effective as granting local communities greater autonomy over their resources and the introduction of a system of direct repatriation of specified percentages of all revenue realised from each community back to them. While this may not necessarily be in the form of cash transfers, sovereign wealth funds may be specifically created for coastal communities. (Ackah, 2021).

CONCLUSION

The historical and current economic challenges faced by Nigeria's coastal communities highlight the urgent need for a paradigm shift in how access to the sea and marine resources is managed. Blue Justice presents a transformative opportunity to redress longstanding imbalances by empowering coastal communities as active partners in the stewardship and use of their maritime resources and marine environment.

By aligning the interests of local communities with national economic goals, Blue Justice can foster sustainable development, protect livelihoods, and promote social equity. For Nigeria,

embracing this approach means not only safeguarding the environment and traditional ways of life but also unlocking the full potential of its coastal regions as engines of inclusive growth. Thus, ensuring coastal communities' access to the sea through Blue Justice is essential for achieving a just and prosperous maritime future for Nigeria.

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9. DECARBONISING GLOBAL SHIPPING: STEERING TOWARDS A JUST AND EQUITABLE OCEAN FUTURE

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INTRODUCTION

As the global shipping faces the urgent need to combat climate change in an equitable and transformative manner, this contribution explores the unique challenges and opportunities facing Africa as it seeks to align with global efforts to decarbonise shipping, while ensuring equity for coastal communities.

DECARBONISING GLOBAL SHIPPING AND THE IMPERATIVE OF EQUITABLE OCEAN FUTURE

The urgent need to mitigate climate change, as emphasized by the Intergovernmental Panel on Climate Change, has spotlighted high greenhouse gas (GHG) emitting sectors, particularly maritime transport. According to the IPCC, humanity has a narrow window to limit global warming to 1.5°C above pre-industrial levels, urging immediate emission reductions across all sectors (IPCC, 2018). As of 2025, fewer than five years remain to meet this target. The focus on oceans is thus not only strategic but essential. But why oceans?

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Oceans absorb over 25% of anthropogenic CO₂ emissions annually, making them natural carbon sinks and crucial buffers against climate change (Coleman, 2023). Warnings that oceans are nearing their absorption limit (Coleman Daukorude, 2023) jeopardizing their role as climate stabilizers and beg for emissions reduction ambition.

Understanding the various contributors to greenhouse gas (GHG) emissions is a good start to seeking means and ways to reduce, store, or eliminate them from the environment. Our lives and livelihoods depend on this ambition.

World Ocean Day serves as a vital reminder of the intrinsic connection between human activities and the health of our marine environments. As global attention turns to the sustainable management of the ocean, decarbonizing the international shipping sector offers a profound opportunity for Africa on one hand and a critical challenge on the other.

International shipping facilitates approximately 90% of global goods distribution (Criswell, Deyon, & Laffineur, 2025). However, it contributes significantly to GHG emissions, accounting for about 3% of the global total (Smith et al., 2020), making its decarbonisation paramount for a sustainable future (Bergsma et al., 2021).

This paper explores the challenges and opportunities for African nations in aligning with global decarbonisation efforts within the international shipping industry, considering the socio-economic vulnerabilities and the need for equitable solutions. The IMO has set targets for reducing carbon intensity by at least 40% by 2030 and total annual GHG emissions by at least 50% by 2050, compared to 2008 levels (Tadros et al., 2023; Rasowo et al., 2024), signalling a commitment to climate action and spurring innovation in green shipping technologies.

To achieve these goals, the use of low-carbon alternative fuels, such as green ammonia, hydrogen, methanol, and biofuels, will need to make a significant contribution to the total

amount of CO₂ reductions required (Cullinane & Yang, 2022). Consequently, ports must also evolve into energy hubs, incorporating infrastructure for onshore power and alternative fuel refuelling (March, Woolley, & Failler, 2024).

Repositioning this industry for a sustainable future requires urgent global solutions. One of such solutions is reflected in the draft Net Zero Framework (NZF) recently approved by member states at the United Nations (UN) International Maritime Organisation (IMO).

While this multilateral framework may not have gone far enough in its stringency and ambition, its achievement is a major first step. Therefore, this paper takes an African exploratory perspective on measures taken to reduce GHG emissions from international shipping as we celebrate World Ocean Day.

It considers the imperative for sustainable and equitable relationships with marine environments in which the ocean is at their core. The focus on Africa's Ocean Economy offers a potent case study for how ocean governance and policy can be reimagined to deliver both environmental sustainability, economic empowerment, and social justice.

A 'COMMUNITY-FIRST IMPERATIVE' FOR AFRICA'S COASTAL POTENTIAL

Africa's potential for growth in sectors like ports, shipping, and tourism is well documented. As a continental island, boasting an extensive 30,000 km coastline, renewable energy resources, and over 50 significant international ports, Africa stands at the precipice of transforming into an industrial hub for global renewable energy generation and supply. Within its potential is the exploitation of its coastal resources for attracting millions of tourists from around the world and becoming a blue economy region. Yet, Africa has not realised the material evidence of these vast opportunities.

A successful blue economy strategy cannot afford to ignore resident power players at the community level. As small-scale fishers who continue to face challenges such as depleted stocks and increasing climate risks, the effort to support cleaner oceans is an economic imperative (Bond, 2019). Thus, a ‘community-first’ approach that places coastal populations at the heart of law, trade, and climate diplomacy must influence regional and national policies. Approaching a sustainable blue economy from this community-driven perspective is an essential risk management for the entire ocean economy and not merely altruism.

In other words, following research highlighting rights-based fisheries and trade-anchored standards, inclusive governance approaches are key drivers of climate resiliency and shared prosperity. In this sense, ocean policy measures must begin on the land and connect with people, especially the coastal communities.

Then, this policy flows outward, connecting coast to coast. As such, communities are the ultimate test for credible ocean governance. Among the global institutions making policies for cleaner oceans is the IMO, with a recent historical framework approved to reduce GHG from international shipping (IMO, 2023).

DECARBONISING MARITIME TRANSPORT: A GLOBAL AND AFRICAN CHALLENGE

With coastal communities in mind, it becomes critical to ensure all ocean-related activities that may undermine their health, well-being, and prosperity for a sustainable blue economy are curbed. In this sense, maritime transport becomes a crucial sector to ensure it operates congruently with intended policy actions for safer and cleaner oceans. Within the maritime sector, international shipping accounts for about 3% of global greenhouse gas (GHG) emissions due to its reliance on fossil fuels, raising an urgent global need to reposition the industry for a

sustainable future. Ports, traditionally seen as carbon-heavy logistics hubs, must be reimagined as climate action and sustainable development hubs.

Achieving this GHG reduction feat requires a regulatory framework mandated to transform the international shipping industry from the current fossil fuel-based operation to new fuels kinder to the environment without emitting greenhouse gases (carbon dioxide, nitrous oxide, and methane). Herein lies the tension between legitimate environmental imperatives and economic challenge.

IMPLEMENTATION CHALLENGES AND OPPORTUNITIES IN AFRICA

IMO's remit is to formulate policies for the protection and preservation of the marine environment. A focal point of IMO's efforts is the International Convention for the Prevention of Pollution from Ships (MARPOL), particularly Annex VI, which regulates the prevention of air pollution from ships and is seen as IMO's entry into the journey for shipping decarbonisation.

While the IMO's initial strategy on reducing GHG emissions from ships was adopted in 2018 and revised in 2023, the ratification and implementation of MARPOL Annex VI by African countries has been poorly conceived, according to some assessments. Out of the 55 countries in the African Union, only 17 had ratified Annex VI, as noted in one source. Ratification of IMO conventions is the foundation for global maritime governance, but national frameworks are the crucial building blocks for implementation. Challenges exist for African countries and the Sub-Saharan African region regarding shipping decarbonisation under the African Union Commission (AUC).

TECHNICAL AND ECONOMIC PATHWAYS

The transition to low-carbon shipping requires a multidimensional approach balancing technoeconomic and sociotechnical factors. African participation in global shipping decarbonisation necessitates a multifaceted approach. This includes adopting Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) to evaluate alternative fuels (Cucurachi et al., 2018), alongside national policy integration and international cooperation.

A recent readiness assessment underscores the importance of port infrastructure, alternative fuel availability, and supportive investment climates (Coleman, 2023). Methodologies integrating LCA and energy system modelling (ESM) or global energy transition (GET) models are used to understand the full impacts across the fuel lifecycle and different policy scenarios.

Critical to this ambition are ports, as they play a central role in this energy transition. Ports will need to adapt and invest in infrastructure for alternative fuels and onshore power. Ports also serve as innovation hubs where investments converge.

However, integrating new technologies and coordinating diverse stakeholders across different regions adds logistical and regulatory challenges for ports, especially African ports.

Some African nations are actively engaging in this transition. These few countries supported the implementation of a shipping carbon levy reflected in the NZF to reduce GHG emissions. Such a levy aims to lower the carbon footprint, align with national climate goals, and create a financial incentive for cleaner technologies and alternative fuels.

Economically, it could generate substantial revenue for much-needed reinvestment in sustainable development and job creation (Tadros et al., 2023), as the energy transition will ultimately have a disproportionately negative impact on many developing countries. Approaching the decarbonisation of international shipping in this way underpins the principles of justice, inclusivity, and equity, ensuring that no one is left behind.

A JUST AND EQUITABLE TRANSITION

Tension arising from this decarbonisation strategy has economic implications for all countries, as studies conducted by the United Nations Conference on Trade and Development (UNCTAD) indicate. Policy measures aimed at decarbonising shipping, such as Market-Based Measures (MBMs) like levies, can have regressive economic effects, negatively impacting the lowest-income countries, including Small Island Developing States (SIDS) and Least Developed Countries (LDCs), the most.

Analysis using composite vulnerability indicators combined with the IMO's Comprehensive Impact Assessment (CIA) shows that countries vulnerable to food security risks also tend to face higher price increases in imported agricultural products due to maritime transport cost shocks. This vulnerability is particularly clear for Africa, SIDS, and LDC countries.

ADDRESSING EQUITY IN CLIMATE FINANCE AND POLICY

IMO's aim to decrease the maritime sector's overall annual GHG emissions by no less than 50% by 2050 requires substantial investment, particularly in the production and supply of alternative fuels like e-fuels. While Africa has substantial renewable energy resources and can potentially participate in this fuel production market, history indicates that this poses a funding challenge.

Africa, like a few developing nations, has poor access to funding and attracts higher costs of capital (IRENA, 2023). This finance access challenge means Africa's e-fuel production will likely double the price of e-fuels compared to developed economies, regardless of the region's superior and substantial renewable energy resources. This risk of concentrating future e-fuel production in already-advantaged economies contradicts what is deemed as a 'just and equitable transition' that the IMO has committed to in its GHG strategy.

To address this opportunity inequity, targeted financial support mechanisms are needed. A proposed solution involves directing a calculated percentage of funds raised from IMO's carbon levy towards grants and concessional finance to offset these higher financing costs in low-income countries and those able to contribute to the global e-fuel stock (Dominioni, 2023; Fricaudet et al., 2025).

International shipping needs a substantial e-fuel stock to achieve the intended GHG reduction targets. The estimated initial scale of IMO funds required for this element alone is around \$50bn. However, the current approved NZF meets only a fifth of this target, making the potential for achieving the GHG reduction measures stated in the Strategy very slim.

Further addressing the significant financing gap required for scaling renewable fuel production and infrastructure is crucial. IRENA estimates, for example, that green hydrogen production alone needs \$1.4 trillion globally by 2050, far exceeding anticipated IMO revenues. This underscores the need for supplementary funding mechanisms, including public-private partnerships and international climate finance, particularly for African nations.

The consequence of not addressing these inequities may result in the ocean and the coastal communities bearing the brunt, with the economic position of Africa negatively impacted without the region's unified stance for the application of justice and equity to the disbursement

of the revenue resulting from the MBM encoded in the NZF. As such, taking measured approaches to ensure the use of revenues from decarbonisation policies supports a just and equitable transition is crucial.

Market-Based Measures (MBMs), such as levies or feebate mechanisms, can generate revenues. The discussion then turns to how these revenues should be distributed to support a just and effective transition. Stakeholders emphasise balancing immediate needs like infrastructure and workforce training with long-term institutional strengthening and innovation.

Crucially, analysis suggests that limiting revenue use solely to ‘in-sector’ shipping investments, as preferred by some, would not effectively address negative impacts like food security risks in many vulnerable states. Many countries comparatively more at risk from policy impacts would be unlikely to receive significant revenues under a strict ‘in-sector’ allocation.

This highlights a potential conflict with the principle of leaving no country behind. Therefore, future IMO’s revenue distribution discussions should consider a broad range of options, potentially including distribution into components along the food system value chain or fostering long-term structural improvements in food security in recipient countries. Strategic alignment of revenue distribution with national priorities and readiness levels is essential to prevent regional disparities and ensure an equitable transition.

CONCLUSION

Setting out to chart a course towards a sustainable ocean future necessitates confronting the challenge of shipping decarbonisation head-on this World Ocean Day 2025. The maritime sector must reaffirm its commitment to just and sustainable ocean development. While

technological advancements and international policies through the IMO are crucial steps, their success hinges on ensuring a just and equitable transition.

This requires acknowledging and addressing the unique vulnerabilities and financial needs of developing nations, particularly in Africa. Failing to do so will set the region back and pose challenges in achieving the region's blue economy potential.

A just, community-first approach remains central. Only by placing people—particularly the most vulnerable, at the core of blue economy planning can we ensure that the benefits of a decarbonised maritime future are shared by all.

By fostering policy coherence, leveraging diverse financing streams, and ensuring that revenues generated from decarbonisation policies are distributed broadly and equitably to mitigate adverse impacts and support capacity building, the global maritime community can move towards a future where sustainable shipping truly benefits all nations and protects the health of our shared ocean.

Above all, it necessitates a 'community-first' approach, embedding coastal people in the heart of ocean policy and practice, ensuring that the benefits of the Blue Economy truly reach the African people.

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10. LOOKING INTO THE FUTURE, CATCHING THEM YOUNG: MARINE POLLUTION AND ENVIRONMENTAL EDUCATION

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INTRODUCTION

Marine pollution is one of the most pressing environmental challenges of our time, threatening the health of global ecosystems, economies, and human populations. Addressing this crisis requires not only technological and policy solutions but also a fundamental shift in societal attitudes, perception and behaviour.

Central to this shift is the education of children, who represent the future stewards of our planet. By instilling knowledge and values related to marine pollution and waste management early in life, we can empower younger generations to adopt sustainable habits, influence their communities, and effectively drive innovative solutions.

This contribution explores the critical role of environmental education in combating marine degradation with a focus on pollution, highlighting its benefits, the risks of neglect, and successful global initiatives that demonstrate its transformative potential.

THE GLOBAL SCALE OF MARINE PLASTIC POLLUTION AND THE URGENCY FOR COORDINATED SOLUTIONS

Each year, millions of tons of plastic waste enter the ocean, making it increasingly urgent to address this crisis. Yu et al. (2023) report that over 1,000 rivers contribute to 80% of the world's annual plastic emissions, with Asia being the largest contributor, followed by Africa, South America, North America, Europe, and Oceania. Additionally, Ellos et al. (2025) identified microplastics and mesoplastics as the primary contributors to ocean plastic waste, with small microplastics dominating surface ocean plastics by particle count.

To combat this escalating problem, recycling and reuse have been proposed as sustainable solutions. These solutions- it has been posited by the proponents- not only promote the circular

economy concept but also help reduce carbon emissions, potentially enabling the acquisition of carbon credits (Alaghemandi, 2024).

However, many researchers stress the urgent need for coordinated global efforts aimed not only at reducing but ultimately at eradicating plastic waste to protect marine environments. While recycling and reuse are integral to comprehensive waste management strategies (Yu & Singh, 2023; Yu et al., 2023; Alaghemandi, 2024; Ellos et al., 2025), a coordinated plan to phase out plastic pollution is essential.

Yu and Singh (2023) emphasise the severe threats microplastic pollution poses to marine ecosystems and human health, highlighting the need for expanded scientific research and strong policy measures. In this context, educating children about marine pollution and effective waste management emerges as a proactive, long-term approach.

By fostering environmental stewardship from an early age, education equips future generations with the knowledge and values necessary for sustainable living. Without such education, the risk of environmental degradation and its cascading effects on future generations becomes even more alarming.

This contribution explores the significance of environmental education for children, its extensive benefits, and the potential consequences of neglecting this vital aspect of sustainability.

THE IMPORTANCE OF EARLY ENVIRONMENTAL EDUCATION

Children are highly receptive to new information and behaviors, making early education a powerful means to instill environmental values. Introducing concepts such as marine pollution and waste management during formative years establishes a foundation for responsible habits

that can endure a lifetime. Lamanauskas (2023) notes that environmental education at an early age fosters awareness and cultivates the skills and attitudes necessary for developing a sustainable and responsible lifestyle in the future.

The continuity and sustainability of such education are therefore crucial. This perspective is supported by an earlier research by some of the authors of this contribution (Otitoju et al., 2025), who found positive reception toward holistic implementation and integration of environmental education content across subjects. Moreover, children often act as agents of change within their families and communities, amplifying the impact of their learning (Otitoju et al., 2025).

Research demonstrates that educational interventions can significantly improve children's understanding of and concern for marine litter. For example, Hartley et al. (2015) studied British schoolchildren aged 8 to 13 and found that participation in a marine litter education program increased their awareness and led to more pollution-reducing actions.

Similarly, Bettencourt et al. (2023) conducted an intervention combining theoretical, laboratory, and hands-on activities, culminating in a beach clean-up, which allowed students to apply classroom learning in a real-world context.

Their results showed improvements in knowledge, perceptions, and behavioral intentions, especially regarding marine litter identification, degradation timelines, and microplastics observed in local sand samples—activities particularly appreciated by participants.

BENEFITS AND ADVANTAGES OF MARINE POLLUTION EDUCATION FOR CHILDREN

Enhanced Environmental Awareness

Programmes focused on marine pollution help children understand the sources and impacts of oceanic waste. This awareness fosters responsibility and encourages proactive behaviours such as reducing plastic use and participating in clean-ups.

Bettencourt et al. (2023) found that such interventions positively influenced schoolchildren's literacy, advancing education on marine litter. In the same vein, Ahmad-Kamil et al. (2022) further argue that addressing marine litter aligns with Sustainable Development Goal (SDG) 4, especially target 7, which aims to ensure learners acquire knowledge and skills for sustainable development and lifestyles. It also aligns with the SDG 14 which primarily focuses on the protection of the marine space.

Development of Sustainable Habits

Early education promotes sustainable practices and fosters collaboration among stakeholders in marine education. Children learn about recycling, proper waste disposal, and the dangers of single-use plastics. More important they learn about the imperatives and strategies of phasing out single use plastics. Gazol et al. (2019) demonstrated that diverse partners—including children, parents, teachers, managers, and associations—can collaborate effectively to improve sustainability education in early childhood. Their study emphasised integrating sustainability education into preschool routines. When ingrained early, these habits can yield long-term environmental benefits and ecological integrity.

Empowerment and Community Engagement

Initiatives like the Healthy Seas programme actively involve children in hands-on activities such as beach clean-ups and recycling projects, empowering them to participate in environmental conservation (Healthy Seas, 2025). These activities, often conducted with schools and the public, raise awareness about marine litter, climate change, marine animals, the circular economy, and sustainable consumption. Participation reinforces learning and strengthens community bonds.

Influence on Family and Community

Children educated about marine pollution often become catalysts for change in their families and communities. For instance, in Papua, Indonesia, students influenced their families to adopt sustainable practices, demonstrating the ripple effect of early environmental education (Adnyana et al., 2023). This education increased children's awareness and knowledge about marine conservation.

Urban children showed appreciation for marine ecosystems during snorkeling trips observing coral reefs, while children from small islands (such as the Maldives) expressed strong determination to protect their marine environment, especially after witnessing urban peers' amazement at local ecosystems (Adnyana et al., 2023).

Consequences of Neglecting Marine Pollution Education

Neglecting education on marine pollution and waste management can have serious consequences.

First, environmental degradation will continue unabated. Without awareness, harmful practices persist, worsening pollution and threatening marine biodiversity. Pollutants disrupt marine

flora and fauna and food chains (Citarasu, 2024). Natural factors such as radiation, storms, waves, volcanic lava, tsunamis, ocean water movements, global warming, and freshwater runoff contribute to changes, but human activities—oil spills, hazardous heavy metals, persistent toxic substances, radiation, thermal discharges, and ship-based hazards—intensify the problem (Citarasu, 2024). Thushari and Senevirathna (2020) highlight how plastic pollutants of all sizes disperse through ecosystems, causing harm through entanglement, ingestion toxicity, suffocation, starvation, and facilitating invasive species spread by providing new habitats. Such degradation leads to loss of ecosystem services and biodiversity, threatening trophic relationships.

Second, cultural heritage is at risk. Marine pollution threatens not only ecological integrity but also coastal cultural heritage, as seen for example in Senegal and the Maldives . Plastic waste endangers not only marine biodiversity but also underwater cultural heritage sites like shipwrecks and submerged settlements of historical value (UNESCO-CMAS, 2024). Despite Senegal’s 2020 ban on single-use plastics for example, much plastic waste remains untreated, accelerating environmental degradation and threatening landmarks like Gorée Island, a UNESCO World Heritage site vulnerable to erosion and rising sea levels (UNESCO, 2022).

Third, neglecting marine pollution education results in lost opportunities for innovation. Youth with environmental education are more likely to develop creative solutions to environmental challenges. Knowledge fosters critical thinking, problem-solving, and commitment to sustainability (Otitoju et al., 2022). For example, UNICEF’s i-UPSHIFT programme in Uganda has empowered over 12,000 out-of-school youth with 21st-century skills, leading to more than 1,700 community-based climate solutions addressing plastic waste and deforestation (UNICEF, 2023). In China, increased education investment correlates with advancements in

renewable energy and sustainable practices, showing how human capital drives environmental innovation (Tao, Tao, & Wang, 2022).

Conversely, neglecting education stifles this potential, limiting youth engagement in environmental problem-solving. UNESCO reports only one in three 15-year-olds in OECD countries have the emotional and behavioral competencies needed for environmental sustainability, with disparities especially among socio-economically disadvantaged groups (UNESCO, 2024). This gap risks underutilizing a generation's capacity for climate resilience. Without education, youth are less likely to adopt sustainable behaviours or positively influence communities. Investing in comprehensive environmental education is therefore essential to harness youth innovation and ensure global sustainability.

GLOBAL INITIATIVES AND SUCCESS STORIES

Several global programmes demonstrate the effectiveness of early environmental education.

One good example is the O'Neill Sea Odyssey, founded in 1996 by Jack O'Neill, provides free hands-on marine science education to fourth through sixth graders, especially those from socioeconomically disadvantaged backgrounds (Suite, 2019).

Conducted aboard a 65-foot catamaran in Monterey Bay National Marine Sanctuary, students engage in interactive lessons on marine biology, ecology, and navigation. Participants show significant increases in environmental awareness, with 75% retaining knowledge about the link between personal behavior and ocean pollution two to five years later (Hanneman, 2013).

The programme's focus on community service projects empowers students to apply their learning in real-world contexts, reinforcing long-term environmental commitment (Suite, 2019).

The Eco-School Program in ASEAN educates youth across Southeast Asia about marine plastic waste while promoting regional cooperation. Launched in 2021 by the ASEAN-Japan Centre and the Regional Knowledge Centre for Marine Plastic Debris, it reached over 12,500 elementary and high school students by 2022 (ASEAN-Japan, 2024).

Interactive lectures address the dangers of single-use plastics and marine pollution. Surveys show high concern among participants, though only about half knew effective plastic waste reduction methods, highlighting the need for ongoing education (ASEAN-Japan, 2024; Collard et al., 2024).

In the Maldives, several innovative initiatives have been adopted to promote environmental education among school children. One notable programme is the Fehi Madharusa (Green School) framework, developed through collaboration between an NGO Soneva Namoon and the National Institute of Education (UNESCO, 2024). This initiative integrates eco-literacy and sustainability into classroom practices, with emphasis on hands-on learning, reduction of ecological footprints, and community participation. Activities include the formation of environmental clubs (as seen in Villa High School), hydroponic gardening, and the adoption of eco-friendly practices such as minimising or avoiding plastic use. Teachers receive specialised training to support these efforts, and students actively participate in projects like tree planting, waste reduction, and nature-based field trips.

Another example is the UNESCO's "The Sea is Not a Trash Can" Campaign in Senegal, launched in 2021, engages students and communities through school programs, workshops, and discussions, reaching over 30,000 students and 15,000 online participants (UNESCO, 2022). By integrating Education for Sustainable Development, it empowers individuals to

conserve their natural and cultural environments, helping preserve Senegal's heritage for future generations.

CONCLUSION

Early environmental education on marine pollution and waste management is crucial for fostering lifelong ocean stewardship. Introducing young learners to marine litter sources, degradation timelines, and real-world impacts as well as strategies for dealing with the problem through classroom and hands-on experiences cultivates awareness and sustainable habits.

Research shows these interventions boost knowledge, concern, and responsible behaviours—such as reducing single-use plastics and participating in clean-ups—that extend beyond school. As children share their understanding with families and peers, they become catalysts for broader change, embedding conservation practices in communities.

Neglecting marine pollution education risks perpetuating harmful practices that degrade ecosystems, threaten biodiversity, and undermine coastal cultural heritage. Without targeted instruction, youth miss developing critical thinking and problem-solving skills that are essential for environmental innovation—skills that have already driven community climate solutions and sustainable technologies around the world.

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11. WHEN WAVES CARRY WASTE: THE PLASTIC BURDEN ON THE SOUTH AND THE CALL FOR A JUST TREATY

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INTRODUCTION

Today, plastic waste has become the most widespread form of pollution in the world's oceans. Every year, an estimated 19 to 23 million tonnes of plastic waste end up in lakes, rivers, and seas across the globe (UNEP, 2025). Most of this plastic doesn't come from ships or offshore activities - it enters the ocean from land, especially in places where waste management systems are weak or underdeveloped.

But while the entire planet feels the impact, not everyone suffers equally. Coastal communities in the Global South, from the shores of West Africa to small island nations in the Pacific, are facing the worst consequences, despite being among the least responsible for producing plastic waste (Qadir, 2024). This injustice has led many to call the global plastic trade a new form of "waste colonialism", where wealthier nations export their plastic problems to poorer countries (Salamat, 2024) (Michaelson, 2021). Many of these developing countries lack the infrastructure and regulatory tools to properly manage the growing tide of plastic waste. This blog explores how plastic pollution is harming marine life and local economies in the Global

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South, how its burden falls hardest on those with the fewest resources to fight it, why existing solutions have fallen short, and how a strong and fair UN Global Plastics Treaty could help bring about much-needed change.

HOW PLASTIC HURTS OCEANS AND LIVES THEY SUSTAIN

Plastic pollution is silently destroying our oceans and the people who depend on them. Coral reefs are getting strangled by floating debris. Mangroves and seagrass beds, which are important for fish nurseries and coastal protection, are being choked by waste. Sea turtles, whales, dolphins, and even seabirds are getting tangled in abandoned fishing nets or mistaking plastic bags for food. These aren't just isolated problems; they're symptoms of a larger crisis.

According to a UNEP report (2021), plastic makes up at least 85% of marine waste (UNEP, 2021). It calls plastic “the most harmful and persistent” form of marine litter (UNEP, 2021). When the plastic waste is exposed to sunlight and waves, this waste breaks down into microplastics (microscopic plastic particles) (Alimba, 2019).

These microplastics are now found throughout the water column and have been detected in fish, shellfish, sea salt, and even the water we drink (UNEP, 2021). Marine animals that consume these particles suffer from poisoning, internal injuries or starvation. Some plastics even carry toxic chemicals or invasive species, which can further disturb fragile marine ecosystems (Alimi, Budarz, & Tufenkji, 2017).

The Food and Agriculture Organization (FAO) and the World Bank estimate that 80% of global fisheries livelihoods come from small-scale, often coastal fisheries. (World Bank, 2025) In countries like Indonesia, Ghana, and Senegal, small-scale fishers have noticed dwindling catches, partly because plastic pollution destroys fish breeding grounds. A 2021 study from Ghana found that plastic waste clogged estuaries and coastal waters, causing a sharp decline in juvenile fish populations. So, when plastics damage these habitats, fish populations decline,

and it directly threatens both food security and economic survival for coastal communities in the Global South (World Bank, 2025) (Backhaus & Wagner, 2019).

As one fisher in Ghana told researchers, *“For some years now, whenever we cast our nets, all we catch are plastics. Sometimes, after a whole haul, you can only get a dozen fish, and the rest is just waste”* (Dini-Osman, 2022).

Plastic pollution is also hurting tourism. In Zanzibar, it is estimated that littered beaches cost the island around US\$13.7 million in tourist losses (Glyde, 2023). (Xie, The Costs of Environmental Degradation from Plastic Pollution in Selected Coastal Areas in the United Republic of Tanzania, 2023). Across the Caribbean and Pacific Islands, countries that rely on their coastlines for tourism now spend millions each year just to clean up the plastic washing ashore. If left unchecked, global plastic waste management is expected to cost governments US\$670 billion between 2021 and 2040 (World Bank, 2025).

The impacts of plastic pollution are not limited to oceans. In Senegal, rural communities are forced to burn plastic due to a lack of proper waste disposal options. This practice pollutes the soil, damages crops, and has even caused livestock deaths. Women farmers in the Kaolack region have reported increased crop failure and health issues due to plastic smoke. These ripple effects on farming and health make the problem even more severe and affect everyday life and livelihoods in vulnerable communities (World Bank Group, 2023).

WASTE COLONIALISM AND GLOBAL INEQUITY

One of the most upsetting parts of the global plastic problem is how unfairly the burdens are shared. Most plastic is made and used in the wealthier parts of the world, especially in the Global North. But a large part of this waste ends up in the poorer countries in the Global South, where it's cheaper to dump and environmental regulations are weaker. Many researchers and

activists have started calling this pattern what it really is: a new kind of “waste colonialism” (Michaelson, 2021).

The term captures how old colonial patterns of exploitation continue today, but in a different form. High-income countries often ship their post-consumer plastic waste at low cost to developing countries that lack the means to manage it safely. A series of investigative reports by *The Guardian* exposed how the UK, Germany, and France have rerouted their plastic waste to countries like Turkey and Vietnam (Michaelson, 2021).

A Turkish researcher put it bluntly: Some of *the top waste producers in Europe...have to find ways to deal with this issue. And the way they’ve found is exporting to poorer countries without effective waste management systems... This is waste colonialism.*” (Michaelson, 2021).

The numbers tell a shocking story. Since the late 1980s, more than 250 million tonnes of plastic waste have been shipped across countries, mostly moving from rich nations in the Global North to poorer ones in Asia and Africa (Salamat, 2024). When China put a stop to most plastic waste imports in 2018 through its “*National Sword policy*”, the waste didn’t stop; instead, it was simply redirected. Countries like Malaysia, Vietnam, Indonesia, Turkey, and India quickly became the new destinations (J. Barnes, 2019).

After just 3 years, from 2021 to 2023, Malaysia received around 1.4 billion kilos of plastic scrap, Vietnam and Turkey got about 1 billion each, Indonesia 600 million, and India 200 million kilos (Salamat, 2024). Many of these countries were once colonies, and now, years later, they’re once again carrying the weight of other nations’ mess, often from the very same regions that once ruled over them.

What makes the situation even more unfair is that the countries suffering the most from plastic pollution are often the least responsible for causing it. Take West Africa, for example. In 2018, all 17 countries in the region together produced about 6.9 million tonnes of plastic waste, and

Nigeria alone was responsible for 4.7 million tonnes (World Bank Group, 2023). A lot of this waste is generated near the coastline, which makes it more likely to end up in the sea. But even then, West Africa's share of global plastic pollution remains small.

The real issue is how this waste is handled. More than 80% of this waste is “mismanaged”, meaning it's either dumped in the open, burned in the open air, or left to leak into rivers and oceans (UNEP, 2021). As a result, these countries face some of the worst environmental and health consequences, even though they've done very little to create the problem in the first place. The financial burden is huge.

According to the World Bank, the economic and social damage caused by marine plastic in coastal West Africa can be anywhere from US\$10,000 to US\$33,000 for every single tonne of waste (World Bank Group, 2023). That's a massive cost for countries that barely even contribute to the global plastic crisis.

The same goes for Small Island Developing States. These nations produce just about 2% of the world's mismanaged plastic waste, but they are hit hard – their fishing industries, tourism, and community well-being all suffer because of it (Chen, Mattila, & Hakim, 2024).

WHY CURRENT FRAMEWORKS AREN'T ENOUGH

Even though there are global and national rules to deal with plastic waste, like the Basel Convention, Extended Producer Responsibility policies, and plastic bans, they often don't work the way they are supposed to, especially in countries across the Global South. These laws sound good, but poor enforcement, weak infrastructure, and unchecked plastic production make them fall short.

In 2019, the Basel Convention took a major step by adding new rules to control the global trade of plastic waste. For the first time, countries had a legally binding agreement that required them to follow a “Prior Informed Consent” process, which means they had to get clear permission

from the receiving country before exporting certain types of plastic waste. The idea was to stop wealthier nations from quietly shipping their plastic waste to poorer countries without proper oversight. According to the UN, if implemented effectively, these rules could prevent up to 53 million tonnes of plastic waste from being traded internationally by 2030 (Benson & Mortensen, 2021).

But in practice, implementing these rules has been far more difficult. Many poorer countries in the Global South simply don't have the staff, technology, and infrastructure to properly check every shipment or enforce these rules. In 2021, environmental watchdog groups found that plastic waste from the UK was illegally dumped in Turkey and Greece, despite the supposed restrictions (Greenpeace International, 2021).

Then there's EPR – Extended Producer Responsibility. It's the idea that companies that make plastic products should also be responsible for cleaning them up. EPR Countries like France and Germany have been doing this for years with some positive results (Pruess & Garrett, 2025). More recently, nations such as Vietnam, Kenya, and India have introduced their own EPR rules for packaging waste. But in many lower-income countries, EPR still hasn't moved beyond paper (Qadir, 2024).

A 2025 study from Lebanon found that many producers had never even heard of EPR, and those who had often didn't have the tools, support, or government guidance to follow through (Hammoud, Massoud, Chalak, & Abiad, 2025). On top of that, in many places, the waste sector is dominated by informal workers (thousands of people who collect and sort waste outside official systems) but they're rarely included in formal policies.

Plastic bans and taxes have also become more common. From Nigeria to India, governments have introduced laws to ban single-use plastics like carry bags, cups, and straws (Santoz, 2024) (Press Information Bureau, 2022). These bans have made a difference in some ways, as beaches

are cleaner and drains are less clogged. But overall, the results are mixed. In many rural or less-resourced areas, enforcement is weak, and alternatives to plastic are either hard to find or too expensive (Qadir, 2024).

As a result, the rules are often ignored. And in places where there are no proper landfills or systems to manage waste, people still dump or burn plastics in the open or throw them in water bodies (Chen, Mattila, & Hakim, 2024).

PROMISES OF THE GLOBAL PLASTICS TREATY

In 2022, the UN Environment Assembly announced plans for a legally binding Global Plastics Treaty – a treaty that would address the full life of plastic, from its production in factories to its final journey as waste.

For people living in the Global South, where plastic often ends up on their beaches or is burned in open dumps, this moment felt like it should have happened a long time ago. It wasn't just about picking up trash but more about fixing a system where richer countries made and used plastic, made money from it, and then pushed the waste onto poorer nations.

This treaty gives hope for real change. Instead of just dealing with plastic after it becomes waste, it planned to stop the problem early by cutting down on how much plastic is made, banning dangerous types of plastic, and making companies take full responsibility.

The European Union even pushed for the inclusion of the "polluter pays" principle so that big plastic and petrochemical companies would finally bear the cost of the pollution they cause (Directorate-General for Environment, 2024).

Many Global South countries made one thing clear: the treaty won't work unless it brings real support. At the negotiations, delegates from nations like Somalia and small island states argued that they cannot shoulder the burden without financial help, technology, and fair decision-making power (Federal Republic of Somalia, 2024).

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Advocates urged negotiators to link the treaty to the human right to a clean and healthy environment, especially for communities living near landfills, coastlines, and polluted rivers (UNEP, 2025).

But getting all countries to agree has been really hard. In late 2024, more than 170 countries met in Busan, South Korea, to talk about the Global Plastics Treaty. But the talks didn't go well (Omolere, 2025). One big problem was whether to set a limit on how much plastic can be made. Over 100 countries wanted strong rules to reduce plastic. But countries like Saudi Arabia, Iran, and Russia didn't agree (Koshy, 2024).

They said it would harm their economies because they make a lot of money from oil and plastic (The Washington Post, 2024). Some developing countries were also unsure. They were worried that making less plastic might slow down their growth or make things more costly for regular people (Laville, 2024).

Still, the story isn't over. Powerful ideas are on the table that could help make the treaty fair and effective, especially for countries in the Global South. Some experts have proposed setting up an *International Plastic Pollution Fund*, where polluting industries would pay into a global pot that supports clean-up and waste systems in poorer countries.

Others suggest *Plastic Footprint Accounting*, which would force companies to measure and reduce how much plastic they produce and use. There are also talks of *plastic passports* i.e. digital tracking systems that follow plastic products from production to disposal, and of new legal tools that would let people sue major polluters by invoking the right to a healthy environment. For small island nations that import most of their goods and can't send plastic waste back out, one promising proposal is the *exporter take-back obligation*. If a country exports plastic to them, it would be required to take responsibility for collecting and properly disposing of that waste (UNEP, 2023) (UNEP, 2023) (UNEP, 2022) (UNEP, 2024).

But for any of these ideas to succeed, the treaty must be more than just a list of promises. It needs to include the people who deal with plastic every day, like waste pickers in Nairobi or coastal fishers in the Philippines.

In Colombia and Brazil, local governments have already started recognising informal waste workers, giving them fair wages and basic protections. These community-led models could become global examples of what just and inclusive plastic governance looks like (Jebe & Park, 2025).

CONCLUSION

Plastic pollution is a problem all over the world, but not everyone feels its impact the same way. In many parts of the Global South, people see the damage every day in the form of plastic waste piling up on beaches, fewer fish in the ocean, and thick smoke from burning trash making it hard to breathe. And sadly, a lot of this damage comes from how richer countries live and use plastic.

The Global Plastics Treaty has a chance to change things but only if it's strong and fair. It can't be just another half-step. This treaty could become one of the most important environmental agreements since the Paris Climate Accord. But for that to happen, countries must stay bold. We need real action: cutting down how much plastic is made, making the big polluters pay for the harm they've caused, and giving real help to the countries and communities that are most affected.

This is also our chance to do better, to recognise that everyone deserves a clean and healthy environment and that countries sending their plastic waste abroad should also help deal with the damage it causes. At the core of this issue is the need for unity. Wealthier nations and big companies need to step up, but the people living with this problem every day must also have a say. Their voices matter.

The United Nations says we are facing a “triple crisis” – plastic pollution, climate change, and loss of nature all at the same time (UN, 2022). That’s why this moment matters so much. What we decide now will shape the future, not only for the oceans but for the people who depend on them.

This World Ocean Day, let’s be clear: we need real action, not more empty words.

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12. THE SPECIAL STATUS OF THE CARIBBEAN SEA UNDER THE REVISED TREATY OF CHAGUARAMAS & THE NEXUS WITH MULTILATERAL PROCESSES SUPPORTING THE RIGHT TO A HEALTHY OCEAN

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INTRODUCTION

The States of the Caribbean Community (CARICOM) and its nine full Member States comprising the smaller union of the [Organisation of Eastern Caribbean States \(OECS\)](#), are a collection of primarily English-speaking political entities nestled between North, Central and South America. Both CARICOM & OECS States (C&OC) are considered large oceans ([Lancaster](#), 2024, p. 66). Small Island Developing States ([SIDS](#)), which share a history of colonisation and a future marred by threats from climate change, as well as the other [two triple planetary crises](#) of biodiversity loss and pollution. For C&OC States, the Caribbean Sea and Atlantic Ocean, which wash their shores, are the golden thread that has bound peoples and places across the Region and is an important highway for the movement of peoples and their innovations. The marine environment is therefore a linchpin of Caribbean civilisation, providing cultural, spiritual, recreational and mental health benefits, and has been central to the Region's economy since the [arrival of Christopher Columbus](#) in October 1492.

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Columbus' arrival ushered in the [age of](#) exploration, which gave birth to the most [exploitative](#) economic enterprise of modern history, resulting in the almost entire repopulation of the Region's peoples and the extractivism of its terrestrial , and to a lesser extent, marine resources. It was the ocean which brought enslaved peoples from [Africa](#) through the [Trans-Atlantic slave trade](#) and [indentured](#) labourers from Asia, China and Europe, and it was the ocean that [transported](#) the economic wealth of the Region toward Europe, at times *via* North America.

Accordingly, by the mid-1960s, when the [first waves](#) of [independence](#) arrived at the shores of the C&OC, the agrarian lands of the Caribbean were heavily exhausted from plantation agriculture, and for States not blessed with mineral or forestry resources, the [pivot](#) to the sun, sand and sea resources in the form of tourism became a key cornerstone of their post-colonial economic strategy. This Contribution Blog Post will examine how the ocean's importance to the States and peoples of the C&OC has become a crucial part of their law, policy and their quest to develop the [blue economy](#).

This approach it will be demonstrated, is in consonance with the recognition in April 2025 of the human [right to a clean, healthy and sustainable ocean environment](#), the increasing role of the ocean in climate mitigation, and the most recent blueprint for the development of SIDS adopted at the Fourth International Conference on Small Island Developing States, the Antigua & Barbuda Agenda for SIDS ([ABAS](#)).

THE IMPORTANCE OF THE OCEAN IN THE CARICOM & OECS CARIBBEAN

A first expression by Caribbean States to mark their newfound independence from European States, was the forming of inter-governmental unions to promote economic, political, and social cooperation.

The first union was the short-lived [West Indies Federation](#), which was succeeded by the larger structure of CARICOM and the smaller alliance of OECS comprising States in the Eastern Caribbean, which hold a close geopolitical relationship with the French overseas departments and regions of Guadeloupe and Martinique (Lancaster & St. George 2015, p. 231).

From the very beginning, these unions recognised the importance of the natural resources of the Caribbean as essential to the Region’s future right to development and prosperity of their peoples. By 2001, when Member States of the Caribbean Community agreed to the *avant-garde* regional integration instrument of the [Revised Treaty of Chaguaramas](#), they included an article which attributed a “special status” to the Caribbean Sea. By Article 141, the Treaty requires that Member States protect the Region’s marine spaces “... from the potentially harmful effects of the transit of nuclear and other hazardous wastes, dumping, pollution by oil or by any other substance carried by sea or wastes generated through the conduct of ship operations ...”

The significance ascribed to the marine environment of the C&OC cannot be underestimated, as with the exception of Guyana, the Exclusive Economic Zone (EEZ) of CARICOM & OECS Caribbean States are larger than their land masses ([Heileman](#), 2005, p. 18), and in fact the majority are large ocean States. While C&OC States also share a close inter-relationship between the terrestrial, coastal and marine environment for island and coastal States, a phenomenon known as the ridge-to-reef [approach](#) (Lancaster, 2025), the ocean plays a fundamental role in [small-scale] [fisheries](#) and related [health-related human rights](#) of C&OC peoples since it provides these ocean-facing, ocean-dependent societies with a source of inexpensive, accessible protein. Additionally, the associations between the ocean and coastal marine ecosystems, such as [blue](#) and [teal](#) carbon, are also important [nature-based solutions](#) to global, regional and national climate [mitigation](#) and [adaptation](#) efforts.

The ocean also supports significant economic activities such as tourism and other maritime industries such as shipping, as, like in colonial times, the Caribbean is a [significant transshipment area](#). Socially, the ocean is important for the livelihood and employment, as well as the maintenance of cultural, spiritual rights of the Caribbean's [Indigenous](#), [Afro-descendant](#) and traditional peoples. Accordingly, the ocean is a vast transboundary resource, and by including Article 141 in the *Revised Treaty of Chaguaramas*, C&OC States have provided a potentially important nexus between the regional policy and international environmental law, international human rights law, international biodiversity law, international climate law, international fisheries law and law of the sea.

THE SPECIAL STATUS OF THE CARIBBEAN SEA & THE NEXUS WITH MULTILATERAL PROCESSES SUPPORTING THE RIGHT TO A HEALTHY OCEAN

According to a “special status” for the ocean space which washes the majority of the CARICOM & OECS Caribbean States, incorporated principles enshrined in the 1989 [Port of Spain Accord on the Management and Conservation of the Caribbean Environment](#), a soft law document, which was a key point in the evolution of the Caribbean's consciousness and action of the environment and development.

The *Accord* identifies fourteen priority issues for the protection of the environment, including those concerned with pollution and coastal and marine environments. These principles are supported across the *corpus* of the *Revised Treaty*, for example, an article on the conservation of the natural and cultural resources of the Region – including the marine environment – through proper management (Article 55 (2) (f)). Other notable articles include an agricultural policy which promotes the efficient management and sustainable exploitation of natural resources, including the living resources of the exclusive economic zone (Article 56 (1) (f))

through *inter alia* taking the special needs of artisanal fishers (Article 57 (1) (b)) and the collaboration between fishers and [o]the[r] social partners in agricultural development (Article 57 (2) (d)).

In this regard, the *Revised Treaty* imposes the requirement for prudent and rational policies for the management of the resources (Article 65 (1)), including the preservation, protection and improvement of the quality of the [marine] environment (Article 65 (1) (a)) and the protection of marine biodiversity (Article 65 (1) (b)).

To achieve these objectives, Member States are expected to formulate measures (Article 65 (2)) which address transboundary regional environmental problems, such as the pollution of the marine space (Article 65 (1) (c)).

While the *Revised Treaty* is primarily an economic integration agreement, these provisions broadly support the multilateral commitments under key regimes and, in fact, require a synergetic approach. The leading example is the ocean-climate nexus ([Morgera et al., 2023](#)), as increasing evidence has underscored the role which the ocean as a body of water serves as both a [carbon and heat sink](#). Oceans store excess heat and approximately a quarter of anthropogenic carbon dioxide in the water column, seabed and marine mega- and micro-diversity, including fish, marine mammals and plankton, and sequester other greenhouse gases from the atmosphere.

Marine sequestration is [complemented](#) by sequestration occurring in coastal marine ecosystems, which absorb carbon dioxide through photosynthesis in tidal marshes, seagrass beds, and mangroves at a rate up to two times faster than forests *per* unit area and store it for longer periods, both in the plants themselves and also in the sediments below them. However, the ocean and its biodiversity's role as carbon and heat sinks are under [threat](#) from climate

change, which threatens the role which healthy and sustainable oceans can play in sustainable development and human rights.

The impacts of climate change on the ocean endanger the benefits which coastal peoples can derive from marine and coastal resources, and while a global issue, it is particularly [prejudicial](#) for SIDS such as those in the CARICOM & OECS Caribbean, given their increased vulnerability to the climate phenomenon.

Caribbean SIDS have long recognised the impacts of the nexus between climate change and the ocean, and in 2022, led the request for the now-landmark [advisory opinion](#) from the International Tribunal of the Law of the Sea. The [findings](#) of the Opinion underscored the relationship between the climate phenomenon and the ocean environment and mentioned *en passant*, that climate change “raises human rights concerns”, such as the now [well-established](#) legal nexus between human rights and environmental protection, including the human right to a healthy, safe, and sustainable environment and the recently adopted human right to a clean, healthy and sustainable ocean.

Article 141 in principle supports the human right to a clean, healthy and sustainable ocean but requires wider law and policy support to adequately operationalise the right. In this regard, the participation of C&OC in the work of the [Inter-American Commission](#) is important since most States do not actively participate in the other institution of the Inter-American system, the [Inter-American Court of Human Rights](#).

Caribbean States have also neglected to endorse the [Protocol of San Salvador](#), an additional protocol to the [Pact of San José](#), which, with the support of the [Special Rapporteurships](#) such as on Economic, Social, Cultural and Environmental Rights ([REDESCA](#)), the [Rights of Indigenous Peoples](#) and the [Rights of Afro-Descendants and Against Racial Discrimination](#), promote the protection of economic, social, and cultural rights in the Americas.

Despite these omissions in the area of international human rights in the Caribbean, the entry into force of the 2018 *Regional Agreement on the Access to Information, Public Participation and Justice on Environmental Matters in Latin America and the Caribbean* (the [*Escazú Agreement*](#)) and the adoption of Member States in 1997 of the [*CARICOM Charter for Civil Society*](#) provide powerful opportunities for synergistically advancing the human rights in the C&OC. *Escazú* is progressively being ratified by C&OC States and has been endorsed by the two apex courts in the Caribbean, the [*Caribbean Court of Justice*](#) (Lancaster and Mugadza, 2025) and the [*Judicial Committee*](#) of the [*Privy Council*](#) (Lancaster, 2025).

The *Charter*, on the other hand, despite being indigenous to the CARICOM grouping, remains largely a document which exists on paper, as opposed to charting the course for the human rights and people's inclusion in the C&OC Region.

The *Charter* mirrors many of the civil and political rights found in Commonwealth Caribbean Constitutions but importantly contains social, cultural and economic rights which are generally absent from the Constitutions of CARICOM States, except Guyana, Haiti, Suriname and to a lesser extent Belize.

Additionally, the *Charter* was drafted in a period when social, cultural and economic rights were maturing and requires a revisiting in its entirety as a means to create a binding indigenous Caribbean human rights framework (Hinds, 2024).

Finally, an important nexus between Article 141 and supporting environmental policies under the *Revised Treaty* is the support and articulation through the membership of C&OC States in the *Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region* (the [*Cartagena Convention*](#)) and its three protocols on [*oil spills*](#), [*specially protected areas and wildlife*](#) and [*land-based*](#) sources of pollution.

The *Convention* implements the the 1982 *United Nations Convention on the Law of the Sea* (UNCLOS) in a regional context and dovetails with the *Revised Treaty*'s provisions on ocean and coastal environments within the Convention Area (as defined in Article 1), as well as the ridge-to-reef approach, and according to the treaty regime, it is a crucial link with the law of the sea, international biodiversity law, and international fisheries.

Further, as the United Nations Environment Programme's [Regional Seas Programmes \(RSP\)](#) for the Wider Caribbean Region, the *Convention* defines and regulates ship-based, land-based, sea-bed and airborne sources of pollution which can affect the Convention Area and which it regulates. In regard to the latter issues of air pollution, the *Convention* is also important to supporting Article 192 of the UNCLOS in regard to climate change.

Over the years the RSP has promoted both regional and international cooperation between participating States which are also encouraged to define specially protected areas where there are rare or threatened ecosystems or habitats for threatened species and conduct environmental impact assessments (EIAs) before undertaking major development projects in coastal areas which can impact the coastal marine ecosystems in the Convention Area.

Over the years, activities under *Cartagena* also reverberate with the *Antigua & Barbuda Agenda*, which for SIDS offers a transformative vision for addressing challenges related to extreme weather and sea level rise, emphasising resilience-building, sustainable development, and social equity as cornerstones for a secure and prosperous future.

The conservation, restoration and sustainable use of oceans, marine resources and biodiversity; establishment of area-based management tools; the role of the ocean in the blue economy; disaster risk reduction in response to SIDS' vulnerability to [climate](#) change; the fostering of sustainable energy solutions and enhancing food security are fundamental to the *Agenda*. In consonance with food (and nutrition security), *Cartagena* is a pivotal companion to Article 141

and its supporting provisions on fisheries management and development (Article 60), by supporting fisheries policies as well as health-related issues which impact fisheries, such as the discharge of hazardous pollutants, plastics and microplastics into the marine environment.

Fisheries management and development in the C&OC is spearheaded by the [*Agreement Establishing the Caribbean Regional Fisheries Management Framework*](#), and in 2014, Member States adopted the [*Caribbean Community Common Fisheries Policy*](#) (CCCFP), a final policy document which enables participating States to collectively undertake action to *inter alia*, develop rational harvest strategies and fisheries management plans to ensure optimum sustainable use of the fishery resources, the protect the coastal marine ecosystems, enforce conservation and management measures to protect their fishery resources and improve welfare and working conditions of fishers, including improving competitiveness and effectively developing fisheries and aquaculture value chains.

CONCLUSION

The ocean is the largest remaining aspect of the territorial sovereignty of C&OC States and a crucial resource for the States and peoples of the C&OC, especially within the context of the threat from climate change and other planetary crises.

As C&OC States both explore the bounds of their vast exclusive economic zones (EEZs) under the banner of the blue economy and seek to ensure the resilience of the right to a healthy ocean in the face of the climate emergency, Article 141 of the *Revised Treaty* is a significant linchpin between regional actions and multilateral processes supporting the right. However, while Article 141 is supported buttressed by a diversity of economic and environmental obligations in a variety of multilateral instruments support under human rights frameworks lag severely behind in the Caribbean. In this regard, the C&OC has a diversity of options open to [*deepening*](#) the human rights of the Region's citizens, such as through the *Escazú Agreement*, the Inter-

American system and the indigenous instrument of the CARICOM *Charter of Civil Society*. In this regard, further, given the [Caribbean's leadership of climate action](#) in the context of SIDS, the strengthening of the nexus between the regional integration system and multilateral processes supporting the right to a healthy ocean can serve as a model within the context in accordance with the *Antigua & Barbuda Agenda* for other SIDS in the Pacific and Indian Oceans and the African continent.

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13. SUSTAINABILITY AND THE DYNAMICS OF MICROCLIMATE CHANGE IN COASTAL ECOSYSTEMS

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INTRODUCTION

Coastal ecosystems are dynamic and complex environments which play an important role in supporting biodiversity and providing essential ecosystem services.

Microclimates, which refer to localized climate conditions, have a significant impact on these ecosystems, influencing vegetation, temperature, humidity, and wildlife habitats.

Understanding the role of microclimates in coastal ecosystems is essential for developing effective conservation and adaptation strategies to mitigate the impacts of climate change

MICROCLIMATE CHANGE IN COASTAL ECOSYSTEMS

Coastal areas are located at the transition between land and sea and are influenced by processes that occur on land, in freshwater and in marine waters. Coastal areas are the boundary between two or more communities with a high diversity of natural resources and serve to provide environmental services such as recreation, tourism, fisheries and transportation. Coastal ecosystems are complex and dynamic environments that are strongly influenced by microclimatic conditions. These coastal areas, which include sandy beaches, dunes and salt marshes, are shaped by a variety of physical factors such as sediment transport, wind patterns,

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temperature and rainfall. Interactions between these environmental variables and the biotic components of the ecosystem, such as vegetation and marine life, create a unique microclimate that is critical to the overall function and resilience of the coastal environment.

Microclimate has an important role in coastal ecosystems because it affects various aspects of the environment and the lives of organisms living in the region. Microclimate or environmental climate factors play a role in the comfort level of an environment (Abraham & Ariffin, 2020; Hermawan et al., 2018).

According to Noor et al. (2018), comfort is a term used to express the influence of the state of the physical environment of the atmosphere or climate on humans, plants, and animals (Prasetyo, 2012). Human activities can affect the state of the microclimate in coastal ecosystems.

The condition of climatic elements such as temperature, humidity, wind, and sunlight intensity can affect the behavior and metabolism that takes place in living things, and vice versa, the existence of these living things can affect the condition of the surrounding microclimate. So it can be said that there is a reciprocal relationship between the microclimate and the living things around it.

HERE ARE SOME OF THE MAIN ROLES OF MICROCLIMATE IN COASTAL ECOSYSTEMS:

Influence on Vegetation

Microclimates influence the type and distribution of coastal vegetation, such as mangroves, seagrass beds and other coastal vegetation. Locally varying temperature, humidity, wind and sunlight intensity can determine the plant species that can grow and thrive in a given area. Microclimate impacts on environmental quality and the lives of coastal communities. Changes

in microclimate can affect air temperature and humidity around mangrove forests and help reduce coastal erosion and abrasion that can occur due to climate change and extreme weather.

As a Temperature Regulator

Microclimates help regulate local temperatures in coastal ecosystems. Coastal vegetation such as mangroves can provide shade, reduce extreme temperature fluctuations, and improve thermal comfort conditions, creating more stable conditions for biodiversity and ecosystem balance.

Maintaining Air Humidity and Water Cycle

Micro air humidity in coastal areas is influenced by vegetation and proximity to the ocean water cycle. Mangroves and other coastal vegetation play an important role in regulating soil moisture and the surrounding air, which in turn affects ecosystem processes such as carbon sequestration, organic decomposition and nutrient availability.

Protection against Coastal Erosion and Abrasion

Erosion is the erosion or loss of part of the land from one place due to uplift to another place, caused by ice, wind, or water movement. An avalanche event that occurs naturally or due to irresponsible human actions, while abrasion is the process of eroding hard materials or rocks such as rock cliffs accompanied by landslides caused by sea waves.

Coastal vegetation influenced by microclimate, such as mangrove roots, can help stabilize soil and prevent coastal erosion and can withstand seawater waves as protection against coastal abrasion. In addition, microclimates are more stable if winds move regularly and are not too strong, which can help reduce the risk of soil erosion.

Creating Habitat and Biodiversity

Microclimates create a variety of microhabitats in coastal ecosystems, which support species diversity. Microconditions such as air humidity, temperature, wind and light availability vary in coastal areas, creating ideal habitats for a diversity of organisms to grow and thrive.

THREATS FACED BY COASTAL AREAS DUE TO MICROCLIMATE CHANGE

Microclimate change refers to climate change on a global scale that has an impact on the local or micro scale so that it can pose various threats to coastal areas. Here are some of the main threats faced by coastal areas due to microclimate change, including:

Sea Level Rise:

Sea level rise refers to the gradual increase in global average sea level over time. This phenomenon is mainly caused by two main factors: thermal expansion and melting of ice sheets and glaciers.

As the global Sea Surface Temperature (SST) continues to rise due to human-induced climate change, the world's oceans absorb more heat, causing water to expand and sea levels to rise. In addition, melting ice sheets and glaciers, particularly in polar regions such as Antarctica and Greenland, contribute significantly to sea level rise.

The impacts of sea level rise are far-reaching and pose serious threats to coastal communities, ecosystems and infrastructure. Low-lying areas are particularly vulnerable to flooding and erosion, putting millions of people at risk of displacement.

In addition to the immediate impacts on human populations, sea level rise also has long-term implications for biodiversity and ecosystems. Coastal habitats such as mangroves, salt marshes and coral reefs are at risk of submergence, leading to the loss of important habitats for marine species. Coastal cities and communities around the world are already feeling the impacts of sea level rise, which is occurring more and more frequently. Sea level rise can cause, among other things:

- Coastal Erosion and Abrasion:

Rising sea levels can accelerate erosion and abrasion of coastal areas, eroding or retreating coastlines and reducing land abrasion:

- Coastal Flooding:

Low-lying coastal areas are subject to more frequent flooding that threatens infrastructure, residential areas and local ecosystems.

Changes in Weather Patterns:

Changes in weather patterns as a result of global climate change will impact coastal areas and can cause extreme weather, such as:

- Storms and Tropical Cyclones:

Increased frequency and intensity of storms and tropical cyclones can cause physical damage to infrastructure areas and coastal ecosystems, as well as an increase in the speed of ocean currents that have an impact on changes in fishing grounds for certain fish.

- High Intensity Rainfall:

Changes in rainfall patterns with high intensity can cause flash floods, affecting water quality and the health of coastal communities.

Changes in Sea Water Temperature:

Changes in seawater temperature cause several significant impacts on the marine and terrestrial environment, such as:

- Coral Reef Bleaching:

Rising sea temperatures can cause coral reef bleaching, threatening marine biodiversity and the tourism industry that depends on coral reef ecosystems.

- Changes in Marine Ecosystems:

Marine species will migrate or become extinct due to temperature changes, disrupting food chains and local ecosystems.

- Increased Ocean Acidity:

Increased seawater temperatures lead to increased ocean acidity as the ocean already absorbs 90% of the excess heat created in the climate system. As a result, hotter water temperatures make mixing of water layers more difficult. In addition, 20 to 30 percent of carbon dioxide emitted by human activities is absorbed by the ocean, which can inhibit the growth of shellfish, various fish species, coral reefs and other biodiversity.

Saltwater Intrusion:

Saltwater intrusion can occur in addition to climate change; it is also caused by various human activities and natural factors that affect the balance of groundwater and the sea. Saltwater intrusion results in negative impacts on the environment and coastal communities, including

- Freshwater Contamination:

Sea level rise can cause saltwater to seep into freshwater aquifers and reduce the quality and availability of drinking water.

- Affected Agriculture:

Salinization of agricultural land can reduce agricultural productivity in coastal areas.

- Reduced Soil Fertility:

Seawater intrusion can reduce soil fertility, making the soil no longer effectively usable for agriculture.

- Building Damage:

Brackish well water can cause damage to buildings, such as damage to water pipes and other buildings made of materials that are not resistant to salt water.

- Health Problems:

Freshwater sources becoming brackish can lead to health problems, such as diseases caused by high salt concentrations in the water.

- Effects on Ecosystems:

Seawater intrusion can disrupt ecosystems, such as changes in biota composition and ecosystem structure, which can impact the balance of the environment.

1. Coastal Ecosystem Damage:

Damage to coastal ecosystems will negatively impact the following:

- Habitat Loss:

Mangroves, vegetated lands, seagrass beds and other coastal ecosystems may be damaged or lost, reducing natural protection against storms, coastal erosion and abrasion.

- Decreased Biodiversity:

Loss of important habitats can lead to population declines of species that depend on coastal ecosystems.

- Threats occur on some small islands:

Ocean sand mining also endangers small islands by changing the shape of the seabed and the patterns of ocean currents and waves. Uncontrolled export of marine sand can result in important changes in coastal structure, such as shoreline retreat. As a result, over a long period of time, the small islands around the marine sand mine will be submerged.

Socio-Economic Influence:

As a result of the rapid population growth supported by the rapid development of industrialization activities, land conversion has occurred to damage green areas in coastal areas.

These influences include:

- Settlement Shift:

Coastal residents may be forced to move due to increased risk of tidal flooding, abrasion and erosion resulting in social and economic displacement.

- Economic Losses:

Industries that depend on coastal ecosystems, such as fisheries and tourism, will suffer major losses.

Addressing these threats requires comprehensive mitigation and adaptation efforts, including the development of climate-resilient infrastructure, protection and restoration of coastal ecosystems, and sustainable management of water resources. In addition, it is important to increase the awareness and capacity of coastal communities in dealing with the impacts of microclimate change. vicinity of marine sand mines will be submerged.

Adaptation to Microclimates

Microclimates are localized climates specific to a small area, often influenced by local geography and environmental conditions. Adaptation to microclimates in coastal areas involves strategies to adjust to changing local climate conditions. Some adaptation strategies that can be implemented include:

Climate Resilient Infrastructure Design:

- Building infrastructure that can withstand extreme weather conditions, such as buildings that can withstand flooding or high winds.

. Use of Local Vegetation:

- Planting local vegetation that is resistant to specific microclimate conditions to help reduce erosion and provide habitat for local fauna.

. Extreme Weather Early Warning System:

- Develop an early warning system for extreme weather and changing microclimate conditions.

. Water Management:

- Develop an effective water management system to prevent floods and droughts.

. Livelihood Diversification:

- Encourage coastal communities to develop multiple sources of livelihood other than those dependent on natural resources that are vulnerable to climate change.

. Sea Level Rise Risk Management:

- Management of sea level rise risk through inundation risk management and vulnerability analysis to sea level rise, and development of priority programs for adaptation.

.Hazard and Risk Analysis:

- Analysis of hazards and risks associated with climate change in coastal areas, such as sea level rise, waves and storms, and their impacts on communities and the environment.

.Adaptive Capacity Development

- Development of community adaptive capacity through the development of social networks, human capital, and institutions, as well as the development of technology that suits the conditions of coastal areas.

SYNERGY BETWEEN CONSERVATION AND ADAPTATION TO MICROCLIMATE IN COASTAL AREAS

An integrated approach that aims to protect biodiversity and ecosystems while adapting to climate change at the local scale.

Conservation focuses on preserving ecosystems and species, while microclimate adaptation aims to adapt local conditions to specific climate changes. Coastal conservation and microclimate adaptation complement and support each other.

Conservation of healthy coastal ecosystems can increase resilience to microclimate change, while microclimate adaptation can strengthen conservation efforts by addressing specific local conditions.

Overall, an integrated approach that combines coastal conservation and microclimate adaptation is key to maintaining the sustainability of coastal ecosystems and the well-being of people living in these areas.

CONCLUSION

In conclusion, microclimates play a vital role in coastal ecosystems, influencing vegetation, temperature, humidity, and wildlife habitats. However, microclimate change poses significant threats to these ecosystems, including sea level rise, changes in weather patterns, and saltwater intrusion.

To address these challenges, comprehensive mitigation and adaptation efforts are necessary, including climate-resilient infrastructure design, use of local vegetation, and livelihood diversification. An integrated approach that combines coastal conservation and microclimate adaptation is crucial for maintaining the sustainability of coastal ecosystems and the well-being of people living in these areas. By working together to protect and preserve these ecosystems, we can ensure the long-term health and resilience of our planet's coastal environments.

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14. PARTICIPATORY RIGHTS OF COASTAL COMMUNITIES IN WIND ENERGY DEVELOPMENT ON THE OCEAN

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INTRODUCTION

Wind energy is the energy obtained from the wind. It is one of the oldest energy sources exploited by humans and today is the most established and efficient renewable energy source. The academic term for wind power, ‘eolic energy’ is derived from the name of the Greek mythological figure, Aeolus, the keeper of the winds (ACCIONA, 2020).

Wind power consists of converting the energy produced by the movement of [wind turbine](#) blades driven by the wind into electrical energy. Wind energy is a source of renewable energy. It does not contaminate; it is inexhaustible and reduces the use of fossil fuels, which are the origin of greenhouse gases that cause global warming.

In addition, wind energy is a “native” energy because it is available, practicable power everywhere on the planet, which contributes to reducing energy imports and to creating wealth and local employment. For these reasons, producing electricity through wind energy and its efficient use contributes to sustainable development (ACCIONA, 2020). It is the most efficient

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technology to produce energy in a safe and environmentally sustainable manner: it is zero emissions, local, inexhaustible, competitive, and it creates wealth and jobs.

The installation and operation of offshore wind turbines are regulated in both national and international law. The relevant international legal framework is [UNCLOS](#) (United Nations Convention on the Law of the Sea), which regulates the rights and responsibilities of the States in regard to the use of the oceans (United Nations, 1982). The maritime zone in which the offshore wind turbines are located determines which regulatory rules apply.

In the [territorial waters](#) (up to 12 nautical miles from the baseline of the coast), the coastal State has full sovereignty, and therefore, the regulation of offshore wind turbines is fully under national jurisdiction.

The [exclusive economic zone](#) (up to 200 nautical miles off the baseline) is not part of the State's territory but is subject to the coastal State's exclusive jurisdiction and control for selected purposes, one of which is the production of energy from winds.

This means that within this zone, the coastal State has the right to install and operate offshore wind farms and to establish safety zones around them that must be respected by all ships, as long as due notice of the installation has been given. Also, neither installations nor safety zones can interfere with sea lanes that are considered essential for international navigation (United Nations, 1982).

Beyond the exclusive economic zones are the high seas, or the [international waters](#). Within this zone the purpose of producing energy is not explicitly mentioned as a high seas freedom, and the legal status of offshore wind facilities is therefore unclear. It has been argued that the uncertainty of the legal status of offshore wind facilities on the high seas could become an object of interstate disputes over the rights of use. As a solution, it has been suggested that

offshore wind facilities could be incorporated as a high seas freedom by being considered as ships or [artificial islands](#), installations and structures (United Nations, 1982).

As of 2020, energy generation from offshore winds in deep waters is not yet technically achievable due to challenges associated with greater depths (IEA, 2019). Nevertheless, advancements in floating wind turbine technology represent progress toward enabling deepwater wind energy projects.

There is a perspective emphasizing the necessity of linking community benefits to wind energy initiatives, especially large-scale commercial developments, to promote justice and equity for coastal communities.

Recognizing the risks of distributive injustice—such as environmental harm and disproportionate effects on vulnerable regions—can guide efforts toward more inclusive and sustainable development that respects the rights and interests of coastal populations. This view does not imply that all wind farm projects cause harm, nor that all societal groups perceive wind farms negatively.

Additionally, it is not a directive to change current siting practices for these developments (IEA, 2019). Rather, the conclusion is that acknowledging the justice aspects of renewable energy siting is crucial, as low-carbon development can produce uneven social and economic impacts.

Furthermore, justice provides a stronger foundation for offering community benefits than framing them merely as tools to gain social acceptance. Treating benefits as incentives risks granting fewer advantages to communities that readily accept projects, despite evidence that support is often higher in disadvantaged areas (Van der Horst & Toke, 2010). Viewing community benefits as a matter of justice transforms them into social obligations rather than optional developer concessions. This perspective also more accurately reflects the limited

influence of host communities, especially as planning and policy frameworks increasingly prioritize large renewable energy projects and reduce the legitimate scope for local opposition (Department for Energy and Climate Change [DECC], 2011).

Energy companies regularly extol the virtues of fostering positive relations with the communities around their projects, and providing community benefits helps to demonstrate this good neighbourliness. This study does not dispute the virtue of good relations between companies and their surrounding communities but questions whether this places the provision of community benefits on a sufficiently firm footing.

Moreover, literature suggests that the obligations of environmental citizenship follow not simply from being part of a community but from a responsibility to address the harms caused (Cowell, Bristow, & Munday, 2011). This leads to a rather different imperative for community benefits.

To establish the relevance of intra-generational distributive justice, one could start by looking at public responses to wind energy. Researchers regularly find opponents of wind-power projects expressing their concerns in the language of injustice, claiming that wind energy companies are exploiting ‘their environment’, causing adverse effects, while profits are low elsewhere (Gross, 2007).

WIND ENERGY DEVELOPMENT ON THE OCEAN

As human populations increase, so does the requirement to meet the need for sustainable energy and food production whilst tackling global challenges such as poverty, inequality and climate change (High Level Panel of Experts on World Food Security, 2014). Two industries which have been identified as contributing to solving these complex issues are the Marine Renewable Energy (MRE) and aquaculture sectors (European Commission, 2020). The MRE industry is made up of wind, wave, and tidal electricity generators, with wind technologies currently the

most developed. In recent years, the offshore wind sector has experienced high levels of growth, with many countries looking to it as a significant contributor to their energy mixes. In general, public attitudes also support a movement away from fossil fuels for energy production (Olson-Hazboun, Howe, & Leiserowitz, 2018).

Offshore wind power or offshore wind energy is the [generation of electricity](#) through [wind farms](#) in bodies of water, usually at sea. There are higher wind speeds offshore than on land, so offshore farms generate more electricity per amount of capacity installed (Madsen & Krogsgaard, 2010). Offshore wind farms are also less controversial than those on land, as they have less impact on people and the landscape.

Unlike the typical use of the term "offshore" in the marine industry, offshore [wind power](#) includes inshore water areas such as lakes, fjords and sheltered coastal areas as well as deeper-water areas. Most offshore wind farms employ fixed-foundation wind turbines in relatively shallow water. As of 2020, floating wind turbines for deeper waters were in the early phase of development and deployment.

As of 2020, the total worldwide offshore wind power [nameplate capacity](#) was 35.3 gigawatts (GW) (Global Wind Energy Council, 2021). The United [Kingdom](#) (29%), [China](#) (28%) and [Germany](#) (22%) account for more than 75% of the global installed capacity.

The 1.2 GW [Hornsea Project One](#) in the [United Kingdom](#) was the world's largest offshore wind farm. (4C Offshore, n.d.) Other projects in the planning stage include [Dogger Bank](#) in the United Kingdom at 4.8 GW and Greater Changhua in [Taiwan](#) at 2.4 GW (reNEWS, 2017).

The cost of offshore has historically been higher than that of onshore (U.S. Energy Information Administration [EIA], 2010), but costs decreased to \$78/MWh in 2019 (Lee, 2019). Offshore wind power in Europe became price-competitive with conventional power sources in

2017. Offshore wind generation grew at over 30 percent per year in the 2010s. As of 2020, offshore wind power had become a significant part of northern Europe's power generation, though it remained less than 1 percent of overall world electricity generation (Reed, 2020).

A big advantage of offshore wind power compared to onshore wind power is the higher capacity factor, meaning that an installation of given nameplate capacity will produce more electricity at a site with more consistent and stronger wind, which is usually found offshore and only at very few specific

WIND ENERGY DEVELOPMENT AND OCEAN GOVERNANCE

At the forefront of public participation and ocean governance is the Aarhus Convention (United Nations Economic Commission for Europe [UNECE], 1998); although it presently applies primarily to the region of Europe, it has global significance for the promotion of environmental governance.

The Convention focuses on the need for civil participation in environmental issues, as well as on the importance of access to environmental information held by the government and its public authorities.

Aarhus goes further than previous international conventions in providing explicit linkages between environmental rights and human rights. Commencing with the preamble, it states in the 7th and 8th preambular paragraphs:

“Recognising also that every person has the right to live in an environment adequate to his or her health and well-being and the duty, both individually and in association with others, to protect and improve the environment for the benefit of present and future generations,”

“Considering that, to be able to assert this right and observe this duty, citizens must have access to information, be entitled to participate in decision-making and have access to justice

in environmental matters, and acknowledging in this regard that citizens may need assistance in order to exercise their rights.”

The Convention also explicitly deals with governmental accountability, as it grants the public rights of access to information and imposes obligations on public authorities to provide this information. Access to environmental information leads to a well-informed public, equipped to question the actions of the government.

These factors can then lead to more accountable environmental decision-making and greater potential for environmental justice. Article 4 outlines when access to information can be denied, i.e., when the public authority does not have the information requested, when it is unreasonable to provide the information, and when confidentiality is in the public interest (e.g., intelligence or national security information). Moreover, information can be refused if disclosure will adversely affect factors such as the course of justice and intellectual property rights.

At the first Meeting of the Parties to the Convention, the Parties recognized that the revolution in electronic information technology is essential to the promotion of environmental governance.

The Meeting’s declaration called on the Parties to make the government’s environmental information progressively available in electronic format, yet to be kept under frequent review (Meeting of the Parties to the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, 2002). The Meeting of the Parties stressed that the Convention was largely about building partnerships between an empowered civil society and the government, and that the public had responsibility for sustainable development too. It was stated

“The engagement of the public is vital for creating an environmentally sustainable future. Governments alone cannot solve the major ecological problems of our time. Only through building partnerships within a well-informed and empowered civil society, within the framework of good governance and respect for human rights, can this challenge be met.”

The Aarhus Convention is a clear advance in the area of environmental governance. It is an instrument that is being considered for its merits, not only by European countries but also by many countries around the world.

The Aarhus Convention presents us with the type of model for environmental governance which is one that implements civil empowerment, through access to information and resources; and through participation by a variety of stakeholders, including civil society and indigenous groups (United Nations Economic Commission for Europe [UNECE], 1998).

PARTICIPATORY RIGHTS OF COASTAL COMMUNITIES

Achieving real public participation depends to a large extent upon States party to international agreements transforming their written intentions into acceptable practice. A State is likely to be party to a range of treaties containing relevant yet differing requirements and may also be influenced by non-state stakeholders, including international financial institutions (IFIs) and civil society. In the absence of a single system of rules, this can create confusion in the determination of State practice.

For decades, social scientists have developed multidimensional understandings of host community acceptance of renewable power infrastructure that emphasize place attachment, fairness of siting process, ownership models, and economic benefits (Bell, Gray, & Haggett, 2005).

There is a support paradox in the public’s position on wind energy. People theoretically support wind energy, but may still oppose specific projects. One explanation for this paradox is the

existence of two support position categories: ‘qualified supporters’ and ‘unqualified opponents’.

Qualified supporters support wind energy, but only under specific circumstances or with caveats, and their opinions are likely influenced by ideology or impressions. Plans for a local project may trigger opposition in ‘qualified supporters’ because of the specific conditions that influence their support. On the other hand, ‘unqualified opponents’ oppose local wind energy projects regardless of potential benefits or efforts to mitigate potential negative impacts.

Perceived procedural fairness and social trust are key to gaining local support or acceptance of wind energy projects. In planning and environmental management contexts, government agencies and developers use public participatory processes to increase stakeholder support, hoping to improve policy or project outcomes; however, the success of participatory processes heavily depends on understanding the power dynamics of a given context, participant values, the way participants construct knowledge, and the types of knowledge they consider valid.

Effective stakeholder engagement in a natural resource management and land development context requires the correct identification of stakeholders, including their intention to influence outcomes and the identification and comprehension of issues that are salient to them (Dwyer & Bidwell, 2019).

INTERNATIONAL LAW PERSPECTIVE

The idea of individual participation in international environmental lawmaking is premised on the statement in Principle 10 of the Rio Declaration, which reads that “*environmental issues are best handled with the participation of all concerned citizens, at the relevant level.*” (United Nations, 1992). The participatory norms embodied in Principle 10 of the Rio Declaration, more than any other aspect of international environmental law, challenge traditional ideas and limits of both international law and municipal law. The inward bearing of these international

participatory norms has the potential to impinge upon fundamental aspects of the state, including state secrecy, legal procedure, public administration, and even the limits of the very form of municipal governance itself (Anton, 1993).

Furthermore, public participation may also lead to decisions that are better for the environment, protecting the rights of people not to have their health, communities, or natural areas degraded or destroyed (Kravchenko & Bonine, 2008). The public can bring expertise and knowledge to a decision-making process. Public experts may not only criticize mistakes or see negative sides of a plan or program, but also suggest good alternative solutions.

It seems that decisions about environmental protection formally integrate the views of the public. Generally, government decisions to set environmental standards for specific types of pollution, to permit significant environmentally damaging activities, or to preserve natural resources are made only after the impending decision has been formally and publicly announced. Usually, the public has been given the opportunity to influence the decision through written comments or hearings.

In many countries citizens may challenge government decisions affecting the environment in court or before administrative bodies. These citizen lawsuits have become an integral and essential component of environmental decision-making. The remaining sections of this article will look at the public participation elements in the Declaration on the Rights of Indigenous People and the Aarhus Convention.

In the perspective of the United Nations Convention on the Law of the Sea (UNCLOS) (Nandan, Rosenne, & Grandy, 1993), the question of which legal regime applies to offshore wind-energy exploitation essentially depends on the location of wind farm installations. UNCLOS is a multinational treaty defining and codifying the law of the sea. Most of the

development in installations for wind-energy production is likely to happen in offshore waters for at least two reasons.

First, because winds are stronger and more stable out at sea than close to land, and installations placed far offshore can be larger and produce more energy. Second, because it is believed that offshore wind farms would cause less concern among neighboring people, as the blades of the turbines would not be seen and would not be heard from shore. This, of course, does not eliminate the risks of adverse impacts that wind farms may have on marine biodiversity and habitats.

In Part V of UNCLOS the coastal State has sovereign rights and jurisdiction in the area of the sea which allows it to explore and exploit, conserve and manage the natural resources, whether living or non-living, and with regard to other activities for the economic exploitation and exploration of the zone.

Article 56 of the UNLOS is very clear that in the exclusive economic zone, the coastal State has: sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters superjacent to the seabed and of the seabed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water, currents and winds; and this jurisdiction extends to rights to the establishment and use of artificial islands, installations and structures; marine scientific research; the protection and preservation of the marine environment; And other rights and duties as provided for in this Convention.

Unfortunately, the Black Sea Convention, or the Bucharest Convention on the Protection of the Black Sea Against Pollution, signed April 21, 1992 (in force 1994), and the Nairobi-East African Coastal Convention for the Protection, Management and Development of the Marine

and Coastal Environment of the Eastern African Region Nairobi, June 21, 1985, both contain no obligations regarding public participation (Woodhouse, 2003).

AFRICAN UNION PERSPECTIVE

Africa arguably has the largest renewable energy resources of any continent. Sunlight is abundantly available everywhere, while other types of resources are more plentiful in some countries and regions than in others – such as geothermal along the Rift Valley in East Africa or wind power in the Horn of Africa and various coastal areas (KfW Development Bank, Deutsche Gesellschaft für Internationale Zusammenarbeit [GIZ], & IRENA, 2021).

Africa has a substantial energy potential from wind, particularly in the coastal regions, such as Northern Africa, Eastern Africa, and Southern Africa – since these regions have generally better wind resources.

The analysis of energy transitions of developed countries has been well documented (Cherp, Vinichenko, Jewell, Brutschin, & Sovacool, 2018), but less attention has been given to the analysis of such transitions in developing countries, particularly on the African continent. Africa faces a serious challenge in fulfilling the global commitments. The continent's rapid growth trajectories imply a higher volume of emissions, and it is highly unlikely that it will shelve its developmental aspirations in favour of climate change mitigation objectives.

Notwithstanding the progress made to date on many fronts, significant institutional and governance challenges remain, constraining the ability of Member States to effectively formulate and implement policies relating to growth of the relatively new blue economy concept in Africa alongside with policies in favour of environmental protection and the health improvement of ecosystems. An effective policy and regulatory framework is needed to secure investments in sea exploration as well as a sound policy for innovation, transfer of technology and adaptation to encourage inventors.

This should be in place for strengthening of the institutional capacities of key national and regional agencies and organizations for the effective implementation of blue economy-related functions. It would also entail capacity enhancement and incentivization of those entities and structures that are related to the key sectoral aspects of the blue economy, among others (AU-IBAR, 2019).

The Convention for Cooperation in the Protection, Management and Development of the Marine and Coastal Environment of the Atlantic Coast of the West and Central Africa Region (Abidjan Convention) entered into force in 1984 (United Nations Environment Programme [UNEP], 1981).

Recognizing the unique ecological characteristics of the marine and coastal areas in the region, the threats they face, and the urgent need for action, countries in the region convened in 1981 to sign the Convention and its Protocol. Alongside this, they adopted a plan of action aimed at protecting and developing the marine environment and coastal zones.

The Convention, together with its Protocol on Cooperation in Combating Pollution in the Event of Emergencies, was signed in 1981. South Africa, initially not a party to the Convention, applied for accession in 2000 and ratified it in 2002. Angola and Namibia submitted their instruments of ratification in 2017, and Cape Verde acceded recently in 2019. Currently, the Convention has 19 Contracting Parties.

The African Convention on the Conservation of Nature and Natural Resources, under Article 17, safeguards the traditional rights of local communities and indigenous knowledge by stipulating that:

1. Parties must enact legislative and other measures to ensure respect for the traditional and intellectual property rights of local communities, including farmers' rights, in line with the Convention's provisions.

2. Access to indigenous knowledge and its utilization require the prior informed consent of the concerned communities, alongside regulations that recognize their rights and the appropriate economic value of such knowledge.
3. Parties are obliged to enable active participation of local communities in planning and managing natural resources they depend on, fostering local incentives for conservation and sustainable use.

The Abidjan Convention also serves as a regional framework agreement, established to address the need for a coordinated approach to prevent, reduce, and control pollution of the marine environment, coastal waters, and related river waters across West, Central, and Southern Africa.

It facilitates cooperation on issues concerning marine and coastal environments, knowledge sharing, environmental hazards, pollution control, habitat and biodiversity protection, sustainable resource use, and other activities potentially detrimental to ecosystem health.

The Convention encourages scientific and technological collaboration, including information and expertise exchange, to identify and manage environmental challenges.

The Convention's recent Work Programme is structured around strategic priorities reflecting previous efforts, many of which relate to coastal communities and their participatory rights in renewable energy development in marine settings. One key component focuses on ecosystem and habitat assessments, covering areas such as ecosystems and resources, pollution in offshore zones, Exclusive Economic Zones (EEZ), and coastal areas, as well as social and economic factors including the valuation of goods and services provided by marine and coastal environments (United Nations Environment Programme [UNEP], 1981).

CONCLUSION

Offshore and coastal wind power is among the fastest-growing industries, particularly in

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regions with shallow coastal waters that offer optimal conditions for energy generation. However, as this industry expands, concerns arise about potential environmental impacts from installing offshore wind turbines and related infrastructure, such as substations and subsea cables. These impacts may affect biological, physical, and human environments.

Consequently, coastal communities are empowered through international and regional environmental legal frameworks to participate in decision-making processes regarding wind energy management. Public participation is crucial as it incorporates diverse expertise from various stakeholders. Through such involvement, coastal communities can protect their lands and natural resources by ensuring their voices influence governmental decisions.

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15. HOLDING INDUSTRIALISED NATIONS ACCOUNTABLE: LEGAL PATHWAYS FOR CARIBBEAN CLIMATE JUSTICE

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INTRODUCTION

The Caribbean region is responsible for less than one per cent ([London, J. B., 2004](#)) of global greenhouse gas emissions. However, the Caribbean region is facing existential threats ([Rhiney, K., & Baptiste, A. K., 2019](#)) from climate change. The impacts of climate change are being driven by historical and ongoing emissions from developed States.

The consequences of climate change ([Adrian Cashman, Mohammad R. Nagdee, 2017](#)) are manifold, including rising sea levels, hurricanes, and the destruction of biodiversity. The repercussions of climate change on Caribbean communities are profoundly detrimental to their social, economic, environmental, and cultural structures.

This raises a critical legal question: *How can Caribbean States compel high-emission states to take responsibility for their disproportionate contribution to these harms?* While there is no simple answer under international law, emerging legal strategies, ranging from climate litigation to reparations frameworks, offer potential avenues for accountability.

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This contribution examines the most viable legal mechanisms available to Caribbean States. It focuses on four key approaches: invoking state responsibility under international environmental law (such as the no-harm and polluter-pays principles); leveraging human rights tribunals to link climate inaction to violations of fundamental rights; advocating binding reforms to the United Nations Framework Convention on Climate Change ([UNFCCC, 1992](#)) and the United Nations Paris Agreement's ([UN Paris Agreement, 2015](#)) Loss and Damage Fund; and advancing claims for climate reparations based on historical ecological debt.

The contribution examines recent legal precedents, ongoing advocacy efforts and sheds light on the potential and limitations of these tools in addressing the Caribbean's acute vulnerability. The Caribbean's pursuit of climate justice is pushing the boundaries of international law. Furthermore, the Caribbean region's efforts are setting a precedent for other Small Island Developing States (SIDS) that are also vulnerable to climate change in the current era of planetary crisis.

INTERNATIONAL CLIMATE LAW AND STATE RESPONSIBILITY

1. The Polluter Pays Principle & No-Harm Rule

According to the principles of international environmental law, industrialised States can be held legally accountable for their disproportionate contribution to climate change in the Caribbean. The no-harm principle ([Brent, K. A., 2017](#)) is a cornerstone of customary international law, as established in the *United States of America v. Canada*, 1938 ([Trial Smelter Arbitration](#)) cases and subsequently adopted in the Report of the United Nations Conference on Environment and Development (UNCED), 1992, ([Rio Declaration](#)., 1992). This principle obliges states to prevent activities ([Jervan, M., 2014](#)) within their jurisdiction from causing significant transboundary environmental damage.

With regard to the issue of climate change, the ‘no harm’ principle ([Mayer, B., 2016](#)) posits that states emitting substantial quantities of greenhouse gases may be held legally liable for any demonstrable harm inflicted upon Caribbean States by their emissions. Caribbean States have experienced rising sea levels ([Stephenson, T. S., & Jones, J. J., 2017](#)), the destruction of coral reefs ([Riegl, B., 2007](#)) and property, and an increase in the intensity and frequency of extreme weather events.

Furthermore, the ‘polluter pays’ principle ([Khan, M. R., 2015](#)), which is formally recognised in the UNFCCC framework ([Zahar, A., 2020](#)), establishes that states responsible for pollution should bear the financial consequences. This principle complements the ‘no harm’ principle. Together, these principles provide Caribbean States with a normative basis on which to demand mitigation action and financial compensation from major emitters.

Translating the principles of international environmental law into enforceable obligations is a significant challenge ([Proelss, A., 2010](#)). Despite the considerable advancement of attribution science, as evidenced by [Intergovernmental Panel on Climate Change](#) (IPCC) reports and the [Carbon Majors Report](#), it remains challenging to accurately quantify the contributions of individual states and corporations to global emissions. Furthermore, these legal frameworks lack clear mechanisms ([Lees, E., 2021](#)) for apportioning liability for climate-related damage. The absence of robust enforcement ([Bodansky, D., 1999](#)) provisions in international environmental law further complicates efforts to hold parties accountable.

However, Caribbean States could invoke these principles in advisory proceedings before the International Court of Justice, particularly with regard to climate-related disputes.

Caribbean States could argue that industrialised countries have breached their due diligence obligations under international law. Furthermore, success would require robust scientific

evidence linking emissions to regional impacts, whilst also navigating the political sensitivities surrounding climate justice claims against powerful economies.

2. Advisory Opinion from the International Court of Justice

Seeking an advisory opinion ([Buszman, Z., 2024](#)) from the International Court of Justice on climate obligations is one of the most strategically significant ways in which Caribbean States can clarify the legal responsibilities of industrialised States. This approach has been endorsed by the European Court of Human Rights' 2024 judgment in the [KlimaSeniorinnen v Switzerland](#) case. The European Court of Human Rights held that States can be held internationally responsible for violations arising from their contributions to climate change.

For Caribbean States, this process provides a valuable opportunity to show that countries with high emissions may be in breach of the fundamental principles of international environmental law. These principles include the 'no harm' rule ([McIntyre, O., 2020](#)) and the right to a healthy environment ([Cima, E. \(2022\)](#)).

Although advisory opinions are non-binding ([Acquaviva, G, 2024](#)), they carry substantial moral and political weight. They could potentially catalyse more ambitious climate action and provide a legal basis for future compensation ([Kulick, A, 2025](#)) claims through alternative channels.

The International Court of Justice's advisory opinion could address several key issues relevant to the situation in the Caribbean. These may include whether disproportionate historical emissions constitute a breach of international legal obligations and what reparative measures may be required. A favourable ruling would strengthen the case for developed states to provide financial and technical assistance to small island developing states (SIDS), based on the principles of equity and common but differentiated responsibilities ([Rajamani, L., 2000](#)).

Furthermore, such an advisory opinion could influence ongoing cases before regional human rights bodies and national courts. It would also strengthen the position of Caribbean States in climate negotiations. However, the International Court of Justice's advisory processes face significant challenges. These include potential resistance from developed and emitting states, as well as the Court's historical reluctance to address politically contentious issues.

3. Climate Litigation: Human Rights and Domestic Courts

i. Human Rights-Based Claims

A growing number of States are using human rights frameworks ([Toussaint, P., & Martinez Blanco, A., 2020](#)) to hold industrialised countries and their corporations accountable for climate-related damage. They are capitalising on the growing recognition ([Picolotti, R., & Taillant, J. D. \(Eds.\), \(2003\)](#)) that environmental degradation infringes upon fundamental human rights. For example, they could argue that countries with high emissions which fail to mitigate climate change are violating the right to life, health and a healthy environment.

These efforts could involve petitioning regional bodies such as the Inter-American Court of Human Rights. Various court cases have already been used to fight for climate justice in the Latin America and Caribbean region, including [Sacchi v. Argentina](#) case of 2019. In the *Sacchi* case, which was brought before the United Nations Committee on the Rights of the Child, it was affirmed that inaction on climate change may breach states' human rights obligations towards vulnerable populations. In the Caribbean, where climate change is directly threatening ([Leal-Arcas, R., Faktaufon, M., Ribeaud, R., Brown, R., & Prakash, K., 2021](#)) access to freshwater, food security, and housing, climate litigation could legally compel industrialised States to finance mitigation and adaptation measures rather than offering voluntary aid.

Strategic human rights claims and climate litigation ([Elver, H., & Oral, N., 2021](#)) could address the disproportionate impact of ocean acidification on Caribbean livelihoods and culture.

Claimants in the Caribbean could invoke judicial precedents such as the Inter-American Court of Human Rights' ruling in [*Indigenous Communities Members of the Lhaka Honhat Association vs. Argentina*](#) case of 2020, which established a link between environmental damage and indigenous communities' right to their cultural identity. Caribbean States could present the decline of coral reefs — critical to fisheries, tourism, and coastal protection — as a matter of environmental and cultural rights.

Despite jurisdictional challenges and existing barriers, such as the cost of litigation, Caribbean States could collaborate with civil society to file parallel petitions with multiple human rights bodies. This would create various avenues for cumulative pressure, particularly when bringing court claims against non-regional states. If a case were to be successful, it could result in reparations being paid and systemic changes being mandated. Such changes could necessitate wealthy states revising their inadequate emissions targets in line with human rights compliance mechanisms. This approach could transform the debate around climate justice into a legally enforceable imperative, with the vulnerability of Caribbean States forming the evidentiary cornerstone.

ii. Transnational Tort Cases

Caribbean States could use innovative legal arguments to hold corporations liable for climate-related damage in developed countries' domestic courts ([Akhtar, Z., \(2021\)](#)). Caribbean States could pursue transnational tort litigation ([Anderson, M., 2001](#)) against major emitters. Recent legal precedents could inform this approach, such as the [*Milieudefensie et al. v. Royal Dutch Shell plc.*](#) (2021) case, in which a Dutch court ordered Royal Dutch Shell to reduce its emissions by 45% by 2030, which could be a useful starting point. Caribbean States could file negligence or public nuisance claims against fossil fuel companies in the countries where their headquarters and country of origin are located.

Such cases could utilise emerging climate attribution science to demonstrate that specific corporate emissions have measurably contributed to rising sea levels, more intense hurricanes, and the destruction of Caribbean coral reefs. Although these lawsuits face challenges ([Ward, H. \(2000\)](#) regarding causation and jurisdictional boundaries. Successful claims could compel major polluters to set up compensation funds for climate adaptation measures. This would reinforce the idea that corporations should cover the costs of their carbon-intensive activities.

The strategic advantages of transnational tort litigation are twofold. Firstly, it allows for the bypassing political obstacles ([Anderson, M., 2001](#)) in international climate Secondly, it ensures that entities responsible for historical emissions can be held directly accountable. Drawing parallels with the strategies employed in high-profile tobacco ([Rabin, Robert L., 2001](#)) and asbestos ([Barnes, J., 2007](#)) litigation. Caribbean States could collaborate with affected municipalities and civil society groups to file coordinated cases across multiple jurisdictions.

Recent developments in tort law, such as the 2018 [Urgenda Foundation v. State of the Netherlands](#) case, which recognised a ‘duty of care’ towards populations vulnerable to climate change, have strengthened the legal basis for such claims.

However, these cases require meticulous documentation of the impacts of climate change and may be subject to procedural challenges, such as *forum non conveniens* ([Barrett Jr, E. L., 1947](#)) objections. Nevertheless, transnational tort litigation ([Bertram, D., 2022](#)) offers a promising means of securing financial redress and setting a precedent for holding corporations accountable for their impact on the climate. Transnational tort litigation can complement state-level legal strategies in the Caribbean’s pursuit of climate justice.

4. Leveraging the United Nations Framework Convention on Climate Change’s Loss and Damage Fund

The establishment of the Loss and Damage Fund at the [Conference of the Parties \(COP27\)](#) of the United Nations Framework Convention on Climate Change was a significant step towards achieving climate justice. The fund has now been recognised in Article 8 of the [United Nations Paris Agreement](#). It has been set up to provide financial support to developing countries in addressing the socio-economic and environmental consequences of the impacts of climate change. The fund focuses particularly on building the capacity of adaptation measures.

Furthermore, the fund provides financial support to help developing countries recover from climate-related losses and damages. These losses and damages could result from extreme weather events or gradual changes such as rising sea levels.

The Loss and Damage Fund could provide Caribbean States with a mechanism to secure financial redress ([Charles, D., 2022](#)) for climate impacts directly tied to the emissions of Annex I and II developed countries under the UNFCCC. However, the fund's current voluntary contribution structure and complex access ([Lai, M., et al., 2022](#)) procedures risk replicating the shortcomings of previous climate financial mechanisms, in which vulnerable States encountered bureaucratic obstacles ([Prescod, N., 2022](#)) when attempting to obtain inadequate compensation.

Caribbean States must advocate for fundamental international reforms that reflect the principle of historical responsibility. These international reforms should include mandatory contributions based on cumulative emissions, as well as simplified direct access modalities for Small Island Developing States (SIDS).

These demands could be anchored in the 'polluter pays' principle and the 'common but differentiated responsibilities' framework of the UNFCCC. Furthermore, the Caribbean region could push for an equitable distribution system ([Saha, C. K., 2024](#)) that recognises the impact of the fossil fuel-driven growth of developed States on the region's climate resilience.

Caribbean States could submit detailed claims linking specific climate-related harm and damage to global temperature increases caused by developed countries, by engaging strategically ([Charles, D., 2022](#)) with the Loss and Damage Fund's mechanisms and governance. For instance, scientific attribution studies could demonstrate the impact of past emissions on hurricane damage or the accelerated deterioration of coral reefs ([Wolff, N. H, et al., 2015](#)). Scientific attribution studies could provide a basis for requesting quantified compensation.

Parallel advocacy efforts should focus on eliminating the political barriers that currently allow wealthy States to evade their responsibility to make meaningful contributions. One potential approach would be to form alliances with other vulnerable regions within the Group of 77 (G77) and the African Union.

While the fund alone cannot deliver full reparations, transforming it into a rights-based mechanism with predictable financing would be a significant step towards accountability. For the Caribbean region, this would mean shifting from requesting climate aid to demanding reparative justice ([Chapman, A. R., & Ahmed, A. K., 2021](#)) through a legally grounded framework that recognises the region's disproportionate suffering despite its minimal contribution to the climate crisis.

5. Reparations and Climate Debt: Legal Foundations for Restorative Justice

The concept of climate reparations ([Mohan, P. S., 2025](#)) provides Caribbean States with a transformative framework for addressing the historical injustices inherent in the climate change crisis. Moving beyond the traditional paradigm of aid, the concept of climate reparations demands restorative justice.

Based on the principles of international law and transitional justice, claims for reparations could quantify the ecological debt ([Sharife, K., & Bond, P., 2013](#)) owed by industrialised States

for centuries of exploiting fossil fuels to enrich their own economies and cause climate impacts in the Caribbean.

An increasing number of legal scholars ([Gromea, J. V., 2025](#)) recognise that the principle of ‘common but differentiated responsibilities’ ([Josephson, P., 2017](#)), as set out in the UNFCCC, implies reparative obligations for historical emitters, rather than merely providing technical assistance. The Caribbean States could present the developed States with legally substantiated claims, reframing climate finance as compensation rather than charity. They could achieve this by commissioning expert analyses to calculate the financial impact of climate change, ranging from degraded fisheries to hurricane reconstruction costs.

The reparations argument ([Chenier, S., & Tremblay, D., 2025](#)) is particularly compelling in the context of ocean acidification ([Cassotta, S., 2021](#)). Here, Caribbean States could demonstrate how emissions from developed states have effectively appropriated the region’s ecological capital. Coral reefs ([Purcell C & Kearyare M., 2023](#)) are vital for the wellbeing of Caribbean communities. Caribbean coral reefs provide goods and services worth approximately US\$8 billion through tourism ([Bertrand, A. & Hamilton, J., 2024](#)), fisheries and protection of the coastline.

Furthermore, coastal ecosystems offer social, environmental, and cultural benefits. Therefore, the destruction of coral reefs constitutes actionable harm that can be traced back to specific concentrations of atmospheric carbon dioxide. These emission concentrations are primarily caused by industrialisation in the Global North.

Legal strategies could combine moral arguments ([Harrison, J., 2017](#)) with concepts of property law, asserting that excessive carbon pollution constitutes the unlawful appropriation of essential marine resources necessary for the cultural and economic survival of the Caribbean.

Caribbean diplomats could leverage these arguments in bilateral negotiations, debt-for-climate swaps and campaigns to reform the policies of multilateral development banks.

This approach would reinforce ongoing efforts to address loss and damage, providing a solid legal basis for financial demands firmly rooted in the irrefutable historical record of exploitation. It would present a legal case for climate justice in the Caribbean, arguing that the region requires not only future-focused aid, but also restitution for centuries of ecological plunder.

CONCLUSION: A MULTIFACETED LEGAL FIGHT FOR CLIMATE JUSTICE

To pursue climate accountability, the Caribbean States must deploy various legal strategies in a coordinated manner that reinforces each strategy as part of a comprehensive justice campaign. However, no single approach — such as advisory opinions from the International Court of Justice, human rights litigation, loss and damage claims, or reparations frameworks — can address the profound inequities of climate change alone.

Pursuing tort litigation successfully can strengthen arguments for reparations and transform the political landscape of climate finance negotiations. The Caribbean region should continue to pioneer innovative legal theories, such as quantifying the damage caused by ocean acidification using ecological economics and applying the concept of ecocide to willful climate destruction. At the same time, the region should form alliances with other vulnerable states in the Pacific and Africa to amplify its voice in international forums.

This multifaceted fight is about more than just compensation; it challenges the fundamental power structures of international law that have long permitted environmental damage to be inflicted on vulnerable States.

The Caribbean's pioneering role in climate litigation is transforming the global conversation on this issue. This is evident in the landmark United Nations resolution that called for an

advisory opinion from the International Court of Justice. As attribution science improves and legal precedents accumulate, the moral and legal case for accountability grows stronger.

The path forward requires persistent legal creativity, sustained regional cooperation through [CARICOM](#), and strategic partnerships with climate justice movements worldwide. While the obstacles are formidable, the Caribbean's existential crisis leaves no alternative but to relentlessly pursue every available legal tool — both to ensure its own survival and to set important legal precedents that will safeguard vulnerable communities against climate change in the decades to come. The industrialised world's legal immunity for climate harm must end, and the Caribbean is demonstrating how this can be achieved.

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16. IMPACT OF THE FOURTH INDUSTRIAL REVOLUTION ON THE SUSTAINABILITY OF THE OCEAN ECONOMY IN KENYA

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INTRODUCTION

The Fourth Industrial Revolution fundamentally transforms the ocean economy, with Kenya actively embracing technological innovations. However, integrating advanced technologies such as Artificial Intelligence (AI) and the Internet of Things (IoT) presents challenges, including job displacement and cybersecurity risks.

This article examines the influence of the Fourth Industrial Revolution on the sustainability of Kenya's ocean economy by identifying opportunities, challenges, and strategies for development within the country's marine and coastal sectors.

By analysing the impact of the revolution on ocean economy sustainability, the article highlights the necessity for policy reforms and capacity building, which can thereafter enhance sectors such as agriculture, finance (FinTech), healthcare, and education.

FOURTH INDUSTRIAL REVOLUTION – AN OVERVIEW

The Fourth Industrial Revolution refers to a society where connected technologies and IoT bridge the digital and physical worlds to improve quality of life (Schwab, 2016). IoT enables everyday objects to possess identifying, sensing, networking, and processing capabilities,

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allowing communication with other devices and services via the Internet to achieve specific goals (Whitmore et al., 2022).

Artificial intelligence (AI) represents the capacity of robots to demonstrate human-like thinking and behavior, including perception, learning, interaction, and decision-making, often through machine learning techniques that enable independent problem-solving (Mueller & Massaron, 2019).

The holds significant potential to impact the sustainability of Kenya's ocean economy, presenting both opportunities and challenges. While the adoption of 4IR technologies is inevitable, it could pose environmental risks that require careful consideration (Leape et al., 2017).

Kenya's coastline boasts diverse marine and coastal ecosystems such as mangrove forests, coral reefs, terrestrial forests, sandy beaches, and seagrass beds, which contribute substantially to local and national economies. These ecosystems generate high biodiversity and productive waters, enhancing livelihoods and economic activities (Samoilys et al., 2015).

At both global and regional levels, Kenya is a signatory to key international conventions governing marine resources and ocean management. These include the United Nations Convention on the Law of the Sea (UNCLOS), which outlines nations' rights and responsibilities over ocean use; the Ramsar Convention on Wetlands of International Importance (1971), aimed at protecting wetlands; the International Convention for Prevention of Pollution from Ships (MARPOL), which addresses marine pollution by ships; the Nairobi Convention (NC), part of UNEP's Regional Seas Programme promoting regional cooperation for healthy rivers, coasts, and oceans; and the Southwest Indian Ocean Fisheries Commission (SWIOFC), which advocates sustainable use of living marine resources in the Southwest Indian Ocean region, including ecosystem-based fisheries management.

Kenya's ocean economy is rapidly developing, with significant investments such as the establishment of the blue economy fund. This fund supports initiatives promoting sustainable development and economic growth in marine and coastal sectors. The blue economy emphasizes sustainable use of ocean resources for economic growth, improved livelihoods, job creation, and ecosystem health.

Renewable marine energy exemplifies sustainable marine energy's role in socio-economic development. Fisheries contribute approximately US\$600 million to Kenya's GDP, with sustainable fisheries capable of increasing revenue, fish yields, and stock restoration. Marine transport is crucial, as nearly 80% of Kenya's imports and over 55% of its internationally traded goods are shipped by sea, with global trade volume projected to double by 2030 and quadruple by 2050. Ocean and coastal tourism generates about US\$4.1 billion annually in Kenya, creating jobs and economic growth. Climate change impacts such as rising sea levels, coastal erosion, altered ocean currents, and acidification pose serious threats, while oceans also act as vital carbon sinks mitigating climate change. Waste management remains critical, as 80% of ocean litter originates from land-based sources, necessitating improved land waste management to aid ocean recovery.

Kenya is committed to sustainable ocean management, including compliance with the FAO Port State Measures Agreement. Efforts to improve the livelihoods of ocean-dependent communities, such as fishers, are ongoing (Ociewo, 2010). Training programs for fishing crews are enhancing deep-sea fishing skills, and institutional capacity is being strengthened through the Kenya Fisheries Service.

OPPORTUNITIES

Sustainable Resource Management

A sustainable blue economy allows society to derive value from oceans and coasts while respecting their regenerative capacity and ecosystem health. Kenya is advancing sustainable resource management by improving maritime transport efficiency and implementing marine protected areas, fisheries management, and waste reduction initiatives.

The country aims to protect 30% of its oceans through highly protected marine areas by 2030. The Kenya Marine and Fisheries Research Institute (KMFRI) monitors marine litter nationally, supporting SDG Target 14.1 to significantly reduce marine pollution by 2025. Measures include bans on single-use carrier bags, a National Marine Litter Management Action Plan, and partnerships addressing plastic pollution and offshore oil spill prevention.

Fisheries management regulates fishing practices to maintain healthy fish populations and marine ecosystem sustainability. Kenya prioritizes sustainable fisheries to support socio-economic development and food security. The Kenya Fisheries Management and Development Act established the Kenya Fisheries Service (KeFS) to combat illegal, unregulated, and unreported (IUU) fishing and promote sustainable fisheries.

The National Fisheries Policy guides resource management and socio-economic goals. The Fourth Industrial Revolution integrates AI, IoT, and data analytics to enhance monitoring, control, and surveillance (MCS), improve traceability, and optimize resource use, thereby supporting sustainable fishing. Initiatives like the Global Fishing Policy and Project Eyes on the Seas utilize real-time vessel data and satellite imagery to detect illegal fishing and assist law enforcement.

Ocean-going drones provide timely ocean condition and fish stock data at reduced costs. Affordable DNA tests help identify species in ecosystems, while blockchain technology shows promise for tracing fish from catch to consumer (Leape, 2017).

Managing solid, liquid, and electronic waste poses significant ecological challenges for governments. Marine and coastal ecosystems face threats from solid waste impacting tourism, mangrove forests, and fisheries.

The Fourth Industrial Revolution advances waste reduction and marine pollution mitigation in Kenya through digital transformation and automation. Technologies such as IoT, AI, and data analytics support cleaner oceans by establishing efficient waste management systems.

Blue Biotechnology and Aquaculture

Marine life is a valuable source of novel genes and natural products with applications in medicine, food, energy, and bio-based industries (Suttle, 2013). Growing public demand for contamination-free seafood and declining natural marine habitats have accelerated blue biotechnology development.

Blue biotechnology utilizes marine and freshwater bioresources, leveraging molecular biology and microbial ecology to advance sustainable aquaculture. It applies scientific and technological innovations to aquatic organisms for products and services related to aquaculture (Hoang & Sieng, 2023).

The Fourth Industrial Revolution has created significant opportunities in Kenya's blue biotechnology and aquaculture sectors by enhancing aquaculture practices, fish health, and resource optimization. Small-scale onshore aquaculture combined with sustainable agroecological methods is improving food security and incomes for smallholder farmers. Agroecology increases yields while reducing environmental degradation through practices like

organic farming. Aquaculture supplies 58% of fish to global markets and, if managed well, can provide livelihoods, food security, and employment.

Data-Driven Decision-Making

Data-driven decision-making enabled by Fourth Industrial Revolution technologies such as AI, IoT, and cloud computing is transforming ocean management, fisheries, tourism, and shipping industries in Kenya. Data analytics optimises resource use, improves infrastructure, and supports informed decisions for a sustainable and resilient blue economy.

Kenya's marine fisheries have potential for expansion, but existing data on fish stocks are often outdated. Updated research incorporating climate change effects on western Indian Ocean fish stocks is needed. Precision aquaculture, which uses data analytics to optimize production and improve fish welfare, is replacing traditional methods. Sensors and cameras monitor critical water quality parameters like temperature, pH, dissolved oxygen, and ammonia, essential for fish health. This data-centric approach represents a paradigm shift in fish farming (Maina, 2024).

The Agulhas and Somali Current Large Marine Ecosystems (ASCLME) project focuses on the Western Indian Ocean region's large marine ecosystems, supporting data generation and encouraging small-scale fishers to explore non-traditional fishing areas. The Coastal Livelihoods Assessment (CLA) component collects information on coastal activities across nine countries, contributing to national Marine Ecosystem Diagnostic Analyses.

Marine Spatial Planning

Marine Spatial Planning (MSP) is advocated as a tool to allocate marine spaces for various activities to achieve ecological, economic, and social objectives within national planning frameworks. Sustainable ocean and biodiversity use depends on appropriate planning and management of human activities (Dr. Uku et al., 2023). Article 10(2)(a) of the Constitution of

Kenya, 2010, redefined spatial planning and development control, devolving responsibilities to county governments for preparing and implementing spatial plans, reflecting a multidimensional governance approach.

CHALLENGES

Job Displacement and Skills Gap

Digitalization, automation, robotics, AI, and machine learning have transformed workplaces (Buyana, 2022). The Fourth Industrial Revolution, characterized by AI and robotics, can automate tasks formerly done by humans, causing job losses in sectors such as fishing and port operations. Autonomous subsystems communicate to accomplish objectives, replacing operations that required human labor and decision-making (Tim & Lorig, 2015). Automation and digital solutions are replacing manual labor in container handling and cargo processing, raising concerns among port workers.

CONCLUSION

The Fourth Industrial Revolution is ushering in transformative changes to Kenya's ocean economy, presenting both unprecedented opportunities and complex challenges. The integration of advanced technologies such as Artificial Intelligence, the Internet of Things, and data analytics is enhancing sustainable resource management, optimizing fisheries and aquaculture, and enabling data-driven decision-making across marine and coastal sectors. These innovations are helping Kenya to better protect its rich marine biodiversity, improve waste management, and foster economic growth through blue biotechnology, marine transport, and tourism.

However, the rapid adoption of these technologies also brings significant hurdles, including the displacement of traditional jobs, the emergence of new skill gaps, and increased risks

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related to cybersecurity and environmental impacts. Addressing these challenges requires robust policy reforms, targeted capacity building, and ongoing investment in education and training to ensure that local communities can participate fully in the evolving ocean economy.

Kenya's commitment to international conventions, sustainable management practices, and the development of institutional frameworks demonstrates a proactive approach to harnessing the benefits of the Fourth Industrial Revolution.

By balancing technological advancement with environmental stewardship and social inclusion, Kenya can build a resilient, sustainable, and inclusive ocean economy that supports livelihoods, protects ecosystems, and contributes to national and global development goals.

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17. FROM CONCEPT TO CREDITING: THE JOURNEY OF ARTICLE 6.4 AND PARIS AGREEMENT CREDITING MECHANISM (PACM)

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INTRODUCTION

The Paris Agreement Crediting Mechanism [also known as Article 6.4] is a carbon crediting mechanism established under the Paris Agreement. The Paris Agreement is a legally binding international treaty on climate change, adopted by 196 Parties at the 21st session of the Conference of the Parties in Paris, on 12 December, and entered into force on 4 November 2016 (United Nations Framework Convention on Climate Change [UNFCCC], n.d., *The Paris Agreement*).

The Paris Agreement Crediting Mechanism is overseen by a Supervisory Body responsible for developing and managing the necessary requirements and processes for its implementation. On 16 May 2025, the UN-led Supervisory body adopted important new standards to guide how emission-reducing projects measure their impact. The rules adopted set out how to measure a project's actual emission reduction impact under the mechanism. Specifically, two key standards were agreed upon: one, *Baseline Emission Standard*, a standard for estimating the

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emissions that would have happened without a project under the mechanism [known as the 'baseline'].

Second, *Leakage Accounting Standard*, a standard for accounting for any unintended increases in emissions that might happen elsewhere as a result of a project [known as 'leakage'] (United Nations Framework Convention on Climate Change [UNFCCC], 2025, *Key Rules Agreed*).

The adoption of essential standards is a significant step towards improving climate accountability that will influence the future of carbon crediting globally. With these established core standards, the PACM is anticipated to expedite project implementation and initiate scaling up new PACM-based projects by 2026. This post explores the historical origins of PACM and its development.

TRACING THE PROGRESSION: KYOTO PROTOCOL TO PARIS AGREEMENT

The Conference of the Parties [COP] is the annual meeting of nations under the UN's Framework Convention on Climate Change [UNFCCC], established in 1992. As the main decision-making body, COP brings together governments and stakeholders to negotiate and enhance global efforts to reduce greenhouse gas emissions, adapt to climate impacts, and secure support for climate action.

COP has adopted significant agreements, including the Kyoto Protocol [1997] and the Paris Agreement [2015], involving participation from nearly all countries. The Convention, the Kyoto Protocol, and the Paris Agreement established three governing bodies: the COP for the Convention, the CMP for the Kyoto Protocol and the CMA for the Paris Agreement. The Bureau of the COP, the CMP (Conference of the Parties to the Kyoto Protocol [CMP], n.d., *Conference of the Parties...Kyoto Protocol*), and the CMA (Conference of the Parties to the Paris Agreement [CMA], n.d., *Conference of the Parties...Paris Agreement*) support the work of the governing bodies (UNFCCC, n.d., *Governing and Subsidiary Bodies*).

Over the years, COPs have shifted from setting principles to focusing on the implementation of climate goals. This year, the 2025 United Nations Climate Change Conference [COP30] is scheduled to take place in Brazil from November 10th to 21st, 2025. COP 30 will serve as a critical juncture for progressing international climate negotiations, particularly considering the pressing need to achieve the objectives set forth by the Paris Agreement.

The Kyoto Protocol, adopted on 11 December 1997, entered into force on 16 February 2005 after a complex ratification process. It has 192 Parties. The Kyoto Protocol is based on the principles and provisions of the UNFCCC Convention and follows its annexe-based structure. While the Convention asks countries to adopt mitigation policies and report periodically, the Kyoto Protocol commits industrialised nations to limit and reduce greenhouse gas emissions according to agreed targets (UNFCCC, n.d., *Kyoto Protocol*).

Countries with commitments under the Kyoto Protocol had to limit or reduce greenhouse gas emissions to meet their targets through national measures. Additionally, the Kyoto Protocol introduced three market-based mechanisms, i.e. Clean Development Mechanism [CDM], Joint Implementation [JI], and Emission Trading, which led to the creation of the carbon market. The CDM and JI are project-based mechanisms that support the carbon market.

The CDM facilitates investment in projects aimed at reducing emissions or enhancing removal in developing countries, contributing to their sustainable development. In contrast, JI allows developed countries to implement emission reduction or removal enhancement projects in other developed countries (UNFCCC, n.d., *Mechanisms under the Kyoto Protocol*). The projects produced Certified Emission Reductions [CERs], which could be utilised by nations to fulfil Kyoto's legally binding objectives.

The Paris Agreement, adopted in 2015, established a new climate framework that differed from the Kyoto Protocol by employing a more inclusive approach. It required all countries, both

developed [Annex I] and developing [Non-Annex II] to commit to Nationally Determined Contributions [NDCs]. The Paris Agreement comprises 16 introductory paragraphs and 29 articles.

ARTICLE 6 AND THE PARIS AGREEMENT: FROM CONCEPT TO IMPLEMENTATION OF ARTICLE 6.4

Article 6 of the Paris Agreement outlines how countries can pursue voluntary cooperation to reach their climate targets. It consists of nine paragraphs providing principles on how countries can “pursue voluntary cooperation” to reach their climate targets. These high-level principles were intended as a basis for countries to develop detailed rules on how to implement Article 6 in practice.

It enables international cooperation to tackle climate change and unlock financial support for developing countries. In November 2024, during COP29, a historical agreement was reached to operationalise Article 6, nine years after the start of the Paris Agreement. COP29, held in Baku, Azerbaijan, made a breakthrough in global climate action when nearly 200 governments agreed on a framework, an agreement which COP29 President Mukhtar Babayev called a ‘game-changing tool’.

Article 6 of the Paris Agreement sets out the principles for carbon markets and deals with carbon markets and emissions trading. Under Article 6, countries can transfer carbon credits earned from the reduction of greenhouse gas emissions to help one or more countries meet their climate targets. Article 6 defines cooperative approaches under Article 6.2, which allows countries to create bilateral agreements for emissions trading, providing more flexibility; establishes a new mechanism for mitigation and sustainable development within Article 6.4, which, as the successor to the CDM, establishes a centralised market for trading emissions reductions with enhanced safeguards for environmental integrity; and defines nonmarket

approaches within Article 6.8. Articles 6.2 and 6.4 collectively establish the foundation for the forthcoming carbon market framework.

Article 6.2 provides a decentralised framework for bilaterally or multilaterally defined cooperative approaches. Article 6.2 enables participating countries to collaborate bilaterally to trade carbon reductions and removals through the transfer of credits known as Internationally Transferrable Mitigation Outcomes [ITMOs] to achieve their climate targets, i.e., NDCs.

Buyers of ITMOs are typically governmental entities, though companies may also directly engage in these transactions. In 2022, supported by the United Nations Development Programme, Ghana and Switzerland, as well as Vanuatu, were the first countries that had authorized projects as part of Article 6 cooperative approaches for emissions reductions (United Nations Development Programme [UNDP], 2022). UNEP Copenhagen Climate Centre has set up an Excel-based database for Article 6 activities (UNEP Copenhagen Climate Centre, n.d.).

In contrast, Article 6.4 provides for a centrally governed mechanism for climate change mitigation and sustainable development. Article 6.4 of the Paris Agreement established a new international carbon crediting mechanism.

It replaces the Clean Development Mechanism (CDM), which experienced the 'Carbon Panic of 2012' (Kainou, 2022). The PACM is different from private carbon credit programs. It is an official system backed by the United Nations (UN). The Article 6.4 mechanism, also known as the Paris Agreement Crediting Mechanism has a Supervisory Body tasked with developing and supervising the requirements and processes needed to operationalise the mechanism. The Supervisory Body [SBM] is composed of 12 members from Parties to the Paris Agreement:

- (a) Two members from each of the five United Nations regional groups;
- (b) One member from the least developed countries; and

(c) One member from small island developing States (UNFCCC, n.d., *Article 6.4 Supervisory Body*). In 2021, at COP26 in Glasgow, the CMA adopted decision 3/CMA.3 (UNFCCC, 2022, *Report of the Conference...CMA Third Session*), which established the main framework through the “Rules, modalities, and procedures for the Article 6.4 Mechanism” [RMPs]. These RMPs outlined the governance structure, formation of the SBM, specified requirements for host countries, fundamental framework of the PACM activity cycle, share of proceeds [SoP] and overall mitigation in global emissions (OMGE), mechanism registry and its essential functionalities, and provided pathways for CDM activities that comply with all A6.4 RMP requirements to transition to the PACM (Kovács, Rodezno Ayestas, Greiner, & Georges-Picot, 2025).

Since its establishment, SBM has convened multiple times and collaborated with stakeholders to develop comprehensive standards, procedures, and tools for operationalising RMPs. Furthermore, SBM has advanced the regulatory framework concerning activities involving removals and the rules governing the application of PACM methodologies.

Between 2022 and 2024, the focus of SBM's efforts was centred on the development of standards related to removals and methodologies. The Supervisory body operates under the authority of the CMA, and it is fully accountable to the CMA. The UNFCCC secretariat serves as the secretariat of the Supervisory Body and supports the SBM in its work

Under the Article 6.4 mechanism, carbon credits known as ‘Article 6.4ERs’ will be issued under methodologies approved by a dedicated Article 6.4 Supervisory Body. Once the market becomes operational, project developers will seek registration of their projects with the Supervisory Body.

Approval from both the host country and the Supervisory Body is required before any project can begin issuing UN-recognised carbon credits. These credits, referred to as Article 6.4

emission reductions [A6.4ERs], once authorised, may be purchased by countries, companies, or individuals. Article 6 facilitates the transition of CDM projects to the 6.4 mechanism, provided that the host country grants approval and the project complies with the new regulations, excluding those pertaining to methodologies.

In March 2025, the PACM approved its inaugural project, a cookstove initiative in Myanmar. This marks a notable advancement for the United Nations-backed carbon credit system, which is designed to ensure high-integrity offsets. However, this approval was met with some criticism (Giles, 2025).

CONCLUSION

Since COP29, there has been considerable progress in operationalising various components of the mechanism. Nevertheless, numerous detailed standards, procedures, and guidelines remain under development, necessitating continuous monitoring in this dynamic environment.

Closely following the work of SBMs is significant for all stakeholders to truly support the development of a robust mechanism with environmental integrity that contributes to the achievement of the Paris Agreement goals (Qui, 2024).

The May 2025 development by SBM adopting important new standards to guide how emission-reducing projects measure their impact is a welcoming step in the direction essential for ensuring that carbon credits issued under the PACM are ambitious, real, additional, and verifiable.

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18. OCEAN GOVERNANCE THROUGH THE EYES OF SMALL ISLAND DEVELOPING STATES: HOW CLIMATE CHANGE AND BLUE ECONOMY TRANSFORMATIONS INTERSECT

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INTRODUCTION

In 2009 Maldivian President Mohamed Nasheed famously met his Cabinet six meters underwater to demonstrate the impending decline of the nation due to climate change. This action highlighted the fundamental contradiction of Small Island Developing States (SIDS).

They dominate huge oceanic areas yet are still highly vulnerable to sea level rise and weather extremes. In fact, most SIDS are only marginally higher than today's sea level, placing them among the very first to “sink” from uncurbed warming. Islands from Tuvalu to Dominica and even Panama's Guna Yala (Gardi Sug dub) have already experienced serious climate effects – Cyclone Maria had cost Dominica 226% of GDP in 2017, and Panama just relocated an entire

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island town because of tidal flooding. A loss and damage agenda driven by climate has therefore emerged.

Experts observe that for decades Caribbean SIDS have experienced climate disasters undoing development achievements, incurring “permanent financial stress and irreparable damage”. Legally, the ocean treaty regime enables and tests SIDS. Through UNCLOS (1982) – the “Constitution of the Oceans” – the coastal states gained exclusive economic zones (EEZs) to 200 nm, the extension of sovereign rights encompassing fisheries, mineral resources, and sea conservation. Following this reasoning, each SIDS is, in effect, a “Large Ocean State”.

On average, every SIDS has jurisdiction over about 28 times its land area in EEZ. Seychelles alone has a 1.37 million km² EEZ compared with only 455 km² of land. UNCLOS thus gives SIDS access to vast ocean richness – and a powerful legal voice in sea matters. But the Convention is agnostic on sea-level rise, and therefore the baseline and maritime claims of an island could, in theory, deteriorate with its coastlines.

SIDS have then started advocating for global guarantees of permanent boundaries and statehood even when lands are lost. Briefly, Ocean Law has provided SIDS jurisdiction and environmental safeguards but also raises tough questions of stability in a warming world. SIDS have leveraged their legal struggle into outsized diplomatic activism.

The Alliance of Small Island States (AOSIS) – the product of a 1989 Maldives summit – is generally seen as the “moral voice” of the UN climate process. From those early days the group called for a UN climate treaty and special recognition for low-lying islands.

Today AOSIS and related coalitions drive key initiatives – for instance, SIDS were central to the establishment of the Warsaw International Mechanism (WIM) for Loss and Damage in COP19 (2013) to compensate particularly for their climate losses. At latest COPs, SIDS leaders have repeatedly called for reparations for damages inflicted by global warming – as Antigua

Prime Minister stated in 2022, “Those who contributed least to the climate crisis are reaping the whirlwind.” On ocean matters, SIDS also played a role in the new Biodiversity Beyond National Jurisdiction (BBNJ) treaty, now finalized, arguing it must “give due recognition to the unique conditions of SIDS”. SIDS are currently rallying ratification and capacity-building to obtain secure, equitable access to high-seas resources under BBNJ.

Overall, SIDS have used law and negotiation to convert their weaknesses into leverage – they advocate for loss-and-damage funding within climate discussions. and the sustainable use of marine resources in maritime discourse.

Politically, SIDS span broad power relations. Most Pacific and Caribbean island states formally subscribe to being “friends to all and enemies to none” in the midst of growing US-China competition, asking for help while protecting neutrality.

They prefer to act regionally in blocs (Pacific Islands Forum, CARICOM, Indian Ocean Commission) in order to be heard more. To give an example, Pacific SIDS rebranded themselves as “large ocean states” in negotiations such as Rio+20, advocating the Blue Economy idea and obtaining a specific ocean SDG (SDG14).

They also place a strong emphasis on ocean governance sovereignty: at the UN General Assembly (2024), Tuvalu requested permanent recognition of its maritime boundaries to avoid legal erasure by rising sea levels. Moreover, other coastal SIDS, such as Panama, are already undergoing displacement: In 2024, Panama’s Guna people were displaced when increased tides inundated their island, which will be uninhabitable by 2050.

Combined, these examples demonstrate the ways in which SIDS change geopolitics – capitalizing on normative efforts (climate commitments, Sustainable Development Goals) and local cooperation to shield their independence, even while great powers more and more compete for hegemony in their seaways and bases. Economically, SIDS resilience is defined

and challenged by ocean-based livelihoods. Tourism and other marine and fisheries sectors pay more than half of SIDS' GDP. Some of them depend on tuna, coral reefs, and even nascent seabed minerals as revenue sources. Seychelles, for example, has codified this paradigm – its 2018 Blue Economy strategy introduced the world's first sovereign blue bond and a \$21.6 million debt-for-nature swap to marine finance and fisheries reform.

Similarly, Mauritius leads the blue economy via environmentally friendly fishing methods and marine scientific research since it emerges from previous colonial legacies. Such opportunities are balanced with strong constraints. SIDS are faced with high transport costs, limited economies of scale, and inadequate infrastructures.

They take huge loans – and at a high price. From 2016–2020, SIDS distributed about 18 times more in debt servicing (US\$26 billion) than they received in climate adaptation finance (US\$1.5 billion). Heavy debt burdens (usually foreign currency denominated) now constrain the very investments needed for climate and blue-growth resilience.

In response, some SIDS have pioneered new finance: aside from Seychelles' bond and swap, Caribbean governments have tried climate-related taxes and insurance products. However, robust external support is still necessary – just what SIDS emphasise. They highlight the assertion that their sustainable development will rely on stable ocean and climate governance. Briefly, the preface to this volume determines how SIDS are transforming ocean governance at the intersection of climate and blue economy.

They establish the priority of UNCLOS rights in the legal sense and look for new tools (from BBNJ to Loss & Damage mechanisms) to fit climate realities. Geopolitically, they are a collective voice to be reckoned with in spite of having their oceans ringed by great powers. They economically pursue “blue” development (tourism, fisheries, seabed resources) while coping with debt, infrastructure deficits, and climate loss. As World Ocean Day 2025

approaches, these small states in reality punch well above their weight – leveraging their oceanic fragility as a foundation for progressive reform on the the largest platform globally.

CLIMATE CHANGE FUNCTIONS AS CATALYST FOR OCEAN GOVERNANCE

Socio-economic policies are the main instrument to bring SIDS's ocean governance on the right track. The negative effects are devastating and multifaceted.

Existential Problems

One of the most prominent is the direct threat posed to the integrity and sovereignty of states by the rising of the sea level. This means that 50% of the capital city of Tuvalu will be submerged in seawater by 2050, and 80% of the Maldives will be living in an area situated on the seashore where the land is less than a meter above the sea level (IPCC, 2019).

Economic Loss

Over the 50 years from 1970 to 2020, SIDS lost \$153 billion (World Bank, 2021), which is 11.2% more than their average annual GDP in this period. Such financial fragility reflects in the strategic stance of ocean governance, knocking at the resilience-building and adaptation strategies.

Social and Cultural Consequences

Cultural routes are the hardest to rethink, as they are truly threatened by climate processes, leading to the displacement of indigenous communities, e.g., the relocation of 300 Guna families from Panama's Gardi Sug dub island (IOM, 2023).

The ocean governance challenges created by climate change are the driving force propelling SIDS to champion aggressive action and progressive rights-based ocean management measures. Their continued commitment resulted in the integration of the 1.5 °C temperature

with the Paris Agreement and the establishment of the Warsaw International Mechanism for loss and damage (UNFCCC, 2015; UNFCCC, 2013).

THE ‘BLUE ECONOMY – THE BLUEPRINT FOR SUSTAINABLE MARINE EXPLOITATION

SIDS capitalizes the Blue Economy panopticon as the last word in ocean governance, marrying environmentally friendly business with economic development. This idea is the set-up that will completely alter the traditional way of doing business to the use of sustainable grants by the marine community of experts.

Policy Innovations in Blue Economy Governance

The Seychelles was the forerunner in this debt-for-nature swap initiative back in 2018. \$15 million were accumulated with the help of oil bonds, which in turn infused financing to the blue projects that were to improve marine and fisheries. Such a financial innovation proves the fact that the SIDS are advancing in presenting ways in which Bridging of natural capital and economic development (*Seychelles Government, 2018*).

MSP, Marine Spatial Planning—countries like the Seychelles have gone ahead to initiate comprehensive marine planning programs that encompass the whole of their EEZs. Such MSPs aggregate various economically valuable activities, such as fisheries, tourism, energy, and conservation, under a unified governance structure.

In 2020, the Seychelles created history by becoming the first country to exchange a part of their international debt by designating nearly 30% of their ocean territory as marine protected areas for adaptation to climate (Seychelles Government, 2020). This paradigm of leadership shows the leaders of SIDS who are harnessing the marine assets for public debt saving while promoting conservation (Commonwealth Secretariat, 2021).

BLUE ECONOMY SEGMENTS AND POLICY CHALLENGES

The focus of SIDS is on a multi-sectoral approach that will allow the diversification of the economy away from dependability on the fisheries and tourism sector primarily.

Firstly, Legalised Fisheries as well as Aquaculture- from the traditional fishing bringing the integrated aquaculture of modern to an advanced sustainable fisheries management.

Secondly, Sea Biotechnology, because of which, scientists can try to find pharmaceutical and industrial usage of marine organisms.

Thirdly, Ocean Energy (Renewable) through which transformation of offshore wind, tides and the ocean's thermal bore energy systems is possible.

And lastly, Sustainable Marine Tourism- whereby there is consideration of the financial benefits of tourism and how these match up with efforts to conserve our oceans' ecological systems.

The case of each of these areas calls for optimised governance landscapes that touch on development goals and environmental preservation. Many SIDS look to integrate governance arrangements that incorporate local knowledge and science.

INDIGENOUS KNOWLEDGE AND LOCAL KNOWLEDGE INTEGRATION

SIDS' unique approach to the ocean governance sector is that it combines the Indigenous and Local Knowledge (IKLK) with the conventional science. By doing so, this was one of the ways of acknowledging that the local people are valued as well as the modern ones.

Pacific Innovations

Indigenous research methodologies in emerging areas of research in the Pacific Islands are beginning to incorporate their own beliefs directly into existing conventional approaches,

which is a sign of rebellion and the resurgence of local knowledge against past colonization biases in scientific research.

Caribbean Networks

Scaling up the Climate Action–Caribbean Local and Traditional Knowledge Network is a vehicle used to bridge the gap between local and indigenous communities with respect to the way the climate change process is happening.

The Indigenous knowledge application does not go along with the Western ocean governance paradigms. The latter cannot stop at just adjusting but must offer alternative local practices that complement the available managerial knowledge.

INTERNATIONAL CONSULTATION AND NETWORKING FORMATION

SIDS have strategically capitalized on their distress to promote their voices on global ocean governance. The Association of Small Island States (AOSIS), launched in 1990, is a clear example of how powerful the unity of SIDS can be.

KEY GOVERNANCE ACCOMPLISHMENTS

Climate Accord

Agrarian Nations in general and AOSIS in particular have succeeded in getting concerned parties to acknowledge the need for meeting SIDS' special circumstances in the UN Framework Convention on Climate Change. For that matter, AOSIS, again, has led in terms of organising the adaptation financing efforts.

Loss and Damage

SIDS urged the creation of the Warsaw International Mechanism for Loss and Damage in 2013 with an undoubted need to establish international frameworks to facilitate addressing all kinds of climate-related losses.

Security Council Intervention

SIDS took the centre stage through their discussions to have climate change be considered by the UN Security Council as a security threat, given that sea-level rise not only displaces the communities but also threatens the territorial sovereignty of these islands.

The hurdle may be that the innovative approaches of SIDS are pitted against massive challenges around governance

Financing Disparities

In 2019, although the Small Island Developing States confronted disproportionately heavy impacts attributed to climate changes, \$1.5 billion was the total sum of the \$100 billion finance commitment. This kind of disproportion hinders their role in governing the ocean.

Technical Capacity Constraints

Ocean governance is usually too complex for SIDS to undertake properly due to the low level of personnel in the islands, brain drain and the tiny capacity of the local scientific force. Compliance takes a toll on compliance for many SIDS, as they find difficulty in managing the cost that emanates from compliance and technical regulated by international governance.

Scale Mismatches

Smaller administration of SIDS does not take into account the national peculiarities in global governance; therefore, new obligations put heavy burdens of compliance on these islands that can lead to their economic downturn. Instead of focusing the resources on vital local governing needs, nature gets the bigger share through the funding framework that stresses the ‘global rhetoric of funding’.

Science-Policy Integration Challenges

In order to use the scientific insights in their policies, SIDS face specific issues: Visibility Reduction. SIDS scientists and research institutes are not only few but also have lower research visibility in the World leading to less participation in major world assessment reports like those of the IPCC.

Capacity Building Challenge

This is because SIDS are not one of those countries that have science education programs that are reliable and well equipped to provide the needed capacities to develop real ocean governance.

Frameworks in Governance

The challenges, such as the high finances, human capacity issues due to the. SIDS are, however, leaning towards a technology-friendly solution. Multi-Scalar Governance. SIDS are establishing mechanisms and governance frameworks that function across different scales, including control by local communities, cooperation of the region, and advocacy at the international level. Such a multilevel method lets SIDS' territories be the center point of different levels of governance to, thus, give maximum impact.

Adaptive Management

As a response to the ever-changing nature of their environment, SIDS are employing adaptive management strategies that allow for speedy policy changes based on environmental updates.

Partnership-Based Governance

SIDS tend to prefer partnership-centric governance models that make use of international cooperation models, South-South and public-private collaboration in order to eliminate the effects of reduced human capital. Regional Cooperation and Governance Networks.

Regional cooperation is a key factor in SIDS' ocean governance:

Pacific Partnerships

The Pacific Community, as well as the Secretariat of the Pacific regionally Environmental Programme, contributes to SIDS around the Pacific Ocean by providing science-based recommendations on water, sanitation, disaster risk reduction, and food security. Caribbean Integration. Towards this goal, CARICOM SIDS has initiated the implementation of an integrated approach to ocean governance that capitalizes on their common maritime spaces and aquatic biodiversity.

Cross-Regional Learning

SIDS from various corners of the world find common ways of learning and improving the existing governance through several networks like CAS and Pacific, which are emerging. Future Directions and Policy Recommendations.

Institutional Innovations

SIDS have urgent budgetary needs, making innovative financing solutions essential. Instruments such as the Blue and Green Climate Funds, as well as structured access through frameworks like the Green Climate Fund (GCF) and Common Pooling for Climate (CPC) mechanisms, should be prioritized. Capacity development should include infrastructure enhancement and the provision of technical skills. Additionally, access to SIDS-relevant technology and governance tools must be improved.

Global Governance Reform

A radical change calls for a reformation of SIDS concerning international governance: Blue-hemmed compliance measures to suit SIDS. Enhancement of the status of SIDS as large ocean

states in international laws. SIDS should be granted more representation in the international governance bodies.

Deep-Sea Mining: Addressing Legal Vacuums

Deep-sea mining, as the collection of minerals in seabed zones by exploiting new technologies, is causing growing public and governmental questions. The International Seabed Authority (ISA), under UNCLOS, oversees seabed minerals, but the final details of the rules that regulate exploitation – 30 years after its adoption – are still not agreed.

In fact, exploration licences are issued by the ISA in areas totalling approximately 31 fans km². Specific terms for the mining regulations and codes should be agreed upon between now and 2025. Another helpful measure for achieving the set target could be technological assistance from international scientific communities.

This deadline has spurred a push and pull among SIDS – some, like Nauru and Kiribati, have pushed for rapid wildfire industrialization, intending to start commercial mining in 2025 if the rules are not precise. On the other side, other SIDS, like Fiji, Tuvalu, and Vanuatu, have raised concerns over the issue (fisheries, biodiversity, and sea-floor integrity) and want to have a precautionary moratorium on deep-sea mining.

One of the examples is the recent expeditions that reveal some spectacular sea-floor vents and coral ecosystems, which were already thought to be without any life. In conclusion, the fact for SIDS is that they are in the bind of a strategic choice; they can go after mineral revenues or just simple environmental restraint. Currently, there is a standstill, which is shared across a gap – according to UNCLOS, the rights to deep-sea minerals should be equal and in the interest of the entire world, but this is hard to achieve without the final erg or international consensus; interest in DSM is in limbo.

MARINE GENETIC RESOURCES AND THE HIGH SEAS TREATY

Marine environmental governance, which is related to marine genetic resources (MGRs) along the high seas, is highly dependent on both state and non-state actors for best practices. The new BBNJ Agreement, the result of oceanic habitat, finally addresses the access and benefit-sharing of MGRs that we have been experiencing for a long time under UNCLOS.

In a remarkable development of late, the Maldives ratified the BBNJ Agreement in 2023, approximately 13 months later in the 2024 ratification process, with immediate effect. The BBNJ Agreement came into force in 2013 by the third nation (Maldives) out of the thirty-one parties that ratified or became a party to that agreement.

This makes the Maldives a full party to those rules. It is plain that provisions such as minimisation of environmental impact (EIA) and fair share of the benefits of genetic resources (ABS) are most probably intended to change the situation of SIDS. The BBNJ Treaty that is mentioned above is a legal tool that Indian Ocean SIDS are looking forward to in order to ensure their sustainable use of biological diversity in the high-seas.

It offers both the protection of the environment and the promise of collaborative research and trade agreements. These developments underline how SIDS have to make sure to participate in law-making activity over the ocean. The Maldives and its SIDS peers are using UNCLOS-derived agreements (e.g., the BBNJ Agreement) to assert their rights to control the use of ocean genetic resources worldwide.

HARNESSING DATA: GIS, DIGITAL TWINS, AND OCEAN AI



Figure 1: Ocean Technology – Ocean data science allows for the progression of ocean knowledge and the assurance of improved ocean conservation methods, allowing for better tracking and control of ocean pollution.

To picture “Deep Sea Eras”, we should start with the deep-sea mining, deep-sea creatures, and soft corals. Rugged terrains along the Indonesian archipelago, shallow waters of Eastern Australia, and extant ocean currents are zones rich in biodiversity in which ocean tools are applied with extreme caution. These ecosystems, once considered barren, have revealed complex biodiversity that must be protected.

Digital data technologies allow for a new ocean management approach in SIDS communities. Marine (spatial) planners of the islands, through the use of Geographic Information Systems (GIS) and satellite/digital mapping, are in the know about ocean geography and human use of the sea resources.

For example, a tiny island nation like Tuvalu has already embarked on the process of creating a digital twin of its Funafuti Atoll. A 3D model of the islands and reef is being generated with the help of drones and ground surveys, thus helping planners to predict sea-level rise and storm impacts for future development. Similarly, Grenada (Eastern Caribbean) has developed a

digital model of its terrain and coastal waters as a scenario depicting scenarios of varying sea levels and hurricanes. These digital twins compile different kinds of data sources, like satellite imagery, bathymetry, and climate models, to form a single interactive platform. In essence, it places the whole “ocean system” into their fingertips – legislators can therefore test if such spatial plans or the conservation methods meet their requirements and see the estimated outcomes immediately.

Their implementation of data-driven measures has been pivotal for SIDS to develop an evidence-based MSP and observe the alterations in coral reefs, fishing stocks, and coastal infrastructure. The fact is that OBIS is useful only if the data generation systems have a geolocation; this solution allows the SIDS to manage their fishing fast enough. Combined with GIS technologies, Ocean Use Surveys monitor how fishing, tourism, and communities use coastal waters, significantly contributing toward the piloting of marine spatial plans in countries like the Maldives.

Finally, the creation of ocean data platforms and twins is providing the type of information transparency and evidence-based policy-making capabilities that are sorely lacking in most SIDS.

Artificial intelligence (AI) is another game-changer for ocean monitoring. In standards, AI is applied to data related from the ocean, like satellite and radar imagery techniques, using the search for which humans will face the difficulties of finding. Machine learning can be regarded as a striking example in the surveillance.

Global Fishing Watch uses it to sift through billions of satellite data postings of up to 65,000 vessels. Implementing such tools, SIDS will be able to do such activities and services as AI-driven vessel detection, species recognition through underwater imagery, and predicted habitat shifts: AI technologies are currently applied to observe oceanic conditions such as currents,

biodiversity, and climatic trends, as well as other factors that affect the global climate change, is the trend that SIDS ought to consider making their oceans safer.

CONCLUSION: CHARTING THE COURSE FORWARD

Small Island Developing States have transformed from vulnerable climate victims to innovative leaders in global ocean governance. Their strategic approach successfully integrates environmental stewardship with economic development, combining local expertise with diplomatic innovation to create transformative frameworks for international marine governance.

Former President Danny Faure of the Seychelles captured this transformation, positioning the blue economy as "the next frontier in our development". This vision represents a fundamental paradigm shift where traditional ocean management must evolve to address climate challenges while maximizing sustainable marine resource utilization.

The symbolic underwater parliament demonstrated both SIDS governance innovation and existential urgency. Despite facing severe climate impacts, including projected submersion of 50% of Tuvalu's capital by 2050 and \$153 billion in climate-related losses over five decades, SIDS continue developing solutions that balance national survival with global environmental responsibility.

SIDS governance innovations provide exemplary models for climate-era ocean management. Sovereign blue bonds, debt-for-nature swaps, traditional knowledge integration, and regional cooperation networks demonstrate how small states can leverage unique positions to create sustainable solutions benefiting local communities and global environmental health. The displacement of 300 Guna families from Panama's Gardi Sugdub island illustrates that these strategies address fundamental questions of cultural survival and human dignity.

The blue economy framework has enabled comprehensive approaches to sustainable marine resource exploitation through marine spatial planning, integrated traditional-scientific knowledge systems, and multi-sectoral development encompassing fisheries, biotechnology, renewable energy, and tourism. Regional networks including AOSIS, the Pacific Community, and CARICOM have amplified SIDS voices internationally while facilitating crucial knowledge sharing.

SIDS leadership in developing climate-responsive regulatory frameworks operates through evolving global instruments, including the BBNJ Agreement and UNCLOS. The Maldives' early BBNJ ratification demonstrates commitment to establishing equitable high-seas governance frameworks addressing environmental impact assessment and benefit-sharing provisions.

Deep-sea mining governance reflects SIDS strategic diversity, with some nations advocating rapid resource development while others support precautionary moratoria. This range of perspectives contributes essential nuance to global policy development.

Technological advances, including Geographic Information Systems, digital twins, and artificial intelligence applications, enable effective management of extensive maritime territories while providing transparent, evidence-based policy-making capabilities that enhance both domestic governance and international credibility.

The comprehensive SIDS approach, combining legal innovation, technological advancement, traditional knowledge systems, and diplomatic leadership, offers a robust model for contemporary ocean governance challenges. Their transformation represents a fundamental shift in global environmental politics, providing essential guidance for sustainable and equitable international marine stewardship.

Success requires continued recognition of SIDS as legitimate large ocean states, enhanced international support for their governance innovations, and broader adoption of their integrated approaches to ocean management.

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