MITIGATING CLIMATE CHANGE IMPACTS ON THE BLUE ECONOMY IN INDIA: THE ROLE OF ADAPTIVE STRATEGIES

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ABSTRACT

The sustainable use of ocean resources for economic growth, improved livelihoods, and preserving the ocean's ecosystem health is coined as blue economy. However, the ocean's resources are subject to overexploitation, marine pollution, and climate change, which significantly affects the blue economy in India and other countries in the Indian Ocean Region. it is imperative to balance conservation and resource extraction when developing ocean-based economy, through restoration and adaptation measures suggested by soft laws.

Keywords: Blue economy, climate change, sea level rise, vulnerability, adaptative measures, sustainable ocean economy and their legal implication.

1. Introduction

Climate change is "*a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere…"*[1] Climate change impacts land and sea differently because the ocean acts as a buffer, soaking up carbon dioxide emissions. The oceans also represent a potential or at least a partial solution for climate change.[2] The 21st century's Law of the Sea faces a critical test: navigating the tension between harnessing ocean resources and safeguarding its delicate ecosystems.[3] Scientific research now underpins an improved policy understanding of the impacts climate change on the oceans,[4] poses challenges particularly pertinent for coastal states reliant on the ocean economy. [5]This article discusses the ramifications of climate change on the blue economy and explores legal measures aimed at mitigating climate change effects and implementing adaptation strategies for a sustainable ocean economy.

2. Marine Pollution and Climate Change

It is crucial to acknowledge that shipping operations contribute to various forms of marine pollution which exacerbate the impacts of climate change. Oil exploration and transportation activities are another factor contributing to pollution. These activities carry the inherent risk of oil spills, which can have a detrimental impact on the ocean's capacity to absorb carbon dioxide. Geneva convention in 1958[6], pay a little attention, merely places a general obligation upon every state to draw up regulation to prevent pollution of the sea by the discharge of oil form ships and pipelines or resulting from exploitation and exploration of sea bed activities and its sub soil. These obligations were slightly amplified by UNCLOS. Article 208(1) obliges the coastal states to adopt laws and regulations to prevent, reduce and control pollution of the

[1]United Nations Framework Convention on Climate Change, Dec. 9, 1992, 1771 UNTS 107 [hereinafter UNFCCC], article 1(2).
[2] MYRON H. NORDQUIST ET AL., LEGAL ORDER IN THE WORLD'S OCEANS: UN CONVENTION ON THE LAW OF THE SEA (Brill | Nijhoff 2017).
[3] Scott, Karen N. "Legal Aspects of Climate Change." *The Future of Ocean Governance and Capacity Development: Essays in Honor of Elisabeth Mann Borgese (1918-2002)*, edited by Dirk Werle et al., Brill, 2018, pp. 169–74. *JSTOR*, http://www.jstor.org/stable/10.1163/j.ctv2gjwvhb.35. Accessed 13 Feb. 2024.
[4] Karen N. Scott, *Legal Aspects of Climate Change* 169 (Brill | Nijhoff 2019).
[5] Voigt, Christina. (2023). Oceans and Climate Change: Implications for UNCLOS and the UN Climate Regime. 10.1017/9781009253741.006.
[6]Convention on the continental shelf 1958,
https://legal.un.org/ilc/texts/instruments/english/conventions/8_1_1958_continental_shelf.pdf

marine environment arising from or in connection with seabed activities.[7]

And the special requirement for floating or fixed platforms engaged in sea bed activities was provided by the MARPOL under regulation 39 of Annex I.[8] MARPOL annex I regulates the oil pollution from ships, which sets limits on discharge into the sea of oil or oil mixtures from ships. the amendment of the MARPOL is intense pressure rise from marine environment disasters. The Exxon Valdez 1989 incident prompted states to introduce the double hull requirement through 1992 amendment and the more stringent action for phasing out single hull ships. These measures are taken to prevent the chance of oil pollution and its adverse effect.[9]

India's position as the third-largest player in ship recycling shows its significance in the global competition within this industry. The Inventory of Hazardous Materials (IHM) serves as a vessel-specific document, encompassing the ship's entire lifespan, from construction to destruction and its alignment with the principles of the blue economy.

The Basel Convention[10], established in 1989, forms the basis for hazardous material inventory requirements. Hazardous materials like asbestos, lead, PCBs, and other toxic substances are integral parts of End-of-Life (EOL) ships. Once a ship is designated for disposal, it falls under the Basel Convention's jurisdiction, subject to restrictions and the Prior Informed Consent (PIC) requirement. The Hong Kong Convention 2009**[11]** establishes a set of regulations for the design, construction, operation, and maintenance of ships to ensure their safe and environmentally sound recycling, Which applies to both vessels' going for recycling and others which are still operational,[12] shall be designed and provide utilisation of IHM in building ships on compliance with convention. However, the convention does not prohibit the beaching method, prompting the EU to adopt the Ship Recycling Regulation (EU SRR)[13] with stricter

[7] UNCLOS, article 208.
[8] International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 ("MARPOL 73/78"), Annex I, reg. 39.
[9] Harrald, John R., et al. "The EXXON Valdez: An Assessment of Crisis Prevention and Management Systems." Interfaces, vol. 20, no. 5, 1990, pp. 14–30. JSTOR, http://www.jstor.org/stable/25061397. Accessed 14 Feb. 2024.
[10] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Mar. 22, 1989, (entered into force May 5, 1992) [hereinafter Basel Convention].
[11] Honkong convention 2009, https://www.imo.org/
[12] Mazyar Ahmad. "Ship recycling in India environmental stock taking", Indian Law Review, 2022
[13] REGULATION (EU) No 1257/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 20 November 2013, https://eur-lex.europa.eu/

standards, including the prohibition of beaching, downstream toxic waste management, and labour rights protection.

Disrupting Effect of Climate Change in the Blue Economy:

The idea behind the blue economy revolves around the responsible utilization of ocean resources to stimulate economic advancement, improve living standards, generate job prospects, and preserve the well-being of marine environments. The Blue Economy links resource production and consumption with capacity-building and adopts a unified strategy for economic growth.[14] The concept of the blue economy emerged in 1994, proposed by Professor Gunter Pauli at the United Nations University. The emphasis on "zero waste and zero emissions" a strong commitment to environmental accountability. Subsequently, after the Rio+20 Conference in 2012, [15]there was an increasing focus on the importance of the blue economy. Its importance was further emphasized when it was designated as Sustainable Development Goal 14 by the United Nations.[16] In addition to traditional ocean activities such as fisheries, tourism, and maritime transport, the blue economy encompasses emerging industries including renewable energy, aquaculture, seabed extractive activities, marine biotechnology, and bioprospecting. Considering various definitions' advantages and disadvantages India has put forth a working definition: "Blue Economy refers to exploring and optimizing the potential of oceans under India's legal jurisdiction for socio-economic development while preserving their health". This comprehensive Indian definition covers multiple dimensions of oceanic activities.[17]

The Climate Change poses a significant threat to the blue economy due to its potential to disrupt ocean ecosystems and coastal regions, consequently affecting vital resources and industries. These changes pose risks to marine biodiversity, fisheries, aquaculture, tourism, and coastal infrastructure, thereby impacting the livelihoods of coastal communities and economies dependent on marine resources.[18] With nearly half of the global population expected to reside

[14] Smith-Godfrey, Defining the Blue Economy, Maritime *Affairs, 2016Volume 12, Issue 1, Pages 58-64*
[15] Bennett, Cisneros-Montemayor, Blythe, Silver, Singh, Andrews, Calò, Christie, Franco, Finkbeiner, Gelcich, Guidetti, Harper, Hotte, Kittinger, Billon, Lister, Lama, McKinley, Scholtens, Solås, Sowman, Talloni-Álvarez,
[16] M. Fusco, S. Schutter, M. Cisneros-Montemayor *Sustainability, 2022,* Oil, Transitions, and the Blue Economy in Canada, *Volume 14, Issue 13, Pages 8132-8132*
[17]Bari, Elsevier BV, 2017 Our Oceans and the Blue Economy: Opportunities and Challenges, Volume 194, Pages 5-11, 10.1016/j.proeng.2017.08.109.
[18] Weatherdon, Magnan, Rogers, Sumaila, Cheung, Observed and Projected Impacts of Climate Change on Marine Fisheries, Aquaculture, Coastal Tourism, and Human Health: An Update, Frontiers Media, 2016 Volume 3, 10.3389/fmars.2016.00048

in countries bordering the Indian Ocean Rim (IOR) by 2050,[19] the region holds significant economic, strategic, and environmental importance. Moreover, the IOR boasts a diverse range of natural resources, both on land and in the sea, crucial for the welfare of its inhabitants, as well as for trade and environmental stability, however it is also subjected to the risk of climate change.

1. Impact on Small Island States:

Climate change also heightens threats to coastal regions, with rising sea levels and more frequent extreme weather events triggering erosion and inundation, confront a stark reduction in maritime territory, heightening their vulnerability to climate change. Accelerated sea-level rise and associated coastal impacts are likely to put the goal of sustainable development out of reach for small island states.[20] The Indian Ocean Region (IOR), the third largest oceanic region, has a population of 2,538.41 million (36.40 percent of the global population)[21]. It is a politically and culturally diverse region with an array of socioeconomic status. The IOR economy depends on fisheries and aquaculture, tourism, port infrastructure and related services, shipping, and offshore oil and gas. Given that much of the population and economic activities are concentrated in these coastal areas threatens their region's economy.

The recent report of Intergovernmental Panel on Climate Change on Ocean and the Cryosphere concludes that sea level is rising at faster rates than previously predicted and could reach 1.1 meters by 2100. Small Island States, particularly low-lying ones, are at the front lines of experiencing the adverse impacts of sea level rise and the profound consequences this brings for people and ecosystems.[22] Thus, various countries during the Small Island States Conference on the Human Dimension of Global Change in 1989 adopted the Male Declaration on Global Warming and Sea Level Rise. SIDS have been continuously involved in the developing climate dialogue since the Male Declaration. The declaration highlights: *"Small islands, low-lying coastal, and atoll states are particularly vulnerable to even small changes to the global climate*

[19] Timothy Doyle (2018) Blue Economy and the Indian Ocean Rim, Journal of the Indian Ocean Region, 14:1, 1-6, DOI: 10.1080/19480881.2018.1421450

[20] John C. Pernetta. "Impacts of climate change and sea-level rise on small island states", Global Environmental Change, 1992

[21]Dominique Benzake, Blue Economy in the Indian Ocean Region: Status and Opportunities, http://www.jstor.com/stable/resrep05888.14

[22] "Sea Level Rise and Implications for International Law," panel discussion hosted by the Permanent Missions of New Zealand, Peru, Portugal, Romania and Turkey, sponsored by the Alliance of Small Island States, the Pacific Island Forum and the Permanent Mission of Liechtenstein, held on Tuesday, October 29, 2019.

and are already adversely affected by alterations in ecosystems, changes in precipitation, rising sea levels and increased incidence of natural disasters.[23]

2. Impact on Fisheries:

Climate variability has resulted in alterations in oceanic temperatures and oxygen concentrations, consequently influencing the dispersion and population sizes of various fish species. As sea levels rise and ocean temperatures increase, vulnerable fish species migrate towards polar regions, leaving those unable to travel long distances susceptible to mortality, while deep-water fish ascend due to deoxygenation, leading to their over exploitation of fishing and disrupting fishing-dependent communities unable to fish within their maritime zones. fisheries human security is questioned. In 2018, the total global capture fisheries production reached the highest level ever record at 96.4 million tonnes- an increase of 5.4 percentage from the average of previous three years.[24]

However, The UNCLOS set the obligation on the state to conservation of marine living resources and utilization of marine living resources article 61 and 62 of UNCLOS.[25]by implementing proper conservation and management measures based on scientific evidence to prevent over-exploitation, regulating fishing activities through licensing fishermen, vessels, and equipment, Combatting illegal, unreported, and unregulated (IUU) fishing through regulatory measures.

Climate Change and its Legal Implication

States have been sluggish in acknowledging the significance of climate change for the oceans, unlike their recognition of its impact on the atmosphere and biosphere. The subordinate status of the oceans in the climate regime is perpetuated by the 1992 United Nations Framework Convention on Climate Change (**UNFCCC**) itself, which pays scant attention to both the impacts of climate change on the oceans. And the 2015 Paris Agreement, which establishes a global average temperature increase target of "well below 2°C above pre-industrial levels" with

[23] Mali Declaration on Global Warming and Sea Level Rise, adopted by the Small States Conference on Sea Level Rise, held in Mali, Maldives, 14-18 November 1989, UN Doc. AIC.2/44/7, 22 November 1989, Annex, at 2 et seq.
[24] Ibid 21.
[25] Article 61 and 62, UNCLOS III 1982.

the aim of limiting the increase to 1.5°C.[26] there has been minimal discussion as to the implications of a 2°C rise for the oceans, and there is no comparable target relating to ocean pH change. Although the 1982 United Nations Convention on the Law of the Sea (UNCLOS III) purports to provide a constitution for the oceans, comprehensive in regulatory scope, it is not the primary regime for climate change mitigation. [27] Lawmakers did not consider the effects of climate change on marine biodiversity when developing the UNCLOS in the 1970s and early 1980s.

Pollution, as defined in Article 1(1)(4) of UNCLOS, refers to the introduction of substances or energy into the marine environment by humans, resulting in detrimental effects on marine life and human health. Anthropogenic CO2 falls under this definition and The obligations outlined to safeguard and conserve the marine environment, as well as to prevent and mitigate all forms of marine pollution, are undoubtedly broad enough to encompass anthropogenic climate change and ocean acidification. [28] In the South China Sea Arbitration, the Permanent Court of Arbitration stated unequivocally that the obligation under UNCLOS to 'protect' the marine environment includes protection from future damage, whereas 'preserve' means to maintain or improve the marine environment's current condition.[29] A remarkable advancement of the BBNJ Agreement[30] is a clear recognition of "*the need to address, in a coherent and cooperative manner, biological diversity loss and degradation of ecosystems of the ocean, due, in particular, to climate change impacts on marine ecosystems, such as warming and ocean deoxygenation, as well as ocean acidification*…" [31]

Climate change and adaptation measures

In an endeavour to bridge disparities between oceanic and climatic regimes, numerous soft objectives have been formulated. A notable instance is Aichi Biodiversity Target 10, endorsed within the framework of the 1992 Convention on Biological Diversity, which enjoins parties to mitigate the impacts of climate change or ocean acidification on coral reef and other

[26] United Nations Framework Convention on Climate Change (UNFCCC), Paris Agreement: Decision 1/CP.21, adopted 12 Dec. 2015, UNFCCC, FCCC/CP/2015/L.9/Rev.1 (entered into force 4 Nov. 2016) [hereinafter Paris Agreement].
[27] Ibid 2, pg.no 170
[28] UNCLOSIII, article 207 and article 212
[29] The South China Sea Arbitration (Philippines v. China) (Award of 12 July 2016) PCA Case no. 2013-19, para 941.
[30] (General Assembly resolution 72/249), 2015,
[31] Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction | (un.org) (preamble of the BBNJ Agreement)

susceptible ecosystems. Similarly, the 2012 UN General Assembly resolution adopting 'The future we want' urged concerted action to forestall further ocean acidification and to foster ecosystem resilience. Sustainable Development Goal 14, adopted by the UN General Assembly in 2015, emphasizes minimizing and addressing the impacts of ocean acidification through enhanced scientific cooperation at all levels.[32]

The Ocean at COP26 At the United Nations Conference on Climate Change, the 2021 Glasgow Climate Pact ensuring the integrity of marine ecosystems, protection, and restoration. The pact mandated relevant work programs and constituted bodies under the UNFCCC to consider strengthening and integrating ocean-based action within their existing mandates and workplans, with subsequent reporting obligations on these activities.[33] Notably, at COP 26[34], the united mobilization and coordination of the ocean community, epitomized by the "Ocean for Climate" Declaration endorsed by over 100 civil society organizations, underscored the collective voice of NGOs, scientists, companies, and international organizations. the preamble of the Glasgow Pact,[35] recognizing "the importance of ensuring the integrity of all ecosystems, including forests, the ocean, and the cryosphere".

Intergovernmental Panel on Climate Change (IPCC) Adaptation

In 2023, the Ocean & Climate Platform (OCP)[36] reviewing the IPCC Special Report on Global Warming of 1.5°C (2018), the Special Report on the Ocean and Cryosphere in a Changing Climate (2019)[37], and the IPCC Sixth Assessment Report (2021-2023)[38], released "What Ocean for Tomorrow?"[39], synthesizing insights from the IPCC Sixth Assessment Report on marine ecosystems and climate change. Recognizing the urgency, the IPCC advocates for Marine Nature-based Solutions to bolster ecosystem resilience, delineating three distinct solution types. Marine Protected Areas (MPAs) aim to conserve biodiversity, with higher protection levels restricting more human activities for greater ecological benefits. Scientific and political recommendations advocate protecting at least 30% of marine and terrestrial areas by 2030. In

[32] Goal 14: life below waters, https://www.globalgoals.org/goals/14-life-below-water/
[33] Ocean at COP 26, ocean-decade-cop26-2021.pdf (sprep.org), COP 26, para 21
[34] Ocean at COP 26, ocean-decade-cop26-2021.pdf (sprep.org)
[35] Glasgow pact, cop26_auv_2f_cover_decision.pdf (unfccc.int)
[36] Ocean climate platform, https://www.undrr.org/organization/ocean-climate-platform.
[37] the Special Report on the Ocean and Cryosphere in a Changing Climate (2019), https://www.ipcc.ch/srocc/
[38] IPCC Sixth Assessment Report (2021-2023), https://www.ipcc.ch/assessment-report/ar6/
[39]what-ocean-for-tomorrow-marine-ecosystems-in-a-changing-climate-insights-from-the-ipccs-sixth-assessment-report, https://ocean-climate.org/en/ /

(January 2022), MPAs cover 7.9% of the ocean, with 2.8% highly protected.[40] Most MPAs are in coastal zones, with the high seas largely unprotected. Climate change necessitates reconsidering MPA design and management to accommodate species migration and impacts. Proposals include expanding coverage, enhancing protection standards, and establishing MPA networks.

Ecological restoration involves aiding degraded or destroyed ecosystems, like replanting mangroves or rehabilitating salt marshes. Emerging methods, like species transplantation and genetic manipulation, demand careful supervision to safeguard vulnerable ecosystems. At the same time, marine and coastal ecosystems including mangroves and sea grasses can store large amounts of carbon in their sediments for long periods of time, performing as carbon sinks (a phenomenon termed blue carbon) and mitigating the effects of climate change. The preservation and rehabilitation of such habitats may generate local revenue through voluntary carbon credits, as well as by providing other essential ecosystem services such as fisheries and coastal protection.

The sustainable management of fisheries, as addressed under UNCLOS, is paramount for protecting species from fishing and climate change impacts, safeguarding livelihoods. Measures such as setting quotas aligned with scientific advice and implementing gear modifications can enhance fish populations and mitigate CO2-related stresses on marine ecosystems. Scientists advocate for an ecosystem-based approach to fishing, urging less destructive techniques and banning harmful practices like bottom trawling. Supporting fishing communities' transition is crucial, offering diversification and retraining opportunities.

The IPCC mentions the restoration of blue carbon ecosystems as well as measures known as geoengineering. Marine geo-engineering projects including carbon capture and storage (CCS) and ocean fertilisation. In particular, in 2006, the London Protocol was amended in order to expressly permit and create a legal basis for the disposal of CO2 into sub-seabed geological formations that is ocean sequestration[41]. More controversially, the Protocol was amended in 2013 to include an explicit mandate for the regulation of ocean fertilization,[42] a technique for

[40] Schmidt DN, Pieraccini M, Evans L. 2022 Marine protected areas in the context of climate change: key challenges for coastal social-ecological systems. Phil, https://doi.org/10.1098/rstb.2021.0131
[41] The London protocol and London convention, how global regulation can deal responsibly with climate change mitigation technologies to protect the marine environment, https://wwwcdn.imo.org/
[42] LC PROT 1996 Amendment LP.4(8) / 2013 Amendment to the 1996 London Protocol (Protocol to the London Convention), https://cil.nus.edu.sg/ /

removing CO2 from the atmosphere and storing it in the oceans. Ocean fertilization (OF) has been proposed as a potential solution to reduce CO2 emissions, However, differing views exist, Intergovernmental Panel on Climate Change (IPCC) in 2007[43], which deemed it speculative and unproven with risks of unknown side effects. In October 2008, the contracting parties of the London Convention addressed ocean fertilization activities, stating that, except for legitimate scientific research, Similarly, (COP) 2008 [44] of the Convention on Biological Diversity urged parties and governments to prevent ocean fertilization activities until adequate scientific evidence is available.[45]

Adaptation Strategies of International World Bank

With a focus on biodiversity-climate change linkages, the international world Bank's projects span a range of natural habitats globally, providing essential ecosystem services and acting as buffers against climate change impacts. The Bank's marine projects, including the establishment of Marine Protected Areas (MPAs), focus on conserving fish populations and habitats. Research confirms that MPAs lead to increased biodiversity, larger fish sizes, and enhanced carbon sequestration, contributing significantly to the marine carbon sink.[46]

High Level Panel for a Sustainable Ocean Economy

The High-Level Panel for a Sustainable Ocean Economy. Its mission is to promote a sustainable ocean economy that balances ocean protection, sustainable production, and equitable prosperity. global ocean governance through the High-Level Panel for a Sustainable Ocean Economy a group of ocean nations of which Canada is one that came together in 2018 to work toward sustainable ocean economies that include ocean equity as a key pillar. The panel's work is crucial in advancing the global conversation on ocean sustainability and informing the development of Canada's Blue Economy Strategy.[47] Offshore oil and gas, contributing 15% to Canada's ocean sector GDP, particularly in Newfoundland and Labrador, is crucial for the country's blue economy advancement. there's an emerging approach on both

[43] Climate Change 2007: Impacts, Adaptation and Vulnerability, https://www.ipcc.ch/site/assets/uploads/2018/03/ar4-wg2-intro.pdf
[44] COP 2008, on convention on biological diversity, https://www.cbd.int/cop
[45] Wenta, J., McDonald, J., & McGee, J. S. (2019). Enhancing resilience and justice in climate adaptation laws. Transnational Environmental Law, 8(1), 89–118. https://doi.org/10.1017/S2047102518000286
[46] The World Bank's biodiversity portfolio, as outlined in the 2008 report, 467260WP0REPLA1sity1Sept020081final.pdf
[47] The High-Level Panel for a Sustainable Ocean Economy, (dfo-mpo.gc.ca)

the Canadian and provincial levels that seeks to integrate offshore oil with renewable energy through technology. [48]

Conclusion

Despite slow recognition of climate change impacts on oceans by legal frameworks, there is an urgent need for integrated, multi-sectoral approaches to promote climate-resilient activities within the blue economy. India and other countries in the Indian Ocean Region (IOR) need to develop robust policy frameworks that integrate climate change considerations into blue economy strategies. Enforcing adaptation strategies delineated in global accords and non-binding regulations, holds promise in alleviating the repercussions of climate change on the blue economy. It is imperative to strike a delicate equilibrium between conservation endeavours and exploitation of resources to ensure the sustainable advancement of the maritime-based economy.

[48] Fusco, L.M.; Schutter, M.S.; Cisneros-Montemayor, A.M. Oil, Transitions, and the Blue Economy in Canada. *Sustainability* **2022**, *14*, 8132. https://doi.org/10.3390/su14138132