



OCEANS: SUSTAINABILITY, CHALLENGES AND POLICIES

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Abstract: The world's oceans are a vital component of our planet's ecosystem. The health and sustainability of our oceans is threatened by a number of anthropogenic activities. Ocean plays a critical role in regulating the Earth's climate, absorbing carbon dioxide and heat from the atmosphere. They also provide a significant source of food and livelihoods for millions of people around the world. In response to these threats, governments and international organizations have implemented a variety of policies and initiatives aimed at promoting ocean sustainability and conservation.

Keywords: sustainability, ecosystems, habitat, species, resources, conservation, policy implementation

INTRODUCTION

The significance of OCEANS can be understood by analysing the complex and interconnectedness between hydrosphere, atmosphere, lithosphere and biosphere. The four spheres interact and influence each other to create a dynamic web that sustains life on Earth. It is important to recognize the delicate balance between them for our harmonious existence and other life around us.

Oceans cover over 70% of the Earth's surface and play a crucial role in sustaining life on our planet. In addition to being a source of beauty and wonder, oceans are essential for regulating the global climate, providing food and livelihoods for millions of people, and supporting a vast array of biodiversity. The significance of oceans can be understood from ecological, economic and social perspectives.

The sustainability of the oceans and the seas vastly effect the sustenance of human life. The oceans are a vital component of Earth's interconnected systems, influencing climate, weather and nutrient cycles. Often we are nonchalant about the role of the oceans in regulating the planet's overall health and resilience. The marine ecosystem plays a crucial role in global food security, human health and climate regulation. More than 3 billion people around the world depend on the services provided by marine and coastal biodiversity.

Marine Sustainability is the maintenance of the equilibrium of the **biological, physical, geological and chemical** composition of the oceans by human interference. It is to manage our ocean services and resource in a cautious manner without disrupting the natural functioning of it. "Marine sustainability refers to the ability to maintain the health and productivity of marine ecosystems and resources in order to meet the needs of present and future generations" (Thiede Joern and 19 more, Jan 2015) Marine sustainability refers to the concept of maintaining ecological balance and development in the ocean while ensuring the protection and sustainable utilization of its resources. It involves strategies such as establishing protected areas, putting restrictions on developmental activities, and promoting responsible consumption of marine resources .

According to the World Economic Forum, the global "ocean economy" is estimated to be worth approximately \$2.5 trillion, making it the seventh largest economy in the world, if it were a country. The "ocean economy" is estimated to be worth approximately \$2.5 trillion and provides essential biodiversity and services to around

40% of the world's population. These services include, but are not limited to, food, fresh water, renewable energy, tourism, and trade. The sustainable development of the marine economy requires coordination and unification of marine economy, marine resource use, and marine environmental protection. The oceans are crucial for global food security, human health, and climate regulation, and marine goods and services are seen as important sources of employment, economic security, and sustainable development.

The need to address the environmental crisis and protect marine ecosystems from the adverse impacts of natural processes and human activities, including climate change introduced Marine Protected Areas (MPAs) which are designated areas in the ocean where human activities such as fishing, mining and development are restricted or managed to protect and conserve marine ecosystems. They are important tools for conserving biodiversity, restoring damaged ecosystems and supporting sustainable fisheries. MPAs vary in size and level of protection and can be established by governments, communities or international agreements.

History of human impact on marine sustainability

In the past few decades of human civilization, it can be noted that the disruption of marine ecosystem has multiplied manifold. The evolution of human civilization and the exploitation of marine resources are closely associated with the history of human impact on marine sustainability.

During the prehistoric phase indigenous peoples used prehistoric methods for fishing and gathering. Old civilizations like Greeks, Romans, and Phoenicians established maritime trade networks, but their smaller populations had limited impact on aquatic sustainability. In the Middle Ages, European countries increased fishing fleets and further developed techniques such as salt preservation. But with those concerns about overfishing and habitat degradation emerged. The Colonial Era during the 15th and 19th century brought with it increased global use of marine resources, including fishing, whaling, sealing, and harvesting marine mammals, causing challenges to marine ecosystems.

With the commence of Industrial revolution in the 18th and 19th century brought significant advancement in marine technology like the steam powered vessels and mechanized gears, giving rise to the sector of industrial fishing. It acted as stepping stone to wide scale marine pollution and habitat loss. Industrial activities such as manufacturing, mining and shipping became the source of release of pollutants into the water bodies. Release of untreated waste water, contaminated chemicals, heavy metals and other contaminants also started in this era. This became the reason for habitat loss of marine species.

The rising urbanization, population growth and globalization increased the demands of human community as a whole in the 20th century, leading to the dynamic increase in human impact in marine sustainability. Several commercially imported fish stocks collapsed due to intensive overfishing. The rise of plastic production and dumping of agricultural, industrial and urban waste was intensified, harming the water quality and habitat of marine species. Discoveries of oil fields and shipping of oils lead to the disasters like Oil spills. Events like the Torrey Canyon Oil Spill in 1967 off the cost of Cornwall, England highlighted a significant environmental setback.

During the 1950s and the 1960s humanity witnessed the infamous cause of marine pollution that effected a large mass of humans. The release of ‘methylmercury’ in the Minamata Bay contaminated the marine life with high amount of mercury. Which was then consumed by the local residents causing neurological disorders, sensory impairments and physical deformities famously known as “Minamata Disease”. “Minamata disease, which occurred in Minamata in the 1950s and 1960s, is well known as a food poisoning caused by fish contaminated with methylmercury” (Harada, M. Minamata Disease 1995)

In the latter half of the 20th century, plastic pollution became a serious problem, and it is still getting worse in the current century. Ecosystems, human health, and marine life are all seriously jeopardized by single-use plastics, microplastics, and plastic litter. Prohibitions on single-use plastics, recycling initiatives, and clean up projects are all part of the fight against plastic pollution.

In the modern era, international agreements have been established to address marine sustainability issues like overfishing, pollution, habitat destruction, and climate change. However, challenges remain, including overfishing, habitat degradation, pollution, ocean acidification, and invasive species. Coordinated actions at local, national, and international levels are necessary for long-term success.

Impacts and challenges

The anthropogenic activities that happen in the terrestrial sphere gravely affect the cycle and functioning of the ocean system in various ways. Due to the complex and interconnected nature of the marine ecosystems and the multiple drivers of degradation i.e. mostly induced by human activities. Overcoming human impact on marine sustainability presents numerous challenges:

- 1) **Overfishing and Illegal Fishing:** - Marine life constitutes a crucial source of biodiversity and food supply all around the world. Thus, Fisheries thrive as an old and still growing and prevailing industry which is vital for human sustenance. With high demand and growing industry overfishing has increased drastically over the years. Illegal, Unreported and Unregulated Fishing (IUU) has been possessing a significant threat to marine ecosystems and biodiversity. This illegal fishing activity has increased over the past two decades which has made it difficult to manage fisheries sustainably, particularly in high sea fisheries. This has led to the over exploitation of fish stocks resulting in rapid decline in biodiversity. This further effect the marine ecosystem, reducing fish population, effecting breeding success and consequently harming marine mammals and birds. IUU also cause seafood fraud in markets, posing health risks to consumers, threatening human life. IUU fishing is heavenly prevalent in the Caspian Sea, Antarctica, Cuba, and Australia, usually away from the cost of high fish depended states and good breeding grounds.
- 2) **Pollution:** - Marine Pollution refers to the contribution of the earth's oceans and seas with harmful substances, resulting in adverse effects on marine life and ecosystems. The sources of marine pollution are diverse and include both natural processes and human activities like oil pollution, industrial waste disposal, agricultural waste disposal, marine waste disposal and sewage disposal. These activities effect both marine and human life causing loss of biodiversity and degradation of marine habitats. Harmful algal bloom, red tides causing oxygen depletion. The pollution further contributes to contamination of seafood with toxins and heavy metal debris posing health hazard. Further it leads to damage to marine species, including entanglement of marine organism in old fishing nets and debris and ingestion of plastic. For example: - in the recent years the turtle species have been gravely harmed by the disposable plastic straws. Pollution also economically impacts fisheries, tourism and coastal communities.
- 3) **Habitat Destruction:** - Habitat destruction of marine ecosystem refers to the degradation or loss of marine environment to a degree where they can no longer support the diverse animal and plant life that typically inhabits them. This destruction is caused directly through human activities such as mining, dredging, construction or aquaculture. When marine habitats are destroyed, they cause harm to essential ecosystem services which both human population and environment benefit from, having immense ecological, social and economic importance. These services can include commercial actives like fishing and ecotourism, as well as indirect benefits such as coastal protection, carbon fixation, nutrient cycling, biodiversity support and recreational opportunities.
- 4) **Climate Change:** - Climate change is significantly impacting the world's oceans with various consequences that effect marine biodiversity and coastal communist. It leads to rising sea levels, more frequent and intense marine heatwaves and loss of marine biodiversity. The thermal expansion and melting ice caps cause *sea level to rise*, increasing the risk of flooding, erosion and storm surges for coastal communities. Rising ocean temperatures result in longer and severe *marine heatwaves*, damaging coral reefs and marine ecosystems and threatening biodiversity. Damage to coral reefs and other ecosystems, along with species migration, contribution to the loss of marine biodiversity, endangering millions of species and impacting costal economies and societies. As temperatures continue to rise, more marine species face the risk of extinction. It is estimated by 2100 over half of the world marine species could be at risk. The climate change has far reaching consequences for both the marine life ecosystem and the livelihood and lives of coastal communities. Rising sea levels have caused many coastal communities to lose their land and migrate like happening in Bangladesh.

- 5) *Resource extraction*: - There has been a recent surge of mineral extraction from the seabed as it is an area of interest for both mining industry and marine scientists. There is very less information that we can get in the ecological impacts of deep sea and the shallow seabed even with modern day improved methods of geological investigation and enabled mapping techniques. A legal framework based on the distance from land governs the regulation and control of anthropogenic activities in the ocean. A coastal state's territorial sea, which includes the airspace, water body, seabed, and subsoil, stretches up to 12 nautical miles (22 km) beyond its shore, as per the 1982 United Nations Convention on the Law of the Sea (UNCLOS). Coastal states have exclusive rights and jurisdiction over resources inside their Exclusive Economic Zone (EEZ), which stretches up to 200 nautical miles (370 km) from the coastline. In addition, certain states might have a continental shelf that extends outside the EEZ, giving them sovereign rights over the mineral resources and seabed there. The process of harvesting minerals from the seabed at depths greater than 200 meters is known as deep-sea mining. The depletion of terrestrial mineral reserves and the rising demand for metals necessary for a variety of technologies, including as cell phones, renewable energy systems, and batteries, are driving the popularity of this method. Deep-sea mining does, however, provide serious environmental hazards. The deep-water harbours distinct and enigmatic ecosystems, and any disruption to these environments may result in permanent harm to the marine biodiversity. The following are a few possible effects of deep-sea mining:
- a. *Disturbance of the Seafloor* - Deep-sea habitats can be destroyed or disturbed by mining machinery, which results in the extinction of species and the breakdown of ecosystems.
 - b. *Sediment Plumes*: When fine sediments on the seafloor are disturbed by mining operations, suspended particles form plumes that can damage marine life, especially filter-feeding species, and travel great distances.
 - c. *Pollution*: Marine animals like whales, tuna, and sharks can be impacted by noise, vibrations, and light pollution from mining machinery and ships. Toxic product accidents and fuel leaks also present additional hazards to maritime environments.
- 6) *Invasive species*: - Invasive species pose significant threats to marine ecosystems with negative impacts including: disruption of predator-prey relationships leading to declines in native species, alteration of habitats through overgrowth, reducing biodiversity, introduction of new diseases or parasites, causing widespread mortality, hybridization leading to genetic pollution and decreased resilience, disruption of ecosystem processes such as nutrient cycling and carbon sequestration, and economic losses in industries like fisheries and tourism. Prevention, early detection, and management efforts are crucial to mitigate these far-reaching and often irreversible consequences.
- 7) *Coastal development pressures*: - In recent decades, there has been a notable surge in the population living along the coast, leading to substantial development of coastal regions. Coastal development can harm the ocean by destroying marine habitat along the shore and causing pollution and sediment runoff. Creating harbours, stabilizing shorelines, and establishing aquaculture all fall under the category of coastal development, which also includes destroying delicate marine habitats like mangroves, coral reefs, and seagrass beds. Sand and silt from coastal construction projects may wash into coastal habitats, suffocating seaweeds and corals and lowering the amount of light available for photosynthesis. Whole food webs may suffer from the extinction of key habitat-forming species like corals and primary producers.

Marine Policies

Earth and coastal ecosystems are not static, and they usually respond to environmental changes, mostly anthropogenic and climatic. As the global economy continues to grow and the global supply chain becomes increasingly complex, the volume of international maritime transport is on the rise. Maritime policy is a key component of sustainable development in the maritime industry, encompassing governance, economics and environmental protection. It ensures the sustainable exploitation of oceans and seas to promote economic growth while maintaining ecosystem health. The declining health of marine environments around the world highlights the need for strong policy frameworks to address issues such as climate, energy, fisheries and transportation. Ocean governance is also essential for harmonizing environmental management systems and promoting international cooperation to ensure ecosystem-based approaches as well as maritime security, i

In line with the UN's Sustainable Development Goals. Marine policies plays a pivotal role in facilitating the peaceful use of ocean space, sustainable management, conservation, equitable and efficient management and utilization of its resources and also to enhance knowledge and studies on the development, protection and preservation of marine environment. Especially in coastal areas, demographic changes, the growth of infrastructure and activities, and the additional threats brought on by climate change present a significant obstacle to their safe and sustainable development. For the sustainable development and administration of coastal and marine areas, it is therefore necessary to contribute to the creation of particular institutional and public policy foundations. International policies through various mechanism and organisations have set down various regime of law and order in the international maritime.

International Approaches

The international arena is primarily steered by various frameworks, conventions, and organizations when it comes to marine policy. The United Nations Convention on the Law of the Sea (UNCLOS) takes center stage as the chief legal framework for managing marine resources and settling disputes among nations. UNCLOS presents an inclusive framework for maritime boundaries, resource exploitation, and environmental protection, thereby fostering cooperation among states. International organizations like the International Maritime Organization (IMO) and the United Nations Environment Programme (UNEP) have a critical part to play in setting global standards, developing guidelines, and coordinating efforts to tackle marine pollution, climate change, and sustainable resource management. By sharing knowledge, building capacity, and facilitating technology transfer among member nations, these organizations promote a cooperative approach to marine policy.

The United Nations Convention on the Law of the Sea (UNCLOS)

The United Nations Convention on the Law of the Sea (UNCLOS) puts back the doctrine of "freedom of the sea". It sets out a comprehensive legal framework for the global oceans, recognizing the interconnected nature of all ocean-related problems and advocates for a holistic approach to addressing them. This Convention establishes rule for all uses of the ocean and its resources, addressing impacts on marine ecosystems within and beyond areas of national jurisdiction, taking into account the integrity of the ecosystems concerned.

On December 10, 1982, the Convention was signed in Montego Bay, Jamaica, following more than 14 years of collaborative work involving over 150 countries from all regions of the world, with diverse legal and political systems and levels of socio-economic development. The Convention brings together traditional ocean-use rules and introduces new legal concepts and regimes, as well as addressing emerging concerns. Additionally, it provides a foundation for further development of specific areas of the law of the sea. The Convention came into force in accordance with Article 308 on November 16, 1994. It governs distinct aspect of ocean space and maritime problems such as environment control, settlement of oceanic disputes, marine scientific research, technology transfers, delimitation and economic and commercial activities. At present, it is a globally recognized and an integrated regime which deals with all the matters related to global maritime laws.

Objectives

UNCLOS 1982 is considered the most important international maritime treaty, covering seventy percent of the planet's surface. One of the most significant concerns of current times is the protection of the maritime environment, which is one of the many areas in which UNCLOS 1982 has substantial implications. UNCLOS 1982 met the hopes and expectations of the international community for a new international legal framework for the protection of the maritime environment.

- **Coastal States** are entitled to establish their territorial sea's breadth, which should not exceed 12 nautical miles, and allow foreign vessels for "innocent passage".
- International straits permit "transit passage" for ships and aircraft from all countries, while the bordering states can regulate navigation and other aspects of passage. Coastal States have sovereignty over the natural resources and certain economic activities within a 200-nautical mile Exclusive Economic Zone (EEZ) and exercise jurisdiction over marine science research and environmental protection. Other states enjoy freedom of navigation and overflight within the EEZ, as well as the freedom to lay submarine cables and pipelines.

- Land-locked and geographically disadvantaged states are entitled to a fair share of the surplus of the living resources of the EEZ's of coastal states in the same region or sub-region, while highly migratory species of fish and marine mammals are given special protection.
- Coastal countries have sovereignty over their continental shelf, which extends at least 200 nautical miles from their shores and potentially further under specific conditions, for exploring and exploiting its resources. They are required to share a portion of the revenue generated from exploiting resources beyond 200 miles with the international community.
- The limits of the territorial sea, Exclusive Economic Zone (EEZ), and continental shelf of islands are determined in accordance with rules applicable to land territory, while rocks that cannot sustain human habitation or economic activity do not have an exclusive economic zone or continental shelf.
- States that have ratified the Convention are obligated to settle any disputes regarding the interpretation or application of the Convention through peaceful means, such as negotiation or mediation. If a dispute arises, it may be submitted to the International Tribunal for the Law of the Sea, the International Court of Justice, or to arbitration.

Even though many nations have ratified UNCLOS 1982, there are still big variations in how the laws are applied in different nations. Ship waste is dumped into the water by some nations because the restrictions have not been properly implemented. Unfortunately, some countries have not built the facilities and infrastructure required for disposing of waste from ships, which has led to improper disposal. Due to the accumulation of trash in the water, both human health and the marine ecosystem are at risk (Ulfah & Roesa, 2020). Successful implementation also requires efficient procedures for enforcement and monitoring. This entails penalising ships that violate the law and conducting routine inspections of ships to verify compliance with the requirements. Creating public awareness campaigns to inform people about the value of appropriate trash disposal and the harm that marine pollution causes to the environment is another excellent strategy.

For the protection, mitigation, and control of maritime pollution caused by ship trash and other types of ship pollution, there are legislation in this field under both the Navigation Act and the MEPL (Balgos, Cicin-Sain, & VanderZwaag, 2015).

Marine biological diversity of areas beyond national jurisdiction: Legal and policy framework

It is complemented by two implementing agreements, which addresses matters related to the Area, and the Agreement for the Implementation of the Provisions of UNCLOS relating to the *Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks*. In addition to UNCLOS and its implementing agreements, a number of international instruments at the global and regional levels are relevant to the conservation and sustainable use of marine biodiversity beyond areas of national jurisdiction.

On the recommendations of the working group which was established by General Assembly to study issues relating to the conservation and sustainable use of marine biological diversity, in particular, together and as a whole, marine genetic resources, including questions on the sharing of benefits, measures such as area-based management tools, including marine protected areas, environmental impact assessments and capacity-building and the transfer of marine technology. beyond areas of national jurisdiction, the General assembly adopted, on 19 June 2015 “Development of an international legal binding instrument 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”.

Several General Assembly resolutions on oceans and the law of the sea and on sustainable fisheries also provide relevant policy guidance. For example, the General Assembly has expressed its concern at the adverse impacts on the marine environment and biodiversity, in particular on vulnerable marine ecosystems, of a number of human activities, such as over-utilization of living marine resources, the use of destructive practices, physical impacts by ships, the introduction of alien invasive species and marine pollution from all sources, including from land-based sources and vessels. The Assembly has also reaffirmed its role relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction, noted the work of States and relevant complementary intergovernmental organizations and bodies on those issues, including the CBD

and the FAO, and invited them to contribute to its consideration of these issues within the areas of their respective competence.

Significant Measures by General Assembly:

- Develop national, regional and global initiatives to halt the decline of marine life, particularly vulnerable ecosystems.
- Considering ways to integrate and improve, the management of risks to marine biodiversity of seamounts, cold water corals and hydrothermal vents and certain other underwater features on a scientific basis within the framework of UNCLOS.
- Enhancing knowledge and understanding of the oceans and deep sea, including the importance and vulnerability of deep-sea biodiversity and ecosystems, through increased marine scientific research activities, and taking into consideration the need to develop greater taxonomic capabilities, in line with UNCLOS contingency plans for pollution incidents and other incidents likely to have significant impacts on the marine ecosystem and biodiversity.
- Strengthen scientific efforts to gain a better understanding of climate change impacts on the marine ecosystem and marine biodiversity and to develop modalities and tools for adaptation, including, where relevant, precautionary and ecosystem approaches.

International Maritime Organization (IMO)

The International Maritime Organization (IMO) is a specialized structure within the United Nations umbrella. It is responsible for ensuring the safety and security of shipping and preventing marine pollution caused by ships. The IMO plays a crucial role in developing and implementing international regulations and standards for the shipping industry.

The International Convention for the Prevention of Pollution on Ships (MARPOL) is an international treaty that aims to prevent pollution from ships. It sets out regulations and guidelines for the prevention of pollution from various sources, such as oil, chemicals, sewage, and garbage. The MARPOL Convention is one of the most important international agreements addressing environmental issues in the shipping industry. However, in 2013, the IMO made amendments to the MARPOL Convention. These amendments included the introduction of more energy-efficient regulations for new-build vessels and stricter regulations for existing vessels. The purpose of these amendments was to reduce the environmental impact of the shipping industry by promoting energy efficiency and reducing pollution. MARPOL also aims to ensure fair access to new technologies and processes by transferring information and providing assistance to all countries.

The challenge with global climate change and policy is the unknown timeline and lag between action and effect (Kontovas et al., 2011). There is an argument among policy-makers as to the best way to utilize policy to reduce emissions, and force environmental consciousness among consumers and industry. Many resulting policies are classified as incentive policies, either consisting of charges and subsidies or transferable emission permits (Field and Field, 2009).

Legally binding energy-efficient measures

The implementation of these amendments made the IMO the first and only organization to adopt energy-efficient measures that are legally binding across the entire global shipping industry. All countries that are members of the IMO are required to comply with these energy-efficient regulations.

Effects on the industry and innovation

The implementation of energy-efficient regulations has had several effects on the shipping industry. Firstly, it has encouraged the development and adoption of new technologies and practices that improve energy efficiency in ship design and operation. This has led to innovations in areas such as propulsion systems, hull design, and fuel consumption monitoring. Secondly, it has increased the demand for more environmentally friendly vessels, leading to a shift towards the construction of new-build vessels that meet the energy-efficient regulations. Lastly, it has created a more level playing field for all countries in the shipping industry, as the regulations apply to all countries equally. This has helped to prevent unfair competition and ensure that all countries are working towards the same environmental goals.

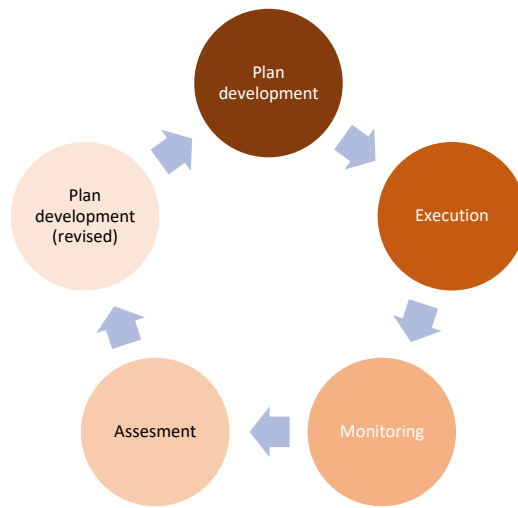
Integrated Coastal Zone Management (ICZM)

The coast is an area where the land meets the sea, and with significant economic, cultural and ecological values. But the environmental problems and developing issues in the world's coastal areas strongly require establish a program of Integrated Coastal Zone Management (ICZM). The idea behind Integrated Coastal Zone Management was first presented during the Rio de Janeiro Earth Summit in 1992. The policy on ICZM is outlined in Agenda 21, Chapter 17 of the summit proceedings. The European Commission defines ICZM as “a dynamic, multidisciplinary and iterative process to promote sustainable management of coastal zones. It covers the full cycle of information collection, planning (in its broadest sense), decision making, management and monitoring of implementation. ICZM uses the informed participation and cooperation of all stakeholders to assess the societal goals in a given coastal area, and to take actions towards meeting these objectives. ICZM seeks, over the long-term, to balance environmental, economic, social, cultural and recreational objectives, all within the limits set by natural dynamics. 'Integrated' in ICZM refers to the integration of objectives and also to the integration of the many instruments needed to meet these objectives. It means integration of all relevant policy areas, sectors, and levels of administration. It means integration of the terrestrial and marine components of the target territory, in both time and space”.

Because of sea level rise and an increase in storm frequency and intensity, many coastal areas worldwide are experiencing coastal erosion and flooding, which is expected to worsen. Nevertheless, some nations still do not have a specific policy in place to direct the implementation of adaptation measures tailored to the coastal zone. This is still the situation in Ireland, a nation with over 7,000 km of coastline, the majority of which is at risk from climate change.

Integrated Coastal Zone Management (ICZM) plays a crucial role in addressing the challenges posed by climate change and rising sea levels on coastal ecosystems and communities. ICZM provides a holistic and sustainable approach to adaptation by incorporating ecosystem-based management principles, enhancing community resilience, and promoting effective decision-making. It emphasizes the need for specific institutional and public policy frameworks to manage coastal-marine areas sustainably. Climate change impacts, such as reduced natural resource yields and environmental changes, highlight the urgency for adaptation strategies and community awareness. ICZM also focuses on operationalizing ecosystem-based management principles, acknowledging uncertainties, sustainability, democracy, and knowledge application, to foster adaptation and just coastal sustainability

Major objectives of ICZM are related to protection of human lives and assets at risk which involves flood risk reduction and prevention, emergency rescue of people during the flood and erosion mitigation. Enhancement of sustainability and ecosystem services include sediment management, limitation of soil subsidence and Climate Change Adaptation (CCA) where regular evaluation of ICZM policies and regulation takes place. Economic development by land use planning, tourism, port and industry play a major role. Through public information and consultation, financial instruments can be disseminated in the public. Due to socioeconomic and ecological factors, the coastline zone is always changing. Therefore, ICZM should be updated and shaped as a continuous process that follows a set policy cycle as per the schedule, rather than being a one-time static plan or a collection of interim measures.



Continuous policy cycle

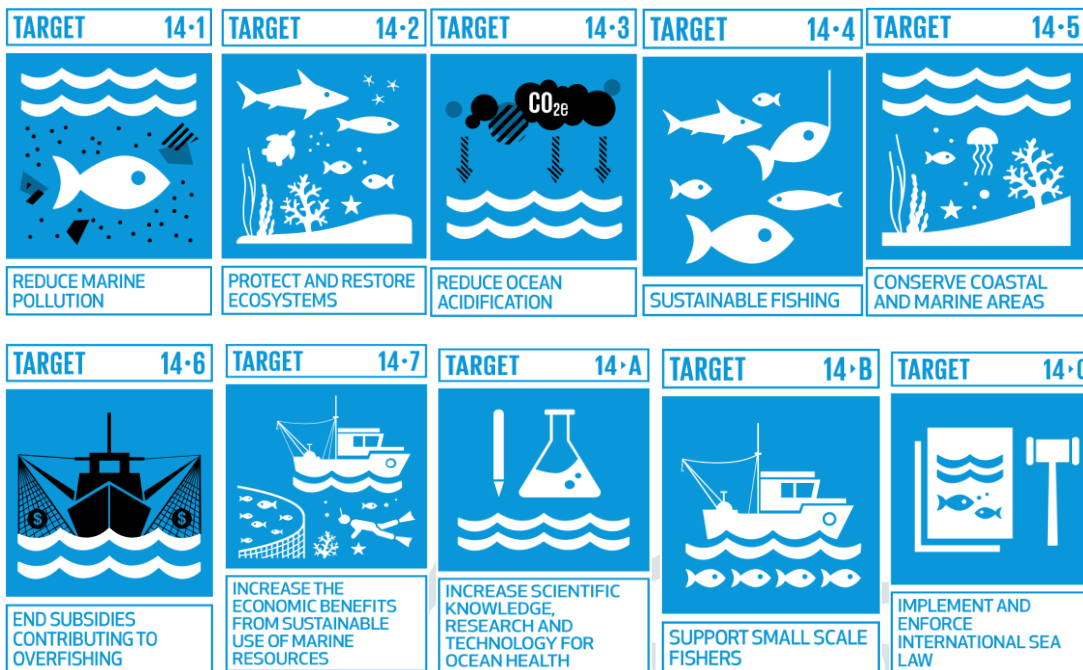
At the local level, comprehensive concrete plans are created and implemented in conjunction with all local and national stakeholders. This cycle is implemented at both the local and national levels. Local plans are incorporated into a national strategy and mandate, national objectives and targets are established, and resources are allotted for their execution at the national level.

Sustainable Development Goal 14

SDG 14, known as "Life Below Water," is a crucial Sustainable Development Goal aimed at conserving marine ecosystems and promoting sustainable ocean resource use. SDG 14 consists of seven targets and three sub-targets (Fig. 1), addressing issues such as marine pollution, overfishing, ocean acidification, and marine conservation. It serves as a key driver for policy-making globally, emphasizing the importance of ocean health. The objective tackles issues that have greatly affected about 40% of the world's oceans, including pollution, overfishing, and habitat loss. Despite efforts, achieving SDG 14 faces obstacles like weak indicators and insufficient recognition of Indigenous knowledge. Regions like the Western Indian Ocean struggle to meet the targets due to limited progress in marine conservation. Overall, SDG 14 underscores the need for equitable and just implementation to protect marine ecosystems and ensure sustainable resource management for future generations.

This is clear with respect to SDG14 (Life below water) that aims to “conserve and sustainably use the oceans, seas and marine resources for sustainable development” (SDG14 – Supplementary Appendix 1) and provides a focus for ongoing action by addressing seven targets and three sub-targets many of which have a direct influence in emerging fisheries governance (Haas et al., 2019), see Supplementary Appendix 1. The targets are reduction of marine pollution; ocean acidification; restoration of ecosystems; conservation of coastal and marine areas; improving ocean science; ending subsidies contributing to overfishing; supporting small-scale fishers; increasing sustainable fishing; economic benefits; and implementing and enforcing international sea law. For example, SDG 14 target 2 talks about “By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans.” reinforces the role of SDG in protecting and restoring marine ecosystem (United Nations [UN], 2018)

Since establishing the SDGs, the number of ocean-related initiatives has increased substantially, with the latest success being the Agreement for Biodiversity Beyond National Jurisdiction (BBNJ). The importance of the oceans is also showcased by the United Nations Decade of Ocean Science for Sustainable Development (2021–2030) However, despite this, the health of the ocean continues to decline. For example, unsustainably fished stocks are increasing (FAO, 2022) and no country is close to achieving SDG 14 (Andriamahefazafy et al., 2022; Sachs et al., 2022). Moreover, access to marine resources and benefits, conservation burdens, and costs are inequitably shared amongst the international community and ignoring these components as well as other socio-economic factors could further exacerbate existing inequities (Armstrong, 2020; Österblom et al., 2020)



SDG targets and sub-targets (ICCR0M)

Objectives

SDG 14 is difficult to implement, and nations have to confront a number of challenges in order to achieve this goal. One uncertainty, which academics have raised repeatedly, is the indicators, which are sometimes characterised as being too general and challenging to measure. More precisely, some indications do not support the corresponding targets' attainment. The target 14.6 indicator is one such. Although goal 14.6 is to "prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing" (UN, 2023), its indicator refers to Illegal, Unreported, and Unregulated (IUU) fishing, which is covered by SDG 14.4. This is a serious mismatch, as subsidies do not necessarily contribute to IUU fishing but to overcapacity (Cisneros-Montemayor et al., 2020). It is also important to acknowledge that the development of the SDGs and their targets were dominated by developed countries and influenced by their western ideas. Significantly, ideas from Indigenous organisations were not included in the final text (Cummings et al., 2017; Liu, 2023; Yap & Watene, 2019).

Implementation

SDG 14 has been one of the least studied and most under-implemented SDGs, with major challenges remaining in all regions and income groups (Sachs et al., 2022; Salvia et al., 2019). SDG 14 consists of seven targets and four of these targets (i.e., 14.2, 14.4, 14.5, and 14.6) were due for completion in 2020 but to date, no country has achieved all four (Andriamahefazafy et al., 2022). Target 14.4 (sustainable fishing) has suffered from the slowest progress and has only been achieved by the Marshall Islands, Papua New Guinea, and Tuvalu, while Target 14.6 (end harmful subsidies) registered the greatest achievements (Andriamahefazafy et al., 2022). The greatest achievement was made for target 14.4. Europe and Oceania serve the highest progress for these four SDG 14 targets. Achieving SDG 14 is further undermined as target 14.3 (reduce ocean acidification) and the three sub-targets are not associated with a due date (Quirk & Hanich, 2016).

Although the SDGs were only initiated in 2015, the objectives were quite old and have been the part of UNCLOS and IMO initiatives.

Identification of the challenges faced by countries in implementing the policies
One major challenge is the lack of capacity and resources to implement the regulations. Many developing countries lack the necessary infrastructure and facilities for the proper disposal of garbage from ships. This includes inadequate waste management systems, limited port reception facilities, and insufficient resources for

monitoring and enforcement. Without these resources, it becomes difficult for countries to ensure compliance with the regulations.

Lack of public awareness- “People tend to underestimate risks of natural hazards”

Low political priority- “There are more urgent issues to be addressed”

Lack of institutional cooperation- “These policies trespasses our field of competence”

Lack of monitoring- “No information is an excuse for inaction”

Lack of funding- “Policy investments do not yield short-term visible benefits”

Lack of experts- “Experts do not understand politics and vice versa”

Challenges of implementation of Marine policies

Second, challenge is the lack of awareness and understanding of the regulations. Some countries may have ratified these policies but are not fully aware of its provisions and requirements. This may result in inadequate implementation or non-compliance with the regulations. It is therefore essential to raise awareness and provide training on the regulations to ensure their effective implementation.

Some countries face challenges related to jurisdiction and enforcement. Many policies apply to international waters, but enforcement of the regulations is the responsibility of individual countries. This may result in a lack of cooperation among countries and difficulty in enforcing the regulations in areas beyond national jurisdiction.

Finally, some countries may face political and economic pressures that hinder effective implementation of the regulations. For example, there may be conflicts between environmental protection and economic interests, such as the shipping industry, which may resist stricter regulations that could increase costs.

Addressing these challenges requires a coordinated effort among countries, international organizations, and other stakeholders. It is crucial to provide technical and financial assistance to countries that lack capacity and resources for the proper implementation of the regulations. Increasing awareness and understanding of the regulations is also important, as well as strengthening monitoring and enforcement mechanisms. Furthermore, cooperation among countries is essential to ensure effective enforcement of the regulations in areas beyond national jurisdiction (Hendriks, 2012)

Marine policies in India

India has a vast coastline of 7500 km with exclusive economic zones (EEZ) extend over 2.2 million square km which suggests that India has a huge potential for Blue economy (Blue economy is the indiscriminate and sustainable use of marine resources for economic growth, without endangering the marine life.) In India Blue economy covers a wide range of sectors, including shipping, tourism, fisheries and offshore oil and gas explorations. India with vast coastlines have a great significance over marine resources and their sustainable use, to ensure the indiscriminate use of oceanic resources and protection of marine life. Whereas, Indian government has initiated various acts, initiatives, projects and programmes in the coastal states and union territories of the subcontinent.

The Indian government has initiated various measures to preserve coastal and marine resources, with a specific focus on *wetlands, mangroves, and coral reefs*. These efforts involve the enforcement of laws and continuous monitoring along with various coastal states and union territories besides other stakeholders.

Notable development for conservation of marine life and sustainable use of oceanic resources are-

Wild Life Protection Act of India (1972), which provides legal safeguarding for numerous marine animals, with 31 major Marine Protected Areas designated under the Wildlife Protection Act, 1972. In 1993, the National

Committee on mangroves, wetlands, and coral reefs was established to advise the government on relevant policies and programs concerning marine species.

The Coastal Regulation Zone (CRZ) CRZ Notification 2011 under which the central government of India declared certain coastal stretches as Coastal Regulation Zone (CRZ) under section 3 of Environment (Protection) Act, 1986. CRZ is covered by different coastal states, union territories and distinct stakeholders who are obliged to Ministry of Environment, Forest and Climate Change for the concerns related to CRZ. The Central Government, aiming to safeguard the distinctive environment of coastal stretches and marine areas, ensure livelihood security for fisher communities and other local residents in coastal regions, and foster sustainable development guided by scientific principles, while considering the risks posed by natural hazards and sea level rise due to global warming, officially designates the coastal stretches of the country and the water area up to its territorial water limit, excluding the Andaman and Nicobar Islands, Lakshadweep Islands, and the marine areas surrounding these islands, as the Coastal Regulation Zone.

Regions which require special consideration under CRZ to safeguard the critical coastal environment and problems faced by the inhabitants are

- Sundarban region of West Bengal and various ecologically sensitive areas under Environment (Protection) Act, 1986 such as Gulf of Khambat and Gulf of Kutchh in Gujarat, Malvan, Achra-Ratnagiri in Maharashtra, Karwar and Coondapur in Karnataka, Vembanad in Kerala, Gulf of Mannar in Tamil Nadu, Bhaitarkanika in Odisha, Coringa, East Godavari and Krishna in Andhra Pradesh shall be treated as Critical Vulnerable Coastal Areas (CVCA) and should be taken care with the help of coastal communities who depend on coastal resources for their sustainable livelihood.
- CRZ for inland Backwater islands and islands along the mainland coast.
- CRZ falling within municipal limits of Greater Mumbai.



Prohibited and outlawed activities under CRZ

The protection and conservation of biodiversity, along with the sustainable use and equitable sharing of its components, are addressed by the Biological Diversity Act of India (2002), Biological Diversity Rules 2004, and associated guidelines.

Pradhan Mantri Matsya Sampada Yojana (PMMSY) under the Department of Fisheries, Government of India to foster sustainable and responsible development in the fisheries sector. The scheme emphasizes the responsible harnessing of fisheries potential and the establishment of a robust fisheries management and regulatory framework.

The Centre for Marine Living Resources and Ecology (CMLRE), an office under the Ministry of Earth Sciences (MoES), is tasked with developing management strategies for marine living resources through ecosystem monitoring and modeling activities. Drawing from 24 years of survey studies, the CMLRE has built an extensive knowledge base on biodiversity within India's Exclusive Economic Zone, identifying conservation hotspots.

Additionally, there are several initiatives like Blue economy, Sagarmala project and clean seas campaign by the Indian government which focuses on vivid perspective to give a boost to marine sustainable development, harnessing the oceanic resources to an equitable extent and conserve the marine life.

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