# INDIA'S BLUE ECONOMY AND IT'S CONTRIBUTION TO SUSTAINABLE DEVELOPMENT GOAL 14: LIFE BELOW WATER

A Dissertation for

Course Code: INR 651

Course Title: Dissertation

Credits: 16

Submitted in partial fulfilment of Master of Arts in International Studies

By

**AARON ANTONIO ANDRADE**

Seat No: 22P0160001

ABC ID: 783324266551

PR No: 20190523

Under the supervision of

**Dr. MUKUND VISHWANATH NARVENKAR**

School of International and Area Studies

**GOA UNIVERSITY**
**गोंय विद्यापीठ**

**GOA UNIVERSITY**

**April 2024**

Examined by: Dr. Mukund Narvekar

Seal of School

# Declaration

I hereby declare that the data presented in this Dissertation report entitled "India's Blue Economy and its contribution to Sustainable Development Goal 14: Life Below Water" is based on the results of investigations carried out by me in the Discipline of International Studies at the School of International and Area Studies, Goa University under the supervision of Dr. Mukund V. Narvenkar and the same has not been submitted elsewhere for the award of a degree or diploma by me. Further, I understand that Goa University or its authorities will not be responsible for the correctness of observations or other findings given the dissertation.

I hereby authorize the University authorities to upload this Dissertation on the dissertation repository or anywhere else as the UGC regulations demand and make it available to any one as needed.

Date: 25th April 2024

Place: Goa University

Aaron Antonio Andrade

22P0160001

# Completion Certificate

This is to certify that the dissertation "India's Blue Economy and its contribution to Sustainable Development Goal 14: Life Below Water" is a bonafide work carried out by Mr Aaron Antonio Andrade under my supervision in partial fulfilment of the requirements for the award of the degree Masters of Arts in the Discipline International Studies at the School of International and Area Studies, Goa University.

Dr. Mukund Vishwanath Narvenkar

Date: 25 April 2024

Signature of the Dean

Date: 25th April 2024

Place: Goa University

School Stamp

# Acknowledgement

The dissertation entitled "*India's Blue Economy and its contribution to Sustainable Development Goal 14: Life Below Water*" is an outcome of several people's persistence and encouragement and my heartfelt gratitude goes to just every one of them.

My deepest appreciation to my guide, Dr. Mukund Vishwanath Narvenkar, Assistant Professor, School of International and Area Studies, Goa University, for his invaluable Knowledge, Guidance, co-operation and encouragement, and most crucially for his supportive nature. I am highly in-debt and appreciative of your genuine interest in the research and for leading us though its completion by providing with necessary suggestions, helping us to efficiently complete the research study.

I owe my outmost gratitude to Late Professor Aparajita Gangopadhyay, Dean of School of International and Area Studies for approving this topic to carry on for my project. I am also thankful to Dr Dattesh Parulekar, Programme Director, discipline of International Studies. Mr Yugank Naik, Assistant Professor, discipline of International Studies and Dr Almin Jose, Assistant Professor, Discipline of International Studies, Goa University. My acknowledgements to Dr Nitin Sawant and Dr Preeti Pereira from the discipline of Zoology and Dr Lata Gawde from the discipline of Microbiology. Last but not the least a special thanks to an old friend whose name was asked not to be taken, helped me immensely in the completion of the research.

25/4/24

Aaron Antonio Andrade

# Table of contents

Chapter I: Research Proposal

Chapter II: Sustainable Development Goal 14: life below water

Chapter III: Understanding India's Blue Economy initiatives

Chapter IV: Synergy between India's Blue Economy and SDG 14

Chapter V: Challenges to India's Blue Economy

Chapter VI: Conclusion

## Chapter I

# Research Proposal

## Abstract

India, endowed with an extensive coastline and vast maritime territories, has recognized the potential of its marine resources for sustainable economic growth. The Blue Economy concept, which promotes sustainable and inclusive development of ocean-based sectors, aligns with the United Nations' Sustainable Development Goal 14 (SDG 14): Life Below Water. This research project aims to analyze India's Blue Economy initiatives, policies, and challenges, while assessing their contribution to achieving SDG 14. By examining the interlinkages between economic activities, marine conservation, and social inclusivity, this project seeks to identify pathways for India to foster a thriving Blue Economy while preserving the health and resilience of its marine ecosystems.

## Introduction

The world’s population is growing at a rampant rate; in less than a century, the population of the world grew from 2.5 billion in the year 1950 to 8 billion in the year 2022, and the global human population is expected further grow by two billion in the next thirty years with 9.7 billion in 2050 (United Nations, n.d.). with the increase in population so will there be an increase in the burden on the earth’s resources, and with the burden on the earth’s scarce resources there will be huge competition for the utilization of these resources. Much of these resources will be subjected to

discrimination and disparity given the fact that the richer and more powerful nations, groups, and individuals will have for themselves the bigger share of the 'Pie' while the rest of the world is left with whatever is remaining of it.

The world population will inevitably increase, however with precise decisions and actions, there is a possibility that disparity and toll on the environment can be tremendously reduced if the principle of sustainable development is followed. Sustainable development is defined as "*The development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (Sustainable Development, n.d.).

The concept of sustainable development or SD received its first major international recognition in 1972 and formed the basis of the United Nations Conference on Environment and Development held in Rio de Janeiro, Brazil, in 1992. Through the Rio Summit, which was attended by more than 100 heads of state and representatives from 178 national governments, and Agenda 21, a comprehensive plan of action to build a global partnership for sustainable development in this summit sustainable development was recognized as a major challenge that remains till date. Furthermore, the World Summit on Sustainable Development, which was held in Johannesburg in 2002, was attended by 191 national governments, UN agencies, multilateral financial institutions, and other major groups to assess the progress of Rio. The summit of Johannesburg delivered three key outcomes which were a political declaration, the Johannesburg plan of implementation, and a range of partnership initiatives. Some of the key commitments included those on sustainable production and consumption, water, sanitation, and energy. Likewise, the concept of sustainable development can be viewed in numerous ways, but its core agenda is to keep a balance between environmental and human development activities (Sustainable Development Commission, n.d.)

In the year 2000, on the occasion of the Millennium Year, the Millennium Development Goals (MDG) was adopted at the Millennium Summit at the UN Headquarters in New York, which led to the formation of eight MDGs to reduce extreme poverty by 2015 (United Nations, n.d). The MDGs proved effective and helped lift more than 1 billion people out of extreme poverty, and hunger and to enable more girls to attend school. Although these were the successes of the MDGs were uneven, and inequalities persist. In 2015, all United Nations member states adopted the '2030 Agenda for Sustainable Development' and put forward the Sustainable Development Goals (SDGs) (The Millennium Development Goal Report 2015, 2015).

The SDGs benefit valuable lessons learned from the MDGs and also aim to finish the unfinished work carried out by the MDGs. Unlike the MDGs, the SDGs have evolved after a long and extensive consultative process which includes seventy open working groups, Civil Society Organizations, thematic consultations, country consultations, participation of the general public through face-to-face meetings, online mechanisms, door-to-door surveys, and so on.

To continue, the MDGs focused only on 8 goals, 21 targets, and 63 indicators, while the SDGs have 17 goals with 169 targets very importantly, the MDGs had a focus on developing countries while the funding came from rich countries whereas the SDGs both the developed and developing countries are expected to work to achieve the SDGs which have to achieve by 2030 (Kumar et al., 2016). All the SDGs are interconnected with one another, meaning achieving one SDG goal will directly or indirectly help to achieve another SDG goal massively. Of the 17 goals, one of the most crucial among them is SDG 14, which emphasizes 'Life Below Water'.

Life underwater is crucial because the Oceans cover 70 percent of the world's surface provide food, energy, and water, and absorb around one-quarter of the world's Carbon Dioxide ($CO_2$) emissions, thereby mitigating climate change and alleviating its impacts (GOAL 14: Life Below Water, n.d). Since time immemorial, the Oceans have been used for numerous reasons such as trade, fisheries, natural defense, and so on, but today in the 21st century, the value of oceans has increased more than in the previous centuries. Now the oceans are used for other activities such as deep-sea mining, internet cable networks, and so on. The fulfillment of SDG 14 will not only protect the Ocean ecosystem but will also help in economic enhancement for the coastal communities and can also help in maritime security and strategy. Activities protecting the oceans which will, in turn, help in the economic benefit for the local community is where the 'Blue Economy' takes shape.

The blue economy does not have one agreed-upon definition. The **World Bank** defines a blue economy as the "*Sustainable use of Ocean resources for economic growth*" (GOAL 14: Life Below Water, n.d). The **European Commission** defines it as "*All economic activities related to oceans, seas and coasts. It covers a wide range of interlinked established and emerging sectors*" (GOAL 14: Life Below Water, n.d). **The Commonwealth of Nations** defines it as "*An emerging concept which encourages better stewardship of our ocean or 'blue' resources*" (Sustainable Blue Economy, n.d.). The **Centre for the Blue Economy** claims, "*The sustainable use of Ocean resources for economic growth, improved livelihoods and jobs and Ocean ecosystem and health*" (Center for the Blue Economy, 2024). Madhushree Chatterjee, Secretary of UN-Water and current Chief of Natural Resources and Interlinkages Branch at the Division for Sustainable Goals of the Department of Economic and Social Affairs (DESA), stated "*Economy that comprises a range sectors and related policies that together determine*

*whether the use of ocean resources is sustainable*" (Center for the Blue Economy, 2024).

The blue economy constitutes a wide range of activities with the oceans in focus. It is an umbrella term that comprises a wide range of activities such as Tourism, Fishing, Aquaculture, deep-sea mining, and so on. The concept rose to prominence after the 2012 Rio+20 summit, where the Pacific SIDS countries adopted the blue economy to frame their interests. The Rio+20', discussed and elaborated on 'Oceans as Natural Capitals' wherein emphasis was given to natural infrastructure in the Oceans, which included coral reefs, mangroves, etc., and ecosystem services such as climate regulation offer important but under-recognized benefits with vast economic value, hence safeguarding these organisms is a need of the hour, speakers across a variety of events called upon the need for methods to quantify the value of ecosystem services often through Marine Protected areas (MPAs) or other enclosures ( Silver et al., 2015). After the Rio+20 summit, the world has taken this concept seriously, and almost all coastal states are framing their policies to harness the best out-of-blue economy. India has also taken important steps to enhance its blue economy ambitions. In the 2019 budget, the then Finance Minister Piyush Goyal put forth the 'Vision for New India 2030' which is a vision document stating what India should achieve by the year 2030. This document has a total of ten dimensions; the sixth dimension is that of improving India's blue economy (termed as Oceans and Coastlines). A draft policy document on the blue economy prepared by the Ministry of Earth Sciences (MoES) taking into consideration the reports of holistic development and growth in this sector; this draft was prepared in 2021 (StudyIQ IAS, 2022).

India has a natural advantage for the blue economy, with a coastline of 7516 kilometers and an exclusive economic zone of around 2.3 million square kilometers; it has two

archipelagic union territories on both the east and west sides off the coast in the form of the Lakshadweep and the Andaman and Nicobar Islands with around 1300 Oceanic Islands (Saha, n.d.), with such massive advantage India can not only carry forward its blue economy ambitions but can also be a global leader when it comes to this sector. With a blue economy, India can finally find a solution to meet its food security, energy security, unemployment, poverty, and many more, and there only needs to be proper policies and implementation.

Aquaculture and Seaweed farming are two of the fastest-growing industries in the blue economy sector, India, with a maritime zone of over 2 million square kilometers, can quickly gain the reputation of being the largest producer of Aquaculture fish and seaweed products. India enjoys a critical position in the Indian Ocean which, as of the 21st Century, is one of the essential oceans. The Indian Ocean comprises around half of the world's shipping, and about two-thirds of the global oil supplies travel across the Indian Ocean SLOCs (CaspianReport, 2018). The blue economy and SDG 14 can be considered almost synonymous as the basis for both ideologies is the economic exploration of oceans with minimal, negligible, or no damage caused to the ocean ecosystem.

## Rationale for Choosing this Topic

The Blue Economy refers to the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems. Sustainable Development Goal 14 (SDG 14) focuses on "Life Below Water" and aims to conserve and sustainably use the oceans, seas, and marine resources for sustainable development. India's Blue Economy plays a crucial role in contributing

to the achievement of SDG 14 for several reasons such as Economic significance, Fisheries and aquaculture, Marine biodiversity conservation, Climate Change Mitigation and Adaptation, Tourism, and International Collaboration in the areas such as the health of oceans, illegal, unreported, and unregulated (IUU) fishing, and marine pollution.

Thus, in essence, the rationale for exploring India's Blue Economy and its contribution to SDG 14 lies in the interconnectedness of economic development, environmental sustainability, and the well-being of coastal communities. By embracing sustainable practices, India can harness the potential of its marine resources while safeguarding the health and resilience of its oceans for current and future generations.

## Research Questions

1. How does the Blue Economy contribute to India's GDP, and what are the key sectors driving this economic impact?
2. How can India enhance fisheries management to ensure the long-term health of marine resources and achieve SDG 14 targets?
3. How can India leverage Blue Economy initiatives to contribute to climate change mitigation, specifically in the context of ocean-based renewable energy sources?
4. What policy measures are necessary to strengthen India's role in regional and global collaborations for the sustainable management of oceans?

## Objective of the study

1. To analyse how the Blue Economy helps in the sustainable development goal 14.
2. To recognise the potential of India's Blue Economy in the fulfilment of SDG 14.
3. To evaluate how India can achieve SDG 14 by using blue economy.
4. To analyse what are the steps taken by India to enhance its blue economy goals and how they will help in the fulfilment of SDG14.
5. What other necessary steps can India take to enhance its blue economy?

## Hypothesis

1. Increased investment in sustainable fisheries management practices within India's Blue economy will lead to the conservation of marine biodiversity, aligning with sustainable development Goal 14.
2. Strengthening international and national collaborations with stakeholders for effective maritime governance and enforcement of regulations in India's maritime zones will contribute to combating illegal, unreported, and unregulated fishing practices, promoting sustainable fisheries, and achieving Goal 14.

## Research Methodology

The study on India's Blue Economy and its alignment with Sustainable Development Goal 14 (Life Below Water) primarily employs a historical approach, focusing on past events, selected initiatives, and their chronological progression. To investigate India's

contribution to Goal 14, a qualitative approach is utilized. The study draws data from both primary and secondary sources.

Primary data sources comprise official statistics, reports, and datasets obtained from relevant government1 agencies, research institutions, and international organizations. Secondary data sources encompass books, journals, and newspaper clippings Additionally articles contribute valuable secondary data available in the library. This comprehensive method ensures a thorough exploration of India's blue economy evolution and its impact on achieving Sustainable Development Goal 14.

## Chaptarisation

1. Introduction
2. Sustainable Development Goal 14: Life Below Water
3. Understanding India's Blue Economy and Initiatives
4. The Synergy Between India's Blue Economy and Sustainable Development Goal 14
5. Challenges to India's Blue Economy
6. Conclusion

## Literature Review

“Blue Economy and competing discourses in international Oceans” by Jennifer. J Silver, Noella. J Gray, Luke. W Fairbanks, and Rebecca. L Grunly. emphasized on the differences between Green economy and Blue Economy, claiming whether Blue Economy is a component of Green Economy or a separate form of Global

Environmental Governance factor. It also states about the UNCLOS and how the law formalizes the right to coastal states to claim, access and manage resources within 200nm exclusive economic zone apart from that of the 70% of the total world's surface covered by the Oceans. Of the total Oceanic territory in the world, 42% is claimed by coastal states and 58% are high seas. emphasis was given on Oceanic natural infrastructure which included coral reefs, mangroves and so on, and ecosystem services such as climate regulation offer important but under-recognized benefits with vast economic value, hence protecting them is a must, speakers across a variety of events called upon the need for methods to quantify the value of ecosystem services often by various government policies 'Oceans as good business' were promoted by representatives of marine sectors like fishing and shipping and actors from various UN agencies, they emphasized on the economic scope of Blue Economy and leaders of different financial organizations expressed their view on the economic prospects of Blue Economy. 'Oceans as integral to Pacific SIDS' was also discussed, the Pacific SIDS countries talked about prioritizing usage of its Ocean resources without overexploiting it keeping in mind that their maritime territory is larger than their land territory.

"Blue Economy in the Indian Ocean Region" by Dominique Benzaken, speaks about the importance of Blue Economy in the Indian Ocean Region (IOR), which is the third largest Oceanic region with about 36.40 per cent of the world's population and how the Indian Ocean's health and resources are critical to the region's well-being and of dependent coastal populations. It mentions about regional initiatives such as the 2050 Africa's Integrated Maritime Strategy (2050 AIM-Strategy), the declaration of the decade of African Seas and Oceans (2015-2025) and the Blue Economy: A Policy Handbook. It also claims that the blue economy will be a vital factor for the fulfilment of the SDG goal 14. It also gives the insights on the various ocean activities conducted

and activities planning to be conducted in the IOR region. In this chapter detailed emphasis is being shown regarding Sustainable fisheries and Aquaculture, Shipping and Ports, Marine-based tourism, Seabed Mining, Oil and Gas, Marine Renewable energy, Digital connectivity, Marine Genetic Resources and Maintaining Ocean ecosystem services building climate resilience. All of the above activities are being conducted in either all the IOR countries or some or the other countries in the region depending on the nature of their resources and infrastructure and all of the above are vital for the growth and development of the region. It also states that since Blue economy and maritime security are the two sides of the same coin and there needs to be co-operation in the region for the control of illegal activities such as smuggling, IUU Fishing (Illegal, unreported and unregulated fishing) and so on. It also suggests that the Indian Ocean Rim Association (IORA) has the potential to bring about the necessary policy and bring about the necessary framework to bring member-states together for regional cooperation.

"China, Japan, India and the East Africa blue economy" by Aidan Buys examines the role of China, Japan and India in East Africa, particularly in the field of its Blue Economy, this paper focuses on China's role in terms of its One Belt One Road Initiative (OBOR) and Indo-Japanese Initiative of the Asia Africa Growth Corridor (AAGC). It emphasises on the economic performance of East Africa region wherein it is stated that two of the most important countries, Kenya and Tanzania are not only the fastest growing economies but they are also gateways for the neighbouring landlocked states, Kenya and Tanzania are ranked as stable powers as per the 2016 McKinsey Global Institute report 'Lions on the move', this report is based on the economic performance and political stability of African countries. Overall the East Africa region is one the fastest growing region in the African subcontinent. It gives a detailed emphasises on the

involvement of China, Japan and India in the region, the Chinese saw a significant expansion in the 1990s, throughout the 1990s and the early 2000s there was a demand in China for the mineral resources, manufacturing and agricultural goods, the Forum for China-Africa cooperation was established in 2000. When it comes to Japan, in 1993 the Tokyo International conference on Africa's Development (TICAD) formed in 1993 and since then it has been a key element to promote cooperation, aid, technology transfer and so on. And when it comes to India, India has strong historic ties with East Africa, however Africa has only prioritised India in its foreign policy vey recently, the India-Africa Business forum was established in 2010, despite trade between India and Africa have jumped from 5.3 Billion in 2001 to 75 Billion in 2014. it also emphasises on the projects initiated by China, Japan and India and the to the concretization of those projects, the three players have ambitious economic, political and diplomatic goals in this region and being in a strategic location it also is important in the security perspective.

"Harnessing the Blue Economy" by Vijay Sakhuja, basically describes the role of blue economy in South Asia and what initiatives the states of this region are taking to enhance their blue economy, emphasis was given on the five important coastal states of this region, these are India, Pakistan, Bangladesh, Sri Lanka and Maldives. The initiatives of these five countries were discussed in details. Bangladesh, in September 2014, they hosted a major conference in Dhaka and proposed the 'Bay of Bengal partnership for blue economy, Bangladesh also set the 'National Oceanographic research institute' for the marine scientific community teaching Oceanography at the Dhaka and Chittagong Universities. India being the largest country in the region with one of the largest EEZ in that region, the sea is vital for the nations economy, employability and livelihood, India's National institute of Ocean Technology (NIOT)

offers technical services and solutions for the management of ocean resources and environment. Maldives has its lifeline in the sea, in 2013 it presented its national report at the Atlantic, Indian Ocean, Mediterranean and south China sea (AIMS) regional preparatory meeting for the third conference of the SIDS in Seychelles, this report focused on the achievements and noted the country had pledged number of initiatives such as UNESCO biosphere reserves. Pakistan has a coastline of about 1050 kilometres and a 240,000 Km2 EEZ, in-spite of the huge potentials, the marine sector remains neglected, this paper has a lot of suggestions for Pakistan to enhance their blue economy such as Port Infrastructure, Fisheries, check on Illegal fishing and so on, the paper also brings into light the few challenges faced by Pakistan in building its blue economy, such as lack of financial and technology in the blue economy sector. Sri Lanka has endorsed the blue economy, Sri Lanka has identified a number of key areas to focus on, these include fisheries, tourism, renewable energy and so on. It also emphasised on the region's collective endorsement when it comes to blue economy.

"Socio-Ecological resilience in South Africa's blue economy: the role of marine protected areas" by Jean Harris and Amanda Lombard, emphasises in the importance in the creation of marine protected areas (MPAs) in the EEZ of South Africa. It emphasizes on how the how the African region is falling behind in terms of ocean protection, South Africa is a signatory to the Convention on Biological diversity, in terms of 2010 COP 10 biodiversity target 11, resolved that at least 10 percent ecologically representative spatial protection which was increased to 30 percent at the 2016 world conservation congress. When this article was published, South Africa has a network of 23 MPAs covering only 0.4 percent of its EEZ. The creation of MPA network is a specific goal of Operation Phakisa Ocean Economy lab, launched in 2014 to develop Africa's Ocean economy, this initiative is to help in the identification of new MPAs, MPA expansion

and so on. This is led by the South African national biodiversity institute with the support of South African department of science and technology. It also emphasizes on why it is important to create MPAs, it gives insights on the various damages caused to the ocean and its implications to the entire humanity, the ocean has a role right from regulating the air quality to influencing rainfall, and these oceans are facing widespread degradation like destruction of habitats, acidification and pollution of the oceans, destruction of oceans and so on. It further emphasises on the benefits of having MPAs, right from the protection of indigenous species to the prevention of invasive species, MPAs will also protect fish spawning and breeding and also limiting the role of fishing in these areas, apart from this MPAs are also low-tech, cost-effective climate adaptation strategies offering benefits at local and global scale and research shows that healthy ecosystems are more resilient to recover more quickly from damages.

“Blue Economy: A Road Map for the Future Planet” by Abhijit Mitra, Nibedita Mukhopadhyay and Sangita Agarwal talks about blue economy as a whole and how it will help in the betterment of the planet, the book claims that due to the increase in the world population there will be a burden on the Earth’s natural resources, the book claims that blue economy can be a solution to this. The book talks in details about the various blue economy sectors including the various forms of energy generation harnessed from the oceans. The book explains how the oceans and seas cover around ¾ of the world total surface area and gives details on the geographical area of the oceans and important seas along with the volume (cubic kilometres), furthermore the book gives us insights on the various geographical areas of the sea. The book also talks about the various marine organisms living in the oceans and the estuarine ecosystems. Laws and policies regarding blue economy were also discussed, policies by both international organizations and Indian government were highlighted.

“Maritime Power through Blue Economy: In the Indian Context” by Somen Banerjee talks about the importance of Blue Economy, its various sectors and how it will help in the development of the maritime sector in India. The book also talks about how Blue Economy also contributes in the wider maritime security of India. It emphasises on how SDG 14 will in turn help in achieving other SDGs such as SDGs 1, 2, 4, 8, 9 and so on. The research talks about the various blue economy sectors and the various government agencies that deal with and these sectors. Furthermore, the research gives suggestions and strategies on how India can capitalise on the existing blue economy. Further the research also mentions inland waterways and how India can capitalize on its inland waterways, in the conclusion the research emphasized on how China has already realized the value of Blue Economy and how it is leveraging it to become a maritime power.

“India’s Waters: Environment, Economy and Development” by Mahesh Chandra Chaturvedi published by CRC press, talks about the geography of India and the environment of India. It emphasises the potential of water development. It also mentions the historical perspective and is discussed in enormous detail. The book also discusses. The author claims that the book is generally based on the study by the National Commission for Integrated water resources Development (NCIWRD 1999) to conform to the official perceptions. In The book water for drinking and sanitation is given the topmost priority, including the supply of water in the rural and urban areas. Water for irrigation accounts for the dominant demand and has been the focus since time immemorial. Irrigation and hydroelectricity accounts to majority of the withdrawals. Technology and social organizations are two tools with which society transforms physical resources with human labour. The book also emphasises on the various challenges regarding water resources in India, the greatest among these challenges is

that of scarcity of drinking water to a lot of people and also other major issues such as agricultural pollution, industrial pollution, domestic pollution, watershed and catchment degradation, groundwater degradation and depletion, biodiversity loss and wetland reduction, river regime and quality, and so on. Although there are also suggestions on how to avoid the above problems, the lack of seriousness within the organizations responsible are the main cause of continuous degradation.

## Chapter II

# Sustainable Development Goal 14: Life Below Water

## Overview of SDG 14 and its targets

SDG indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development, was developed by the Inter-Agency and Expert Group on SDG indicators (IAEG-SDGs) and agreed upon at the 48th session of the United Nations Statistical Commission held in March 2017. The global indicator framework was later adopted by the General Assembly on July 6th, 2017, and is a part of the Resolution adopted by the General Assembly on the work of the Statistical Commission pertaining to the 2030 agenda for sustainable development Annex**.** As per the above resolution, the indicator framework is to be revised every year and also be reviewed comprehensively by the Statistical Commission at its 51st session in March 2020, and its fifty-sixth session which is to be held in 2025.

The global indicator framework includes 231 unique indicators. However, the total number of indicators listed in the global indicator framework of SDG indicators is 248, wherein thirteen indicators repeat under two or three different targets (United Nations Statistics Division, n.d.).

The targets of Sustainable Development Goal 14 have a total of ten targets which are to help conserve the Oceans and seas. These are as follows: -

**Target 14.1 Reduce Marine Pollution: -** The aim of this target focuses on preventing and significantly reducing marine pollution of all kinds by the year 2025, in particular land-based activities which include marine debris and nutrient pollution.

**Target 14.2 Protect and Restore Ecosystem: -** This target aims to sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, this includes strengthening their resilience and taking action for their restoration to achieve healthy and productive oceans. This was to be achieved by the year 2020.

**Target 14.3 Reduce Ocean Acidification: -** Aims to minimize and address the impacts of Ocean acidification, including through enhanced scientific cooperation at all levels.

**Target 14.4 Sustainable Fishing: -** Aims to effectively regulate harvesting and end overfishing and effectively regulate Illegal, unreported, and unregulated fishing practices (IUU), prevent destructive fishing practices, and implement Science-based management plans. To restore fish stocks in the shortest time possible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics. Like target 14.2, this target was also aimed to be completed by 2020, however, it wasn't possible.

**Target 14.5 Conserve Coastal and Marine Areas**: - Aims to conserve at least 10 percent of coastal and marine areas, consistent with national and international law and based on the best available scientific information. This was to be fulfilled by the year 2020, however it got implemented in March 2023, with the passing of the High Seas treaty.

**Target 14.6 End Subsidies contributing to Over-fishing**:- Aims to prohibit certain forms of fisheries subsidies that contribute to overcapacity and overfishing, also to eliminate subsidies that contribute to Illegal, unreported, and unregulated fishing (IUU)

and refrain from introducing new subsidies. Further, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization (WTO) fisheries subsidies negotiation.

**Target 14.7 Increase The Economic Benefits of Sustainable Use of Marine Resources: -** Aim to increase the economic benefits to Small Island Developing States (SIDS) and least developed states from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture, and tourism. This target is set to be achieved by the year 2030.

**Target 14.8 Increase Scientific Knowledge, Research, and Technology for Ocean Health:-** Aims to increase scientific knowledge, develop research capacity, and transfer marine technology, taking into account the Intergovernmental Oceanic Commission Criteria and Guidelines on the transfer of Marine technology, to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particularly the Small Island Developing States (SIDS) and the least developed countries.

**Target 14.9 Support Small-Scale Fishers: -** Aim to provide access for small-scale artisanal fishers to marine resources and markets.

**Target 14. 10 Implement and enforce international Sea Law:-** This is the last of the targets of SDG 14 and it aims to enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in the United Nations Convention on the law of the Sea (UNCLOS), which provides the legal framework for the conservation and the sustainable use of the Oceans and their resources, as recalled

in paragraph 158 of the “The Future we want” (Goal 14: Life Below Water - the Global Goals, 2023).

## Importance of Marine Ecosystems for Global Sustainability

The definition of an ecosystem is “*A group of living organisms existing in a network of interactions with each other and their environment”*. Marine ecosystems are part of the largest aquatic system of our planet, covering more than 70 percent of our planet. The habitats are very diverse range and makeup from productive nearshore regions to the Ocean floor, these ecosystems include salt marshes, coral reefs, mangrove forests, and so on. It is said that there exists a living organism in almost every cubic inch of the Ocean’s 326 million cubic miles (1,358,827275.1 cubic kilometres) of water ranging from bacteria and other microscopic organisms to the largest living organism in the world like the Blue Whale and the Whale Shark. All are connected by feeding strategies and every organism sustains on each other with regards to consumption, in the Ocean even the apex predator is vulnerable to threats (United Nations, 2009).

Apart from the above-mentioned characteristics of the Oceans, it is also extremely vital for the survival of human beings. The oceans are a source of food, energy, minerals, and transport. The Ocean economy will be worth an estimated 3 trillion dollars by the year 2030, which is around 5 percent of the world GDP. An estimated 63 percent of the total value of the biosphere is contributed by marine ecosystems, mostly coastal ecosystems. The Ocean acts as a heat sink absorbing around 90 percent of excess heat caused by Global Warming and around 25 percent of carbon emissions (Baker et al.,2009). Climate change is one of the leading factors and its effects include sea level rise, ocean acidification, and ocean warming, combined with pollution, climate change also leads

to ocean de-oxygenation and other disruptions and so on, these adverse effects in turn causes the degradation of Ocean food webs, anoxic conditions, mass die-offs and species decline.

In the past few decades, the general approach to Ocean governance has evolved from a sectoral development to a more integrated, cross-sectoral management focus. Wider ecosystem approaches also help in the management and conservation of biotic and abiotic assets are increasingly being adopted, reflecting the full range of human impacts and social and economic considerations. There are various drivers of biodiversity loss in the ocean this includes direct exploitation of organisms (for example: - Overfishing, bottom trawling, etc), changes in land and sea use, marine pollution in all its forms, including waste-water and agricultural run-offs, and climate change. Loss of biodiversity and the erosion of ecosystem functions economic, social, and cultural life (Baker et al.,2009).

The United Nations Convention on the Law of the Sea (UNCLOS) identifies different marine spaces between areas within national jurisdiction, the Exclusive Economic Zone (EEZ), ecological protecting zone, and the high seas and seabed area. the UNCLOS also provides a legal framework for all activities in the Oceans and Seas, including the conservation and sustainable use of marine biodiversity beyond areas of national jurisdiction. UNCLOS obliges states to protect and preserve the marine environment (Addis, n.d.).

While countries are responsible for the conservation and sustainable use of waterways under their national jurisdiction, the high seas are now only protected after the High Seas Treaty passed in 2023. Adopted by the Conference on Marine Biodiversity of Areas Beyond National Jurisdiction (BBNJ), the ‘High Seas Treaty’ aims to take stewardship

for the present and future generations in line with the existing UNCLOS. The new agreement contains 75 articles that aim for the protection and nurturing of the marine environment. One of the main aims of the treaty is to ensure Cleaner Oceans from various toxins and millions of tons of plastic waste, emphasizing the fact that more than 17 million metric tons of plastic waste entered the world's oceans in 2021, constituting around 85 percent of total marine litter and projections of it doubling or tripling each year by the year 2040, according to the Sustainable Development Goals report. according to UN estimates, by 2050 there could be more plastic than fish in the sea. Sustainable Management of fish stocks is another aim of the treaty which emphasizes the importance of capacity building and transfer of marine technology, including the development and strengthening of institutional capacity and national regulatory framework or mechanisms.

Countering global warming is another measure to be taken under this treaty, to prevent rising sea levels and salinization of coastal lands and aquifers, treaty has provisions to recognize the rights and traditional knowledge of indigenous people and local communities, the freedom of scientific research, and need for the fair and equitable sharing of benefits. One of the most important aims of the High Seas Treaty is to accelerate the efforts of fulfilling SDG goal 14, by the year 2030 (UN News, 2023). However, the Oceans and the seas can only be protected if we can first find out what are the main issues that lead to unhealthy oceans.

Five main issues contribute to the decline of Ocean health, they are:

**Climate Change: -** The oceans absorb 93 percent of excess heat due to climate change, which impacts habitats and disrupts the sensitive natural balance, along with that the oceans absorb around 23 percent of human-caused $CO_2$ emissions (World Economic

Forum, 2022). however, over the past years these $CO_2$ emissions have built up beyond the ocean's capacity to absorb them, thus forming carbonic acid which contributes to the acidity of the oceans. A warmer and more acidic ocean poses a grave threat to the marine ecosystem, especially the delicate ecosystems, the current projections claim that the ocean can warm up by an additional five degrees by the year 2100 if no proper action is taken. Ocean warming is directly linked to the extinction and displacement of species and has severe negative impacts on communities and economies that rely on fishing and other economic activities that are ocean-based. Ocean acidification is not just limited to that, gradual acidification also affects ocean health, disproportionately impacting some critical ecosystems including coral reefs, leading to a greater risk of ecosystem collapse. Changes in ocean acidity have seen pH decrease by 26 percent since the beginning of the Industrial Revolution. Today the current rate of acidification is ten times faster than it was in any period during the preceding 55 million years (World Economic Forum, 2022).

The combined impacts of a warming climate and a warming ocean could together contribute to a sea level rise of up to 25 cm by the year 2040-2050, causing adverse impacts in low-lying coastal regions and habitats across the world. Hence it is evident that for the mainland to remain healthy, the oceans must remain healthy (World Economic Forum, 2022).

**Ecosystem Destruction: -** The ocean is facing ecosystem destruction in varying degrees, this is mostly driven by human activities and can be witnessed across ecosystems including seagrass, and coral reefs, in fact more than half of global seagrass and coral reefs have been already lost as a result of ongoing habitat destruction the rate of net loss for mangroves has been declining to about 0.04 percent as of the year 2020 (World Economic Forum, 2022). The interconnected nature of mangroves, with other

tidal wetland systems and terrestrial, freshwater and marine habitats means that restoration of already lost ecosystems may take a very long time.

The ongoing diversification of human activities in the ocean is also opening up new challenges for the conservation of marine life, especially in industries like energy production and mining. It is projected that more than 90 percent of global coral reefs will be threatened by 2050, and nearly all will be affected by ocean warming and acidification (World Economic Forum, 2022).

**Overexploitation: -** It is not, that we are unaware of the fact that the oceans and seas face overexploitation and it will get worse if no proper action is taken. Currently, around 65 percent of the marine fish stocks are exploited to the maximum capacity, with another 35 percent being overfished (World Economic Forum, 2022). This situation has become more serious in the southeast Pacific, Mediterranean, and the Black Sea. The decline of fish stocks is driven by market forces and poor governance. Today just 2.8 percent of the ocean surface is protected from the effects of fishing (World Economic Forum, 2022). The risk continues and further evolves as new industries such as seabed mining see growing interest in the oceans. The International Seabed Authority (ISA) has issued 31 contracts to explore deep sea minerals to date. More than 1.5 million square kilometers of the seabed is now reserved for exploitation (World Economic Forum, 2022). This mining poses risks to ocean ecosystems through disturbance of the seafloor, negative impacts of sediment plumes, noise, vibration, and light pollution. Cross-sector public-private partnerships are crucial to address these emerging risks, and limit overexploitation.

**Pollution:** - Another major area that contributes to the decline of ocean health is pollution, mostly from land-based sources. Plastic accounts for around 85 percent of

marine pollution, with around 8 million tons of plastic entering the ocean each year (World Economic Forum, 2022). This was increased after the COVID-19 pandemic, leading to a huge increase in healthcare products such as the consumption of masks, sanitary bottles, delivery packaging, and other single-use items. An estimated consumption of 129 billion face masks and 65 billion gloves every month (World Economic Forum, 2022). While an estimated only three percent of global plastic waste enters the ocean, it makes up 80 percent of all marine pollution (World Economic Forum, 2022). Marine pollution requires a committed shift towards a circular economy approach that reduces waste and cuts pollution. If this is met then it could also unlock a 4.5 trillion economic opportunity through reduced waste, improved innovation, and expanded employment (World Economic Forum, 2022). According to research, a circular economy approach could reduce by 80 percent the volume of plastics entering the ocean by 2040 (World Economic Forum, 2022).

**Ineffective Governance**: - Ineffective governance is also one of the major causes of ocean health degradation. Although there are provisions prescribed by coastal state governments, International Organizations, local bodies, and so on, however, management of the oceans is a complex web of actors at various levels, and each comes with interrelated, intertwined, converging, and competing demands and interests. The modern governance framework reflects this disaggregation. Each body will likely operate within a narrow and defined functional or territorial mandate. Today the Ocean is regulated by 576 bilateral and multilateral agreements, including the UNCLOS and the High Seas Treaty mentioned previously in this chapter(World Economic Forum, 2022). Addressing global challenges will require an integrated and holistic approach to ocean management to stop and reverse the current decline in ocean health (World Economic Forum, 2022).

## Relevance of SDG 14 to India's Maritime Context

India has a unique maritime position with a total coastline of 7517 kilometres, along its coastline there are nine coastal states and 1382 islands. India has 12 major ports and 187 non-major ports. India's Exclusive economic zone is over 2 million square kilometres and is rich in living and non-living resources including recoverable resources of crude oil and recoverable natural gas (Government of India, 2020). The coastal economy sustains over 4 million fishermen and other coastal communities. With such characteristics, India's Blue Economy plays a vital role in the nation's economic growth (Government of India, 2020).

The Indian coasts vary widely in their structural and surface characteristics. The west coast of India is much narrower compared to the east coast except for the Gulf of Cambay and the Gulf of Kutch, where partly due to sedimentation and partly on account of the isostatic adjustments, the plains are wide enough. The Girnar hills, the volcanic cones, appear to be an extension of the older landmass probably separated during the foundering of the west coast. The two gulfs might have been linked together. The silting probably left no scope for dispositional action of the rivers of the west coast and it still retains its narrow extent throughout its length south of Gujarat to the Cape Comorin. It is only in the extreme south that they are somewhat wider along the Western Ghats. A characteristic of this coast is the backwaters. The east coast plains in contrast with the west coast plains are broader, associated with the depositional activities of the rivers, partly owing to the change in base levels. Extensive deltas of rivers such as the Mahanadi, the Godavari, The Krishna, the Kaveri, and so on are characteristic features

of the coast. The progression of the deltaic plains to the sea continues today. Physio-graphically, the coasts are subdivided into-

1. Gujarat Coast
2. West Coast
3. East Coast

The Indian drainage may broadly be divided into Bay of Bengal drainage and the Arabian sea drainage, with distinct water partings. It is distinguished as the Himalayan drainage and the peninsular drainage, although the peninsular streams such as the Chambal River, the Betwa river, the Son River are much older in age and origin, they form part of the Himalayan drainage system (Chaturvedi, 2011, p. 14).

It is necessary that India strives for efficient and sustainable development in the maritime domain. These initiatives are catalysts to strengthen India's maritime interest and Blue Economy. It is speculated that post COVID-19, that India will grow in its marine sector. India should strive for efficient and sustainable utilization of Ocean resources and to integrate and boost Ocean related capabilities, capacities and skills with a view to accelerate employment and gross value addition, while safeguarding the environment and in harmony with the UN Sustainable Development Goals.

India is one of the first country in the world to create a Department of Ocean Development in 1981, now called the Ministry of Earth Sciences (MoES), throughout its existence it has launched initiatives such as "Deep Sea Missions", "Oceanography from Space" and launching of the data buoys" along the Indian Coastline. These initiatives have enabled satellites to transmit data on various oceanographic features including weather for scientific analysis. The MoES joined the UN's "Clean Seas Programme" to develop strategies for estimating and reducing marine litter in the

oceans. The MoES has also signed two contracts with the International Seabed Authority (ISA) for deep Ocean exploration of minerals such as Polymetallic Nodules and Hydrothermal Sulphide in the Indian Ocean.

The government of India's Vision of India by 2030 enunciated in February 2019 highlighted the blue economy as one of the ten core dimensions of growth, the Blue Economy was mentioned as the sixth dimension of the vision emphasising on the need for a coherent policy integrating different sectors to improve the living standards of the coastal communities and accelerate development and employment. The Prime Minister of India Narendra Modi in his 74th Independence Day speech in 2020 highlighted in the contemporary context a neighbour which is not just a one whom we share a physical border but also, but with those whom we also have a harmony in relations. There is also an ongoing objective to connect India's islands at par with the services of the mainland (Buys, 2018).

India's blue economy today plays an even more significant role as the rise of emerging powers in the Indo-Pacific since the late 20th century and represents a fundamental shift in the global balance of power, especially with the rise of China. India is also set on strengthening its power in the Indian Ocean (Sattva Consulting, 2023). As of 2022-23, India ranks 70th in the world when it comes to SDG 14. One of the main steps taken is through the Marine Protected Areas (MPA), which has been used to manage natural marine resources for biodiversity conservation, India has identified 129 MPAs, however, this accounts for less than 0.3 per cent of the total geographic area, 26 per cent of which lies only in West Bengal. Apart from protecting coastal environments, ensuring quality water in coastal waters and rivers can help improve the life below water.

Three important parameters which determine the quality of seawater are- dissolved oxygen, nitrogen content and pH of the water, it is really important to maintain a balance

between the three to make it safe for living organisms. In India, a pH value between 6.5 to 8.5 is considered safe. The central pollution control board data shows that in 2019, water in the river Ganga was acidic with a pH level of 6.05, while the river Krishna had an average pH value of 8.25, which makes it very alkaline, and harmful to aquatic life (India Development Review, 2022).

Sustainable fishing is also critical to ensure life underwater. In 2011-2012, at a constant basic price, the share of fishing and aquaculture in India's GVA (Gross Value Add) was only 68,027 crores, however, by 2019-2020, this had increased to 1,26,370 crores- 85 per cent increase. This industry constitutes 0.95 per cent of India's total GVA, a 40 per cent increase since 2011-12 (India Data Insights. 2022). The growth in fishing and aquaculture share is a result of India becoming the 2$^{nd}$ largest fish-producing country in the world, with around 7 per cent of the world's total fish production coming from India (India Data Insights. 2022).

In the year 2019-2020, India produced 14,164 thousand tonnes of fish, with 74 per cent coming from inland fisheries and 26 per cent from marine fisheries (India Data Insights. 2022). However, despite a huge increase in fish production, the share of marine fish production has declined. With India's fishing and aquaculture booming, sustainable fishing and aquaculture practices should also be taken into consideration to ensure we meet SDG 14.

SDG 14 aims to conserve and sustainably use the oceans, seas, and marine resources for sustainable development, we cannot ignore the fact that freshwater also plays a vital role in preserving marine life. Over the last six years, a total of 1058 crore rupees have been invested for the cleaning and preserving of fresh water bodies, some examples of

freshwater cleaning are related to the clean Ganga and Swachh Bharat Kosh (India Data Insights. 2022).

## Chapter III

# Understanding India's Blue Economy Initiatives

## Principles of Blue Economy and India

The blue economy has been practiced by human beings since time immemorial. Since the beginning of human civilization, practices such as fishing, marine transport, and so on have been carried out by human beings across the world. However, the economic philosophy of the Blue Economy was first introduced in 1994, by Professor Gunter Pauli at the United Nations University (UNU), to reflect the need for future growth and prosperity, alongside countering the threats posed by global warming. However, the concept of a blue economy assumed greater importance after the Rio+20 conference in 2012. The concept is based on developing more sustainable models of development including concepts of engineering based on "no waste emissions" (MOES, 2023).

The year 2023, marked a very significant year in the history of India's diplomacy and global importance as India chaired the G20 summit. During the G20 presidency, there was a two-day G20 Environment and Climate Sustainability Working Group (ECSWG) and environment and climate ministers meeting that concluded by adopting a series of "Chennai High-Level Principles" for a sustainable and resilient blue economy. Officials in the environment ministry claimed that these principles will "serve as a guiding framework globally to drive the transition to a sustainable and resilient blue economy" (Nandi, 2023).

As mentioned in Chapter 2, due to climate change, there are growing threats to the oceans such as acidification, degradation, and so on, and the increasing intensity and frequency of natural disasters are impacting the availability of marine resources and

consequently the lives and the livelihoods of the people who depend on it. The G20 high level has drafted the below principles on sustainable and climate-resilient blue economy. The G20 high-level principles on sustainable and climate-resilient blue economy propose a holistic framework integrating the various aspects of human development, environmental conservation, climate resilience, and economic growth. This was building upon the 2030 agenda for sustainable development, the Global Biodiversity Framework, and the broader G20 efforts to promote sustainable growth. The G20 also encourages that these principles be taken into account by all countries, consistent with their national systems and priorities, legislation, and governance frameworks, and by relevant development partners. This will ensure a strong response to future demographic, social, economic, technological, and environmental challenges, and improve the quality of life and livelihood for the present and future generations, leaving no one or no region behind.

The G20 high-level principles on sustainable and climate-resilient blue economy has a total of eight principles which are the following: -

**Principle 1. Implementing effective and participatory cooperation frameworks**: - Since international waters make up 50 percent of the surface area of the earth (Ministry of Earth Sciences, n.d.). Ensuring their sustainable use requires strong cooperation between governments and at national as well as subnational or local levels. To enable this, legal and institutional frameworks should as appropriate, support and encourage effective integration, collaboration, and a long-term sustainable development vision.

In Chapter 2, the high seas treaty was mentioned, if implemented properly it can meet the need for the protection of the high seas on a massive scale.

**Principle 2: Strengthening resilience and adaptive capacities: -** A regional planning approach should be available to address existing and potential threats and vulnerabilities arising from extreme weather events as well as slow-onset changes.

**Principle 3: Fostering inclusion: -** A sustainable blue economy requires effective stakeholder management and participation. People-centered approaches need to empower individuals and communities to participate in planning and implementation processes. National and sub-national or local policies as well as regional cooperation frameworks must ensure the protection of human rights and maintain socioeconomic harmony.

**Principle 4: Mainstreaming ecosystem-based marine spatial management**: - Ecosystem-based marine spatial management is an approach that recognizes the full array of interactions within an ecosystem, including human uses. Adopting such an approach at regional levels would.

1. Balance the increasing number, diversity, and intensity of human activities with the ocean's ability to provide ecosystem services.
2. Incorporate appropriate ecological, economic, social and cultural perspectives.
3. Support management that is coordinated at the scale of ecosystems as well as political jurisdictions.

**Principle 5: Leveraging innovation and digital technology: -** Creating a sustainable blue economy requires a concerted focus on encouraging innovations that minimize the environmental impact of sectors and industries related to the oceans and coastal areas. Technology-based innovations offer new solutions to achieve circularity (zero waste, zero pollution), ensure climate neutrality, and protection of the investment in nature and biodiversity.

**Principle 6: Ensuring gender equality**: - The regional policy frameworks must integrate gender equality in all areas possible. Adopting a gender-inclusive perspective in regional planning and infrastructure investment would lead to increased health, social, and economic benefits and contribute towards a more sustainable blue economy.

**Principle 7: Recognizing, Protecting, and using traditional knowledge systems**: - The understanding and management of the marine environment requires benefiting from, respect for, and including, traditional knowledge, systems to recognize and value the intangible relationship between humans and ecosystems. Protecting them is vital to ensuring community engagement and inclusion as well as implementing effective participatory conservation methods.

**Principle 8: Enhancing access to long-term finance**: - Ensuring sustained and equitable socio-economic growth requires public finance as well as the adoption of a mosaic of new approaches including blended finance mechanisms to unlock private capital. This requires the creation of institutional, legal, and regulatory frameworks that can mobilize investments and ensure accountability and transparency.

The G20 engagement group met at Diu on 18$^{th}$ and 19$^{th}$ May 2023 as part of the Research and Innovation Initiative Gathering (RIIG) which was hosted by the MoES. The G20 RIIG meeting with the theme "Scientific Challenges and Opportunities for a Sustainable Blue Economy" was organized by the Department of Science and Technol ogy (DST).Globally renowned scientists, decisionmakers, and business professionals a ttended the conference.by giving G20 countries a platform to share information, exper ience, and tactics, the RIIG summit will be essential in advancing sustainable develop ment worldwide.

The RIIG meeting under MoES discussed topics such as:-

1. Marine pollution.
2. Marine living resources.
3. Observations, data, and information services.
4. Coastal and marine spatial planning.
5. Coastal and deep-sea mining, new and renewable offshore energy (Ministry of Earth Sciences, n.d.).

## Key sectors of India's Blue Economy and their contribution to GDP

India has a coastline of around 7516 kilometers and has an exclusive Economic Zone (EEZ) of more than 2.37 million square kilometers, with nine coastal states and four union territories along its coast, it is evident that there are a wide range of economic activities taking place along the coastline and also offshore (PIB, 2022). With each coastal region having its unique features and characteristics it provides an even wider range to carry out blue economy activities. India’s strategic location along the Indian Ocean and the Indo-Pacific as a whole provides an additional advantage to the subcontinent. India’s coastal population is around 170 million which is more than 12 percent of the national population, India’s coastline is home to major Indian cities such as Mumbai, Surat, Chennai, Cochin, Mangalore, and so on (Shridhar, 2017). Since ancient times India’s trade routes had very high importance, they not only helped trade between foreign countries to inland India but also the ports acted as an intermediate from Europe/Arab/Africa to the Far East. Today India is considered as one of the most

important players in the Indo-Pacific. India must invest more and form policies in the blue economy sector to get to its full potential in this sector.

The following maritime blue industries contribute to the GDP of India: -

**Fisheries: -** The fish and fish products sector has emerged as one of the largest export sectors of India. The export market of India has diversified over time. India is the third largest fish producer in the world (PIB, 2023). There are several commercially valuable sea fish species and resources in India some examples being Sardines, Mackerels, Carangids, lizard fishes, jew fishes, sharks, Rays, and so on. The development of the fisheries sector in India has taken off only post-independence. This was possible through the five-year plans which led to the advent of bottom trawling and the modernization of fishing vessels in the 1960s. The yearly fish production climbed from 0.3 million tons in the 1950s to 2.4 million tons in the late 1990s as a result, leading to a significant increase in depth and exploitation (Ayyapan, 2019, p.3). India now has 4.41 million tons of fisheries potential (Ayyapan, 2019, p.3). India has 3.15 million hectares of reservoirs, 2.5 million hectares of ponds and tanks, 1.25 million hectares of brackish water area, cold water resources, and all other inland fishery resources offer production potential of about 15 million tonnes, in addition to its more than 2 million square kilometer EEZ (Ayyapan, 2019, p.3).

The following are significant marine fisheries resources in the nation:-

1. Pelagic resources- Mackerel, Sardine, ribbonfish, Tuna and so on.
2. Demersal resources- Perches, pomfrets, flatfishes, eels, sharks, and so on.
3. Mid-water resources- Bombay duck, Silver bellies, Horse Mackerel, and so on.
4. Crustaceans- Crabs, Prawns, Lobsters, shrimps and so on.
5. Molluscs- Oysters, Mussels, Clams, Squids, and so on.

6. Seaweed resources.

Gujarat, Tamil Nadu, Kerala, West Bengal, and Maharashtra are the coastal states that provide around 59.2 percent of the nation's marine seafood production (Ayyapan, 2019, p.3). State West Bengal contributes the maximum production with 2,259 tonnes/km followed by Karnataka with 953 tonnes/km, Kerala with 878 tonnes/km, Goa with 682 tonnes/km, Tamil Nadu with 496 tonnes/km and Maharashtra with 439 tonnes/km. although the east coast has 57.2 percent of the coastline it contributes only 28.8 percent of the total fish production, 70.2 percent is contributed by the west coast (Ayyapan, 2019, p.3). As of 2019, there are around 279,546 fishing crafts comprising 53,684 mechanized boats, 44,578 motorized crafts, and 181,284 non-mechanized crafts in operation (Ayyapan, 2019, p.3).

**Aquaculture and Mariculture**: - India has the second largest aquaculture, the share of inland fisheries and aquaculture has gone up from 46 percent to more than 85 percent in recent years aquaculture grew by ten times in the 1980s from 0.37 million tonnes to 4.03 million tonnes in 2010, a mean annual growth rate of about 6 percent (Fisheries & Aquaculture, n.d.) . Freshwater aquaculture contributes over 95 percent of total aquaculture production in India. In the freshwater aquaculture industry, the main fishes reared are Carp, Catfishes, Tilapia, Prawns, Pangasius, and so on. Brackish water forms the bulk of major areas of aquaculture activities, the three major carps reared in India are the Catla (*Catla catla),* Rohu (*Labeo Rohita)* and Mringal (*Cirrhinus Mrigala*), the above three species contribute to the bulk of production to the extent of 70 to 75 percent of total freshwater production (Fisheries & Aquaculture, n.d.). Other major freshwater fishes reared are the Silver Carp, Common Carp, and Catfishes forming the rest of the 20 to 25 percent of the freshwater production. However, only 40 percent of the available area of the 2.36 million hectares of ponds and tanks has been put to use (Fisheries &

Aquaculture, n.d.). The national mean production levels have risen from about 600 kg/hectare to 2900 kg/hectare per annum (Fisheries & Aquaculture, n.d.).

When it comes to the Mariculture Industry, mariculture is an option for supplementing the traditional capture fisheries, however, the majority of the mariculture produce in India is that of shellfish such as mussels, oysters, crustaceans such as crab and lobster and seaweeds such as *Gracilaria, Gelidiella, Sargassum, Turbinaria*, and so on. Of the two most important mussel species, the Green Mussel (*Perna Viridis*) and the Brown Mussel (*Perna Indica*), the culture of mussels includes the Rack method, long line, and craft method, the culture is dependent on the depth of the water and nature of the site. Commercial mussel production increased from a mere 20 tonnes in 1996 to a massive 18,432 tonnes in 2010 (Ayyapan, 2019, p.7). When it comes to Oysters, the Indian Backwater Oyster (*Crassostrea Madrasensis*) is the most important species and has a wide distribution, oyster farming has two types, the Rack method and the Tray method, the production levels of around 120 per hectare/year are achieved through the Tray Method (Ayyapan, 2019, p.8-9). The production increased from 5 tonnes in 1996 to 2450 tonnes in 2010 (Ayyapan, 2019, p.8-9). This is mainly from Kerala, of the pearl-producing oysters the Golden Pearl Oyster, producing golden pearls, (*Pincadta Fucata*) produced in the Gulf of Mannar and the Gulf of Kutch, and the Black lip pearl Oyster (*Pincadta Margaritifera*) in the Andaman and Nicobar producing black pearls. When it comes to seaweed farming, although around 60 commercial species are found in India, only a handful are cultivated and are mostly done on the coasts of Gujarat and Tamil Nadu.

Sea cages also provide potential for the growth of mariculture. In India, sea cage farming is not explored very much. For mariculture to be successful, the potential mariculture sites should be mapped concerning the prevalent tidal and wave conditions,

aquatic quality, and pollution. The potential fishes for cage culture include Seabass, Snappers, Groupers, Rabbitfish, and Cobia. Some success has been achieved in the cage culture of Seabass and Cobia. However, little has been done for the exploration and research of the cage fishing industry, if developed properly then it can gain huge potential for the fishing market. Another mariculture produce that can gain huge potential is of the Sea Cucumber which has high demand worldwide and must also be explored (Ayyapan, 2019, p.8-9).

**Marine Transportation and Shipping: -** The maritime transportation sector includes Ports, Shipping, shipbuilding, ship repair, and Inland transport systems. The Ministry of Shipping is the nodal central agency administering the issues related to them. India has around 13 major ports and around 200 minor ports (Shipping, n.d.). The major ports are administered by the union government while the non-major ports are administered by the state governments. The newest major port was Port Bair, which was declared a major port on June 1$^{st,}$ 2010. The 13 major ports carry the majority of the bulk of the traffic (Shipping, n.d.). Out of the 200 ports, most of them are not properly developed. As per the data of 2013-2014, only 61 non-major ports were reported to have handled cargo traffic. The shipping services in India are patterned similarly to the global shipping services, namely tramps and liners. About 95 percent of India's EXIM merchandise trade by volume is moved through the sea route (Shipping, n.d.). The types of ships that are used for overseas trade in India are Dry Cargo Bulk Carriers, Ore/Oil/Bulk carriers, LPG carriers, and so on. The shipping industry also caters to the requirements of coastal trade and offshore supply vessels (OSV) or ONGC and GAIL. India has the 20$^{th}$ largest merchant shipping fleet in the world (Shipping, n.d.). The **Indian shipbuilding industry** accounts for around 1 percent of the global shipbuilding market share. India, as of the year 2018, has 27 shipyards, 19 of which belong to the

private sector (Dasgupta, n.d). The total shipbuilding capacity of Indian shipyards was around 0.5 million deadweight tonnage (Dasgupta, n.d). The major players in this market are the private sectors the ABG shipyard and the Bharti shipyard and the largest government controlled are the Hindustan Shipyard and the Cochin Shipyard, the above four combined account for over 70 percent of the cumulative market share (Dasgupta, n.d). The **shipping industry** is also a major maritime industry, as of 2018 there exist around 235 shipping companies in India in the shipping corporation of India has one of the largest shipping industry accounting for over 30 percent of the total tonnage (Dasgupta, n.d). India has one of the largest merchant shipping fleets with around 997 as of 2018, ranking 17$^{th}$ in the world (Dasgupta, n.d). Another maritime industry that is not highlighted very much is the **Ship-breaking Industry,** the Indian ship-breaking industry has a world market of around 25 percent (Dasgupta, n.d). Alang in Gujarat is one of the largest shipbreaking yards in the world, other shipbreaking yards in India are in Pipavav and Bombay, the ship-breaking industry in India contains a significant share because of its cheap labor and relaxed government attitude towards strict rules and regulations of environment laws (Dasgupta, n.d).

**Coastal Tourism**: - Coastal tourism is one of the main driving forces for the Blue Economy and in some places of India the coastal tourism sector is the most important industry for the economy of that particular region. The coastal tourism sector is not just limited to the beaches and the sea, in some prominent coastal tourism spots that are rich in heritage and culture, coastal tourism can also help supplement the other forms of tourism such as cultural tourism, heritage tourism, hinterland tourism, and so on. The above-mentioned is very much prominent in states such as Goa, Orissa, Gujarat, and so on. The coastal tourism sector is the biggest maritime sector in terms of gross value added and employment generation. This sector is an outcome of a set of concerted

policy measures that address the potential and constraints in promoting this sector. Sea-angling, bird watching, boating, dolphin watching, scuba diving, and swimming in the sea are some of the few activities that come under coastal tourism apart from beach recreation. This sector helps in the rapid development of the locality as when tourism increases, the number of lodging facilities, restaurants, and recreational activities also increases, this provides a huge number of jobs, education, and easy cash flow into the locality. This also increases the value of land and land prices in that particular area, however, over-tourism and lack of quality tourists a major problems in this sector which often results in the ill-treatment of the destination, this includes in littering, over-crowding, performing illegal and illicit activities (including illegal constructions) at or near the spot severely damages the reputation of the location which results in quality tourists avoiding coming to the place and increasing the number of 'cheap' tourists who not always respects the sanctity and the purity of the region (Guercio, 2023).

Some of the most important places in India for the growth of coastal tourism is **Goa** which is very famous, with a coastline of around 105 kilometers (Government of Goa, n.d.). Goan beaches are famous for its white-sandy nature for example- Colva, Benaulim, Calangute, Baga, Miramar, Morjim, Palolem, and so on. However, not all beaches in Goa are sandy, we have beaches such as Siridao, Cacra, Hollant, and so on, which are mostly rocky in nature, nevertheless, they are a habitat to a huge level of ecosystem which can be seen in those rocks (GTDC, n.d.). The state of Goa was a former colony of the Portuguese Empire which lasted for over 450 years, since the Portuguese were a maritime power, they built many sea forts which protected themselves against the Dutch and Maratha forces some of these forts were the Reis Magos, and the Aguada, later, upon the rise of the Marathas, they also built sea-forts such as the Betul fort and the Cabo de Rama forts, however, it was later conquered by

the Portuguese. The Goan coastal tourism industry has given rise to several 5-star hotels, even the locals have opened their lodging facilities for the tourists, many locals have also opened their own restaurants and beach shacks, and many beach recreational activities such as scuba diving, paragliding, jet-ski and so on are also being taken (Government of Goa, n.d.). Coastal tourism also plays a very significant role in the state of **Gujarat,** with the largest coastline of around 1600 kilometers, as mentioned earlier coastal tourism also supplements other forms of tourism, there are many historic shore-side temples in Gujarat such as the Somnath temple, the Koteshwar temple, the Dwarka temple and so on. The Rann of Kutch and the Gir National Park are also near the shores (Gujarat Tourism. n.d.). Gujarat also facilitates or supplements the tourism industry of **Daman and Diu** (now merged with Dadra and Nagar Haveli), Daman and Diu, Dadra and Nagar Haveli are like Goa, a former colony of the Portuguese empire, and there is a significant architectural and cultural legacy present in its churches, forts, houses, etc which attracts tourists, apart from that the neighbouring state of Gujarat is a dry-state wherein alcohol is prohibited so the people of Gujarat flock to the Union Territory for alcohol especially in the weekends (Prabhudessai et al., n.d.). One more very important destination but is not spoken much of are of the islands of India, one Island cluster are the **Andaman and Nicobar,** the union territory is developing as a major tourism hub, with pristine islands and historic landmarks, the islands also have lush green forests with many endemic species. Some of the famous landmarks are The Mahatma Gandhi marine national park, Chatham Saw mill, Mini Zoo, Saddle peak, Mt Harriet, Mud Volcano and so on (Government of Andaman and Nicobar, n.d.).

**Other Blue Economy Industries of India: -**There are many other blue economy industries that are emerging in India, however, due to the lack of research, investments, or lack of public knowledge, they are not highlighted to a very large extent. Some of

these are **Marine Biotechnology and bio-prospecting,** to enhance this there needs to be a map of the genetic bio-diversity of the oceans and generate a germplasm inventory. This will help in well-informed decisions on the conservation of oceanic resources, there's also a need for India to build a separate national-level institute for 'marine biotechnology' that would focus on the non-food sector for the generation of new technologies to enhance the immense potential for commercialization. Another area to focus on is **R&D and Innovation,** for this it is necessary to set up R&D hubs in the nine coastal states and promote the use of modern technology such as Artificial Intelligence (AI). **Deep-sea mining** is another area that needs to be explored to access the oceanic minerals, however, it should be conducted sustainably, the Indian Ocean has a lot of Cobalt-rich Seamount Ferro Manganese Crust (SFMC) in the Indian Ocean, and there need to be more investments in the deep-sea mining technologies such as drilling rigs, pipeline networks, launching and recovering systems, power sources, and so on, apart from this there needs to be a national placer deposit mission in India, a placer deposit is "*Accumulation of valuable mineral minerals formed by gravity separation from a specific source rock during sedimentary processes"*, India has rich in coastal and offshore placer minerals including Nickel, Uranium, Copper, Thorium, Titanium, Poly-Metallic Sulphides, Poly-Manganese nodules, and many more. The oceans can also be harnessed to procure **Offshore Wind Energy** and to fulfill the above various national institutions must be brought together through a common platform through a mission mode project under the Ministry of New and Renewable Energy of the government of India. **Maritime Domain Awareness (MDA),** the development of MDA is necessary, the development of a three-dimensional marine domain would be vital for the part to leverage India's blue economy ambitions, this would include integrating national geo-intelligence framework and space applications, this would put to greater use for marine

spatial planning. There needs to be the importance of continuous review, adaptation, and enhancement of maritime security capabilities and infrastructure for threat mitigation and avoidance (Government of India, 2020).

## The Blue Economy Sectors and Sustainable Development

We know by now that the blue economy and sustainable development go hand in hand, there are many innovations and scientific studies conducted to enhance the blue economy. With innovations coming up in the scientific field as well as investment and social level, corporations, governments, and individuals must adapt and invest in the same. There also needs to be more awareness of the fact that the majority of Earth's Greenhouse gases are absorbed by the oceans, and not trees or forests, hence climate activists, organizations, and educational institutions should emphasise on saving the oceans more than saving the forests, it cannot be denied that forests are vital resources and should be protected, it should not be given over-importance, as mentioned multiple times earlier that majority of the Earth's surface is water, just by planting more trees would not be possible to combat climate change, so to bring the Earth to a carbon negative stance, we need to plant at least billion trees, however due to the rising population and with it the rising demand for goods, services, and more land for agriculture, housing, industrialization and so on, even if billion trees are planted, than there at least some of them would have to be cut down to meet the needs of the population. Hence shifting more focus towards the oceans will be a more viable solution, here are some of the ways wherein Blue Economy industries can help in the combat of climate change and sustainable development (Banerjee, 2018).

**Aquaculture** indeed has the potential to meet food security while maintaining a low impact on the environment, combating climate change, and providing nutrition for the growing population. Aquaculture species are very nutrient-rich and depending on the species and methods of production, they can be more sustainable than land-based animal-source foods, the aquaculture sector, both freshwater as well as from the sea can contribute to combating malnutrition. The development of aquaculture can not only contribute to SDG 14 but can also contribute to the fulfilment of other Sustainable Development Goals both directly and indirectly, it involves directly in SDGs such as SDG 1 (poverty alleviation), SDG 2 (Zero hunger), SDG 8 (Decent work and economic growth) and indirectly in every other SDG (Blue food partnership et al., n.d.). Other marine farming such as the farming of seaweed also helps in the enhancement of sustainable development, many seaweed species are used in the production of fertilizers, food, pharmaceuticals, and so on, however, recent scientific advancements have proven that seaweed can be also engineered to make products with plastic properties, a product that looks and acts like plastic but is bio-degradable (Business Insider, 2022).

Although Aquaculture fish farming is sustainable, it has its downsides that need to be taken into consideration. Firstly, in aquaculture, the organisms are immersed in water and are more intensely exposed to the environment as compared to terrestrial animals, thus they are more sensitive to pollution be it chemicals or their bodily wastes. Secondly, to reap maximum profits the farms utilize dense stocking rates which leads to the fish not having enough space to move about and leads to overcrowding, this overcrowding further leads poor water quality due to decreased oxygen level, high accumulated metabolic products and excrement, rapid growth and transmission of noxious parasites, micro-organisms and pathogens which also leads in the concentration of nitrates and phosphates leading to pollution (Alvares, 2002). Thirdly one of the greatest threats

posed by aquaculture, many fish farmers often tend to farm non-native fish due to various factors such as rapid growth for faster harvesting, easy maintenance, climate adaptability and so on, sometimes some of these fishes often tend to escape into the wild and multiply and later cause harm to the native ecosystem, to prevent this we need to take the necessary precautions to maintain a healthy and sustainable fish-farm, this can be achieved through regular clean water circulation, avoiding overstocking and preferring native fish species over non-native ones (Van Beijnen, 2024.).

Sustainable **fishing** is managing and maintaining fish populations at a healthy level and avoiding exploiting natural resources, demand for seafood and advances in technology have led to fishing practices that are depleting stocks of fishes and other marine organisms. Fishers extract over 77 billion kilos of the sea each year. Catching a huge number of fishes at a time can lead to in an immediate payoff for fishers, however fishing this way consistently will leave a small amount of species in the ocean, and it will make it difficult for them to replenish through reproduction. in many indigenous cultures, people have fished sustainably for over thousands of years (Sustainable Fishing, n.d.), however one may argue that modernization and use of modern technology helps in reaping maximum stocks out, so why should they revert back to the traditional practices, in that case some experts would suggest the establishment of Marine Protected Areas (MPAs).

An MPA is a section of the sea where the government places limits to human activities, it is similar to a wildlife sanctuary but in the sea, in many MPAs even have ban on fishing, and to avoid other ocean destruction activities such as marine pollution and marine litter. Today there are more than 5000 MPAs, however, they cover less than 1 percent of the total oceans. MPAs are mostly established in the open oceans, however, can also be established in estuaries, mangrove swamps and so on, other names for MPAs

are Marine Parks, Marine Conservation zones, Marine reserves and so on (National Geographic, n.d.).

**Oceans for generating clean renewable energy** is one of the cleanest forms of producing energy for consumption, one such form is **offshore wind energy**, this form of energy generation is comparatively new with Denmark having its first wind turbine in 1991 (decommissioned in 2017). India is surrounded by the sea on three sides gives it a massive advantage for the harnessing of energy, the absence of any obstruction in the sea will offer much better quality of wind and its conversion to electricity. Facilitating offshore wind energy in India (FOWIND) is a project that was implemented from December 2013 to March 2018 by a consortium led by the Global Wind Energy Council (GWEC) and supported by the European Union to assist India in its offshore wind power development and in turn contribute to India's transition towards use of clean technologies in the power sector.

The project focused on Gujarat and Tamil Nadu for the identification of potential zones for development through techno-commercial analysis and preliminary resource assessment. Other wind-energy project include the First Offshore Wind Power Project in India (FOWPI) implemented in December 2015 by a consortium led by COWI and supported by the EU with an objective to provide assistance up to the stage of pre-financial-investment-decision (Pre-FiT) and provide general assistance for capacity building of Indian stakeholders within offshore wind sector. Based on preliminary assessment from satellite data and data available from other sources a total of eight zones each in Gujarat and Tamil Nadu have been identified as potential offshore zones for exploitation of offshore wind energy (Ministry of New and Renewable Energy, n.d.).

Another way is **sustainable hydropower** is another way to achieve, hydropower is said to be the 'Giant' of clean electricity and it is expected to double by the year 2050,

hydropower with its reservoirs are also provides flexibility and enables the integration of intermittent renewable energy sources. Reservoirs also play a key role for providing food from irrigated land, drinking water supplies along with reducing the risk of flooding and droughts, hydropower with reservoirs is relevant for the fulfilment of large number of SDGs. (NTNU, n.d.). Globally, hydropower is the leading source of renewable energy, providing around two-thirds of all renewable electricity, the global installed hydropower capability increased by 26 GW to a massive 1360 GW in 2021. Globally 4,250 TWh (terawatt hour) of clean energy was generated through the means of hydropower, much more than the amount of electricity utilized in the EU and more than the cumulative renewable energy consumed , in the case of India, upon receiving its independence in 1947, hydropower capacity was about 37 percent of the total power generating capacity and over 53 percent of power generation, however in the 1960s coal-based power generation was given more importance compared to hydropower and India's hydropower in both capacity and generation declined. In August 2023, hydropower capacity of about 46,865 MW accounted for around 11 percent of power generation in 2022-2023. However, although hydro-power produces low-carbon electricity, they have huge environmental and social costs, It displaces thousands of people and disrupts river ecology, large scale projects lead to blatant de-forestation, projects also lead to the loss of aquatic and terrestrial biodiversity (ORF, 2023.).

Due to the above limitation of hydroelectricity, another alternative can be that of **Tidal energy**, tidal energy is defined as a hydropower that converts the energy from the natural rise and fall of the tides into electricity. Tides are caused by the gravitational forces exerted by the Sun, Moon, and the rotation of the Earth. Tidal energy can be harnessed along coasts that experience 2 high and low tides daily (Student Energy,

2015). Tidal power technologies, the three main technologies spoken about were Tidal Barrages, Tidal Fences and Tidal Turbines. Ocean currents are more effective than Wind Energy since ocean water is 832 times denser than air and therefore applies greater force on the turbines (Student Energy, 2015). However Tidal energy has its own set of limitations such as its very specific site requirements necessary to produce tidal energy and tide cycles not matching daily consumption patterns, hence compared to other forms of energy use of tidal power is relatively low (Student Energy, 2015). When it comes to India, India is estimated to have a potential of around 54 GW of ocean energy which is 12.45 GW of tidal power and 41.3 GW of wave power (Aggarwal, 2021), however, for practical uses this sector is yet to be explored and researched in order to exploit its full potential, another limitation why tidal energy and same goes for offshore wind energy is not feasible is the fact that installations and maintenance of the infrastructure is very costly and requires a huge amount of investment (Aggarwal, 2021).

Hence among the three above-mentioned forms of sustainable ocean-based energy, the two most sustainable (wind and tidal), if need to be exploited and expanded then it has to be cost-effective, this can be done if there is more research and engineering done to enhance this field for the benefit of developed and underdeveloped nations (Aggarwal, 2021).

Today as sustainable development is becoming more and more relevant today, there are firms and companies also adopting **sustainable shipping and ship-building,** this can be achieved as today's due to advancements in technology the concept of **Carbon-Neutral ships**, this is deemed as a 'strategic goal' of Meyer Turku Shipyard of Finland to be achieved by the year 2025 and have a carbon-neutral shipyard not long after in 2030, this can be done by identifying the most significant sources of emissions and other

environmental stressors for the entire life-cycle of the ship and compare the environmental impact of selected materials. Apart from that energy consumption and waste generated are significant environmental aspects in shipbuilding, even at the shipyard and the cabin factories, energy is consumed in production, power equipment and so on, which generates huge amounts of waste. The company claims to have calculated the emissions and the sources a devised a roadmap which would help in the **achievement of the carbon-neutral shipyard by 2030**. One of the main aims in achieving carbon-neutral ships is cutting the use of fossil fuels and utilizing alternative materials (Meyer Turku Shipyards, 2021).

**Sustainable Coastal Tourism** is also one of the main features of a sustainable blue economy. Coastal tourism is strongly dependent upon natural (climate, landscape) and cultural (historic, traditional) resources, henceforth activities related to coastal tourism can only be conducted in particular areas and specific conditions. Coastal tourism has been increasing in the last few decades in both volume and number. Besides the above-mentioned conditions, the development of tourism in coastal areas is also related to socio-economic features of the receiving environment such as local community interests, health and security conditions, political factors including unpredictable crises, exchange rate fluctuations, and traditional models of tourism exploitation. Apart from this, there are also problems of natural calamities and unpredictable climate conditions such as algae blooms, forest fires, tsunamis, storms, and floods, as well as many other constant features or unexpected events, that affect tourism development in coastal areas.

To solve the problems about tourism, it is necessary to carry out tourism planning, tourism planning is necessary as the rationale for tourism development itself of its economic benefits of wealth-creation, employment generation and so on, which further leads to community development, the development of artisanal activities in a

destination, conservation of natural and historical sites, and so on, however we cannot ignore the damages done environmentally and socially. Furthermore tourism planning is necessary firstly since modern tourism is relatively new in many areas, hence governments, local bodies and private firms need a pathway to go ahead, Secondly tourism is a complicated multi-sectoral and fragmented involving many other economic activities, planning will ensure all these activities will happen in integrated manner, thirdly Planning is necessary to determine the optimal type and level of tourism that won't have negative impacts, planning will also enable education and training.

Hence if any tourism activity needs to be conducted, it should be necessary to first examine the pros and cons and further examine how can we avoid any potential ecological, social or environmental destruction.

## Government Policies and Strategies for Promoting Blue Economy

As the blue economy is gaining momentum, many governments across the world have sought to frame various reforms to capitalize their oceans to maximize their economic benefits, India also has drafted many policies and strategies to fulfill their blue economy goals.

### Government Schemes

The most important scheme of the government when it comes to the blue economy is the **Pradhan Mantri Matsya Sampada Yojana (PMMSY),** which was introduced by the Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India. With an investment of 20050 crores for the holistic development

of the fisheries sector. The scheme is implemented in all the states and Union Territories in India for a period of five years from FY 2020-21 to FY_2024-25 (Ministry of Fisheries, n.d.). The PMMSY is meant to address many problems within the fisheries sector and find a viable solution for the same. The erstwhile Blue Revolution scheme finds its origins in the vision of the Honourable Prime Minister Narendra Modi *"It is time now to usher in the Blue Revolution as depicted in the blue colour of the Ashok Chakra".* Accordingly, the blue revolution was launched in December 2015 as a centrally sponsored scheme (BR-CSS) with an outlay of Rs 3000 crores for five years from 2015-16 to 2019-2020 to catalyse "Integrated, Responsible and holistic development and management of the fisheries sector". the main objectives of this scheme firstly, is to harness the potential of the fisheries sector in a sustainable, responsible, inclusive and equitable manner. Secondly, to enhance fish production and productivity through expansion, intensification, diversification and productive utilization of land and water resources. Thirdly, is to modernize and strengthen the value chain including post-harvest management and quality improvement, apart from this the other objectives include double the fish production and income by the fishers, enhance the contribution of the fisheries sector to agricultural GVA and exports, build robust fisheries management and regulatory framework among others.

This scheme garnered huge success with an increase of fish production from 10.26 million metric tons in 2014-15 to 13.75 million metric tons in 2018-19, the productivity of the fisheries rose from 2.3 tons per hectare to 3.3 tons per hectare, moreover the Indian exports rose from Rs 33,442 to 46,589 crore in 2018-19, these are the achievements of the blue revolution. (Department of Fisheries, n.d.).

The further targets of this scheme include increasing fish production to around 22 million metric tons by 2024-25 from 13.75 million metric tons in 2018-2019, which

means producing an output of more than 70 percent, which as we can clearly see is a huge increase it also supports to enhance the aquaculture productivity to 5 tons per hectare from the national average of 3 tons and to further enlarge domestic fish consumption from 5 kg to 12 kg per capita (Department of Fisheries, n.d.).

The Department of Fisheries identified a total of nine strategic priorities of the PMMSY

1. Marine fisheries.
2. Inland fisheries.
3. Fisherman's welfare.
4. Infrastructure and post-harvest management.
5. Aquatic health management.
6. Ornamental fisheries.
7. Coldwater fisheries.
8. Seaweed cultivation.

The scheme provides many incentives to people who wish to start a business in any of the above activities, financial assistance of up to 33 lakhs were provided under PMMSY and other allied schemes. (Department of Fisheries, n.d.).

When it comes to the development of aquaculture and allied activities, the expenditure on developmental activities, according to the scheme the expenditure to be shared on 75:25 basis by the Government of India and the state/UT governments (Ministry of Fisheries, Animal Husbandry and Dairying, n.d.).

On the occasion of the 75$^{th}$ Azadi ka Amrit Mohotsav, the department of Fisheries, Animal Husbandry and Dairying of the Government of India launched the **Sagar Parikrama** program. The program is organized through pre-decided routes covering coastal states and Union Territories, the main objectives of the Sagar Parikrama are: -

- To facilitate interaction with fishermen, coastal communities and stakeholders so as to spread information of various fisheries related schemes and programs being implemented by the government.
- Demonstrating solidarity with all fisher folk, fish farmers and concerned stakeholder as a spirit of Aatmanirbhar Bharat.
- To promote responsible fisheries with focus on sustainable balance between the utilization of marine fisheries resources for the food security of the nation and livelihoods of coastal fisher communities.
- Protection of marine ecosystems.

The Sagar Parikrama also aims in spreading awareness of various government schemes and such as the PMMSY (PIB, 2023.). Sagar Parikrama has many phases, its inception and the first phase started on 5th March and ended at Porbandar on 6th March 2022, it covered the entire distance of Mandvi to the estuary of river Rukmavati (PIB, 2022.).

## Government Projects

Perhaps one of the most important projects in the maritime sector by the government is the **Sagarmala,** which aims to promote port-led development and was approved by the Union Cabinet on 25th March 2015, as part of the program, a National Perspective Plan (NPP) for the comprehensive and holistic development of India's extensive 7500 kilometer plus coastline and maritime sector on 14th April 2016. At the beginning of the Sagarmala, around 802 projects worth around 5.5 lakh crore were part of the programme, among them around 217 projects worth more than 1,12 lakh crores have finished completion and around 225 projects worth 2.17 lakh crore are under

implementation (Ministry of Ports, Shipping and Waterways, 2023). The main vision of the Sagarmala is to reduce the logistics cost for EXIM and domestic trade that too with minimal investment and also includes reducing cost of transporting domestic cargo through optimizing modal mix, lowering logistics cost of bulk commodities by locating future industrial capacities near the coast and so on. The Sagarmala has total five components which are.

1. Port Modernization and new port development.
2. Port connectivity enhancement.
3. Port-linked industrialization.
4. Coastal-community development.
5. Coastal shipping and inland waterways transport.

The Sagarmala programme is also aimed in increasing efficiency especially by reforming the governance in modern ports, it aims in granting greater autonomy in decision making, adopting the 'Landlord Model' of development in order to provide high-class port infrastructure. In the ports of Mumbai, Chennai, Deendayal, Paradip and Kolkata, there is Enterprise Business System (EBS) to provide digital port ecosystem, by doing this it will give the ultimate aid to the processes. In a meeting held in February 2020 by the union cabinet has given an 'in-principle' approval for setting up India's 14$^{th}$ major port at Vadhavan, Dahanu in Maharashtra, it is to be developed on the 'landlord model'. The Sagarmala has also gained immense successes, from the volume of traffic handled 1,052.1 million metric tonnes (MMTPA) per year to 2500 MMTPA (Ministry of Ports, Shipping and Waterways, 2023).

Another area wherein the government of India enhanced its role in the maritime domain is through the **Mission Security and Growth for all in the Region (SAGAR).**

Launched by the Indian government Mission Sagar is an initiative which was launched to provide necessary assistance which included food and medical supplies to the Indian Ocean region during the peaks of the COVID-19 pandemic (MOES, n.d.). The Indian Navy sent ships to 15 countries and delivered a total assistance of more than 3000 metric tons of food aid, around 300 MT of liquid oxygen, around 900 oxygen concentrators and around 20 ISO containers apart from the above rapid assistance team of medical personnel were deployed to countries such as Mauritius, Seychelles and Comoros in handling the COVID-19 pandemic, the above mentioned three countries along with Maldives and Madagascar received 580 tons of food aid. India donated 'Air Evacuation pods' designed indigenously by the navy to the health authorities of Mauritius and Seychelles to help in the evacuation during the pandemic, other countries that were beneficiaries of food aid were Djibouti, Eritrea, Sudan, South Sudan, Mozambique (MoES, n.d.) . The countries who were beneficiaries of medical aid were Indonesia, Thailand, Malaysia, Sri Lanka, Bangladesh and so on (MoES, n.d.).

India also plans on Deep-Ocean Missions (DOM) called the **Samudryaan,** this mission is aimed to develop a 'self-propelled manned submersible' carrying 3 people to the depth of around 6000 meters into the ocean with scientific sensors, equipment and tools for deep sea exploration (MoES, n.d.). With an endurance of around 12 hours of operational period and 96 hours in case of any emergency (MoES, n.d.). The manned submersible device is meant to allow the scientific community to observe and understand unexplored deep-sea areas by direct interventions. Later, it shall improve the capacity for a 'deep-sea' man rated vehicle development. The National Institute of Ocean Technology (NIOT), Chennai, an autonomous institute under MoES, developed 6000 metre depth rated 'Remotely Operated Vehicle' (ROV) and various other underwater instruments such as Autonomous Coring Systems (ACS), Autonomous

Underwater Vehicle (AUV) and deep-sea mining system (DSM) for exploration of the deep sea (MoES, n.d.). The DOM was approved by the Union Cabinet in 2021 with a cost of around 4,077 crore over a five-year period in a phased manner. the mission has a total of six pillars:-

1. Development of suitable technologies for deep-sea mining and a manned submersible to carry three people to a depth of 6000 metres in the ocean. The submersible to be equipped with a suite of scientific tools, censors and an integrated system for mining polymetallic nodules from the Central Indian Ocean. (Khanna, 2023).
2. Development of Ocean climate change advisory services, involving an array of ocean observations and models to understand and future climate projections.
3. Technological innovations for the exploration and conservation of deep-sea biodiversity.
4. Deep-ocean survey and exploration aimed at identifying potential sites of multi-metal hydrothermal sulphides along the Indian-Ocean mid-oceanic ridges.
5. Harnessing energy and freshwater from the ocean.
6. Establishing an advanced marine station for blue biology, as a hub for nurturing talent and driving new opportunities in ocean biology and blue biotechnology.

The DOM is one of the Prime Minister's Science, Technology and Innovation Advisory council (PMSTIAC). The DOM is named Matsya6000, and the crew-members will be named as Aquanauts, the date for launching the DOM is 2025. Only a few countries have achieved deep-sea exploration, those are USA, Russia, China, France and Japan (Khanna, 2023).

Other initiatives that India is by strengthening its **maritime security** has undertaken is by developing its military assets, this is done by increasing its naval defence budgets every year, the proportion of the navy's budget for buying new platforms and equipment

increased by around 45% in 2022 alone with the largest proportion going to the navy (Miller, 2023). Further the Indian navy is attempting to integrate new equipment and technology, in March 2023, the navy tested ship-launched Brah-Mos supersonic missiles, carrying out a successful precision strike. These missiles can be launched by air, land and sea and are thus huge assets to all security areas. The Indian Ministry of defence's agreement to procure US-made, armed MQ-9B Sea Guardian drones will help further enhance national security by improving India's intelligence, surveillance and reconnaissance (ISR) capabilities. Furthermore India is also placing emphasis on improving its Maritime Domain Awareness (MDA) (Miller, 2023).

In 2021, the Indian Ministry of Defence announced that it would establish around forty-two new coastal radar systems in order to strengthen coastal surveillance, in December 2022, the government approved a national maritime domain awareness (NMDA) project to create an integrated intelligence grid that can detect and respond to sea-based threats in real time. India is also engaging in diplomatic and co-operative efforts to bolster India's national security. India is a part of the Indo-Pacific Partnership for Maritime Domain Awareness (IPMDA), a quadrilateral security dialogue whose aim is to give an 'integrated and cost-effective maritime domain awareness picture'. In march 2023, the Indian Navy completed its four-month theatre level operational readiness exercise (TROPEX) in the Indian Ocean, this included seventy naval ships, six submarines, and more than seventy-five aircraft, the exercise aimed in the practise of coastal defence, amphibious actions and weapons testing. In June 2023, the navy displayed a twin-carrier operation exercise in the Arabian Sea, something which even China is yet to accomplish. While India continues to build its maritime technology and ISR capabilities to maintain a significant presence in the Indian Ocean, in future there's likely to increase co-operation with support of the USA, however India must be cautious

of the increasing presence of the USA in the Indian Ocean and its pre-dominance in the IOR. Indian must further develop on its self-reliance strategy (Miller, 2023).

## Coastal and Marine infrastructure development projects

As mentioned in the previous chapters about the various projects initiated by the government of India, however, there are many other projects which are also initiated in the nation by the Ministry of Ports, Shipping, and Waterways. Some of these also include projects from various categories such as port modernization and terminals, the building of new ports/port terminals, RoRo/RoPax and tourism jetties, improving port connectivity, inland waterways, lighthouse tourism, industrialization around existing ports, technology centres, skill development and so on. In the Union Budget 2023-2024, the government of India announced promoting coastal shipping as the energy-efficient and lower-cost mode of transport, through PPP mode with viability gap funding, this is aimed to increase growth of coastal infrastructure leading to the holistic development of the coastal areas. The Ministry carries out regular meetings with the stakeholders, and the Ministry also holds Maritime States Development Council (MSDC) as a framework of consultative planning where challenges and opportunities in the are discussed for the creation of synergy to ensure the optimum management and utilization of the available coastline by way of participation of all stakeholders (PIB, 2023). In October 2023, the Prime Minister Narendra Modi launched projects worth 23,000 crore and unveiled a long-term vision document for the growth of Blue Economy of India under the ‘Amrit Kaal Vision 2047 (Infra, 2023). The blueprint also includes promoting sustainable practices and facilitating international collaboration. This was done during the third edition of the Global Maritime India Summit which was attended by ministers representing countries from Europe, Africa, South America and Asia (including central

Asia, Middle-east and BIMSTEC) and individuals such as CEOs business leaders, investors, officials and other stakeholders all over the world in this summit there discussed key issues of the maritime sector which included de-carbonization, coastal shipping, shipbuilding, recycling and finance, maritime tourism and so on. One of the projects included an all-weather deep-draft terminal, to be built at the cost of around 4,500 crores at the Deendayal Port Authority in Gujarat, the above-mentioned project is a greenfield terminal to be developed in public-private partnership mode (PPP). The terminal is expected to be an international trade hub and will handle next-gen vessels exceeding 18,000 twenty-foot equivalent units (TEUs) and is expected to act as a gateway for Indian trade through the India-Middle East-Europe Economic Corridor (IMEEC). More than 300 Memorandums of Understandings (MoUs) worth more than Rs 7.16 lakh crore for global and national partnership in the maritime sector (Infra, 2023).

India is also leading when it comes to undersea cable systems for communication, the telecom licensing regime of India, the Telecom Regulatory Authority of India (TRAI) sets orders, regulations, and directions on the telecommunications sector, however, the licenses are issued by the Department of Telecommunications (DoT). On June 19, 2023, the TRAI issued the ‘recommendations on licensing framework and Regulatory Mechanism for Submarine Cable landing in India’ recommending the two categories of cable landing station (CLS) locations ‘Main CLS’ and CLS Point of Presence (CLS-PoPs) (India – Submarine Networks, n.d.). The undersea cable operation has hugely increased between the year 2016-2021, the TRAI claims that the total activated capacity of cable landing stations increased by nine times and the lit capacity increased by over four times. The TRAI also predicted that India’s international bandwidth is expected to grow tenfold by 2028, as the international bandwidth demand is expected to grow at a

compound annual growth rate of about 38 percent (Kar, 2023). There are around 17 international subsea cables (excluding Seacom and MENA) that are currently landing on 14 cable landing stations in 5 cities throughout India (Chennai, Cochin, Tuticorin, Mumbai and Trivandrum), with the lit capacity and the activated capacity of these subsea cables are around 138.606 Tbps and 111.111 Tbps respectively at the end of 2022 (India – Submarine Networks, n.d.). Along with that there are also decisions for the construction of new submarine cables, which are MIST, IAX, IEX, 2Africa and so on Apart from the international subsea cables, there are also domestic submarine cables such as the Chennai-Andaman and Nicobar Cable (CANI) connecting Port Blair with seven other islands and the Kochi-Lakshadweep Islands (KLI) cable system between Cochin and Lakshadweep (India – Submarine Networks, n.d.).

The standing committee on energy gave its report on the 'Tidal Power Development in India' in August 2021. The committee claimed that India can harness three main types of Ocean energy which are Wave, Tidal and Ocean Thermal, of which the estimated potential of wave energy is 12.5 Gigawatts and tidal energy is 41.3 Gigawatts, however the estimation for Ocean Thermal energy is not yet estimated (PRS legislative Research, n.d.). In July 2023, the Ministry of New and Renewable Energy (MNRE) considered and adopted the report. The replies from the MNRE to the observations and recommendations contained in the report were received on 22$^{nd}$ September 2022 wherein the Union Ministry of Earth Sciences was asked to perform the assessment on the committee's initial recommendation, which the MNRE stated in a reply on 21$^{st}$ September 2022.

However, ocean energy is very costly and India did venture into developing its tidal energy projects previously, in 2007 and 2011 in West Bengal and Gujarat and both have not come into effect due to its exorbitant cost (Down to Earth, 2023.). In India where

Tidal energy has one of the most potentials is the Gulf of Cambay (Khambhat) region, Prof P.K Bhaskaran of IIT Kharagpur claims that "*the region has a very good potential for a tidal range between high and low waters is around 11-12 meters, the tidal range in the region is about 8 meters and the tidal currents can reach the strength of around 3 m/s while on the eastern coast, the Sundarbans has a tidal range varying between 6-7 meters"* (Aggarwal, 2021). which also has a huge potential to extract tidal energy, however, one of the limitations which would also question the sustainability of tidal power is that many aquatic birds rely on the tide uncovering mudflats for feeding and could be affected, furthermore, it can change the ecological balance of that area by reducing flushing and erosion. However, what India lacks is money spent on Research and Development (R&D), there has been very little when it comes to R&D in this particular sector. India has a target of installed capacity of around 450 GW by 2030 (Aggarwal, 2021). In August 2019, the government of India issued a notification clarifying that energy produced using the forms of ocean energy such as ocean thermal, wave, tidal shall be eligible for the meeting non-solar Renewable Purchase Obligations (RPO). RPO which is a mechanism under the Electricity Act 2003 by which 'the big consumers have to purchase a certain percentage of their total consumption of electricity from renewable energy sources (Aggarwal, 2021).

Apart from the above-mentioned projects, there are many more projects either under construction or in the pipeline, India is building its very first underwater tunnel. Being built in West Bengal, the East-West Metro Corridor, it is a 520-metre tunnel is a metro corridor which will be transporting passengers from IT Hub of Salt Lake in the east to Howrah Maidan in the west across the river (Outlook India, 2024). Another undersea tunnel which India is construction is the Mumbai Coastal Road Project- South (MCRP), aimed to decongest the existing roads, the tunnel has a total of 8 lanes it will be used to

facilitate transport from Priyadarshini Park to Bandra-Worli Sea link (MyBMC – Welcome to BMC's Website, 2021.).

## Chapter-IV

# Synergy Between India's Blue Economy and Sustainable Development Goal 14

## Blue Economy and SDG 14 in India

The Federation of Indian Chamber of Commerce (FCCI) published a knowledge paper titled '*Blue Economy Vision 2025- Harnessing Business Potential for India Inc. and International Partners'* to start a business-driven discourse to meet future challenges to the blue economy. In the paper it is claimed that the current asset value of the oceans is $ 24 Trillion with an annual value addition of about 2.5 trillion and the use of the oceans has been diversified from a classic medium of transport to being a cornucopia of resources (Banerjee, 2018). The economic wealth of the oceans is represented by its variety of living and non-living resources as well as service sector resources and renewable energy. According to the FCCI's Blue Economy Vision 2025, the blue economy is an integral element of Sustainable Development Goals. Dr Kapil Narula claims that the notion of a blue economy and the SDGs are aligned and mutually reinforcing. There is a wide acceptance that to implement the blue economy effectively, the SDGs have to become a foundation. For a very long time, the oceans and seas have been viewed as environmental issues, and neglecting their economic and social dimensions. In India, it will be very unfair if we see a blue economy only in terms of Seas and Oceans, as life underwater also includes the inland water bodies. In India, blue capital can be obtained and assimilated from multiple sources and can be summarized as :-

| **Maritime Domain (related to the sea)** | **Aquatic Domain (inland water bodies)** |
|---|---|
| Coastline | Rivers and Canals |
| Exclusive Economic Zone | Dams |
| Islands | Reservoirs |
| Brackish Water | Tanks and Ponds |
| | Flood Plain lakes |

The SDGs cover a wide range of social and environmental issues and many SDGs are inter-connected to one another. The International Institute of Sustainable Development (IISD) has offered the evidence on the constituent goals of the Blue Economy viz. 2,13,14,15 and 17. FCCI has considered various goals, with Goal 14 as the primary goal, and has connected a total of 12 other goals to Goal 14 as supplementary goals, these goals are SDG 1 (No Poverty), SDG 2 (Food Security), SDG 6 (water and sanitation), SDG 7 (energy), SDG 8 (Decent work and economic growth), SDG 9 (infrastructure), SDG 10 (reduction of inequality), SDG 11 (sustainable cities and communities), SDG 12 (sustainable consumption and production), SDG 13 (climate change), SDG 15 (life on land) and SDG 17 (Partnerships for the Goals). According to Dr Narula, who has identified that a total of 15 of the 17 goals (with the exception of SDG 4 and SDG 5) are connected to SDG 14. According to both Narula and FCCI have considered goal 6 which focuses to water and sanitation and pertains to conservation of inland waters as an element of blue economy. These goals and their targets are intertwined to each-other and also linked to economic, social and environmental aspects of sustainable development (Banerjee, 2018).

The size of India's blue economy is conservatively been estimated to be about 4 percent of India's GDP. However, it could be higher if the methodology is improved. Before India explores into blue economy further, there needs to be a new mechanism to be devised for the collection of data. Furthermore, India needs to learn from global best practices, to enhance this there needs to be a scientific collaboration with leading countries and institutions to develop suitable scientific tools and methodologies relevant to blue economy measurement and management. According to India's Blue Economy: A draft policy by the economic advisory to the Prime Minister of India highlights that the country must also implement the Coastal Marine Spatial Planning (CMSP) approach of the Intergovernmental Oceanographic Commission (IOC)-UNESCO (2009) guidelines, as other marine-based economies have done, adapting these guidelines to suit their own local and national needs. The draft also recommends creating a national authority to define the parameters of CMSP, with the goal of achieving integration between local communities, private enterprises, and all levels of government.

In 1981, India was one of the first nations in the world to establish a Department of Ocean Development. India has developed numerous programs over its more than 40 years of expertise, including "Deep Ocean Mission", "Oceanography from Space", "Launching of Data Buoys", and others (Government of India, 2020). The Ministry of Earth Sciences (MoES), which succeeded it, has partnered with the UN on the "Clean Seas program" to devise approaches for assessing and diminishing marine debris and plastics. In 2019, the government of India launched the Vision of New India 2030, in that blue economy was mentioned as the sixth dimension (Government of India, 2020).

# Progress in India's SDG 14

**Aquaculture and Fishing: -** With over 8% of the world's total fish production, India ranks third in the world for fish production. It also leads the world in aquaculture production and is a major producer and exporter of shrimp. Purushottam Rupala, the Minister for Fisheries, Animal Husbandry, and Dairying, asserted that over the last nine years, the Indian government has implemented ground-breaking measures to advance the aquaculture and fisheries sectors holistically while also raising the earnings of fish farmers and fishermen. The central government has announced and approved investments totaling more than Rs 38,572 during the last nine years. Of the above mentioned amount include:-

- Rs 5000 crore investment under blue revolution scheme.
- Rs 7,522 crore fisheries and aquaculture development fund (FIDF).
- Rs 20,050 crore investment under Pradhan Mantri Matsya Sampada Yojana (PMMSY).
- Rs 6,000 crore sub-scheme under PMMSY, announced in the Union Budget 2023-2024.
- Rs 2584.50 crore for financial year 2024-2025, which is the highest ever annual allocation is 15 percent higher than the current financial year (PIB, 2023).

The PMMSY scheme under its implementation since 2020-2021 and it is by far, the highest-ever investment in the fisheries and aquaculture sector in India (PIB, 2023.). The main objectives of the PMMSY is to harness the potential of the fisheries sector in a sustainable, approachable and 'equal to all' manner. The PMMSY has gained immense success since its inception, with a record in fish production of 175.45 lakh tons in FY 2022-23. The progress of the PMMSY scheme every year goes like this:-

FY 2020-2021: proposals from 34 states and Union Territories with the exception of Chandigarh and other organizations have been approved at a total cost of Rs 2,876 crore under CSS (centrally sponsored scheme) and 129.47 crore under CS (central sector) , with a central share of 1,084.72 crore (PIB, 2023).

FY 2021-2022: proposals from 33 States and Union Territories for developmental projects and other organizations have been approved at total cost of Rs 4,353 crore, of which 3,614 crore under CSS and Rs 739 crore under CS with a central share 1662.36 crore (PIB, 2023).

FY 2022-2023: Proposals from 33 states and union territories for developmental projects and other organizations have been approved at a total project cost of 7,424 crore of which Rs 6706 crore under CSS and Rs 718 crore under CS with a central share of Rs 3,392 crore (PIB, 2023).

FY 2023-2024: Proposals from 33 states and union territories and other organizations have been approved at a total cost of Rs 2,872 crore, of which 2,868 crore CSS and Rs 4.55 crore under CS with a central share of Rs 1,068 crore (PIB, 2023).

Under the PMMSY scheme, it takes into account almost every requirement when it comes to the fishing sector.

The Physical achievements under the PMMSY scheme between 2020 and 2023 were the following: -

**Inland fisheries:** 44,408 number of cages, 20,849.41 hectares of pond area for inland aquaculture, 11,940 re-circulatory aquaculture systems (RAS), 3995 Biofloc units, 2,855 hectares of pond area for inland saline-alkaline culture, 788 fish and 4 scampi hatcheries, 543.7 hectares pens in reservoirs and 14 brood banks have been approved (PIB, 2023).

**Marine fisheries:** 1,518 open sea cages for fish culture, 1,172 up-gradation of existing fishing vessels, 1,380.86 hectares of pond area for brackish-water aquaculture, 463 deep-sea fishing vessels, 17 brackish water hatcheries and 5 small marine finfish hatcheries were approved (PIB, 2023).

**Ornamental fisheries:** 2,153 ornamental fish rearing units and 163 integrated ornamental fish units (breeding and rearing) have been (PIB, 2023).

**Seaweed Cultivation:** 46,095 rafts and 66,330 monoline tube nets have been approved.

All the above infrastructure for the development of aquaculture under the PMMSY scheme. This infrastructure development of the Department of Fisheries was created as a dedicated fund named the Fisheries and Aquaculture Infrastructure Development Fund (FIFDF) during 2018-2019 with a total fund size of Rs 7,522.48 crore (PIB, 2023). FIDF provides concessional finance to Eligible Entities (EE), including states/UTs and state entities for the development of identified fisheries infrastructure through Nodal Loaning Entities (NLE) namely.

1. National Bank for Agriculture and Rural Development (NABARD).
2. National Co-operatives Development Co-operation (NCDC).
3. All Scheduled Banks.

Under the FIDF, the Department of Fisheries provides interest subvention up to 3 percent per annum for providing concessional finance by the NLEs at an interest rate not lower than 5 percent per annum (PIB, 2023).

**Marine pollution:** Marine pollution is one of the greatest threats to the marine ecosystem and is the main cause of oceanic decline. R.B Clark in his book Marine Pollution defines it as "*The introduction of man, directly or indirectly of substances or*

*energy to the marine environment resulting in deleterious effects such as hazards to human health, hindrance to marine activities, including fishing, impairment of the quality for the use of seawater, and reduction of amenities. The focus is therefore human rather than natural inputs to the sea, and the damaging effects of wastes*" (Clark, 2011). Marine pollution might be less fatal as compared to terrestrial pollution, this is because the majority of marine organisms reproduce at a massive scale and a majority of the offspring do not live up to adulthood under natural circumstances, hence the mortality from the toxicity might not be as significant compared with the natural losses and may have little impact on the population. However, on the other hand, when pollution leads to severe damage, it is often considerably difficult to identify the harm caused by low levels of contamination caused by diffuse or sometimes unknown inputs. The damages caused by Pollution causes individual organisms to suffer damage however it depends on the lethality and quantity of the dose that determines how much affected the organism will suffer for example if a sample amount of aquatic life is exposed to toxins, then not all die at the same time, instead the mortality shows a sigmoid relationship to the period of exposure (Clark, 2011, pp. 8-9).

**Sewage disposal** contributes to the greatest amount of organic waste which gets disposed of and is one of the greatest contributors, organic wastes particularly sewage and sewage sludge are discharged to the sea by pipeline or from barges at designated dump sites. Sewage and sewage sludge which are dumped in the ocean have a direct effect on the Benthic Organisms (organisms that live in the seabed), these are exposed to sedimentation of particulate matter and reduction of oxygen concentration because of the increase of bacterial activity excludes the more sensitive species, however, the more tolerant species flourish because of the input of extra nutrients into the ecosystem.

another major pollutant in the ocean is man-made debris, mainly plastic pollution (Clark, 2011, pp. 12-14).

**Oil pollution** is that type of pollution that undoubtedly receives huge public attention, this is because it is visible and people encounter it firsthand either on beaches or they view it in media, however, it is very difficult to calculate the amount of petroleum hydrocarbons entering the ocean. The global production of oil is about 3 billion tons a year- and around 50 percent of it is transported by the sea (Clark, 2011). After the tanker is unloaded, it is required to take seawater as ballast for the return journey to the oilfields. In Oil Pollution, the water-soluble components of crude oils and refined products include a variety of compounds that are toxic to a lot of marine organisms, this again depends on the nature of the oil and what level of toxicity it carries. One of the highest risks of oil pollution causes harm to Plankton populations, oil and oil fractions are toxic to a wide range of Plankton species and since many marine organisms consume these plankton species, it leads to the decline of other marine organisms as well further leading to the decline in the food chain (Clark, 2011).

**Marine litter** although most people think comes from onshore sources such as wastes from coastal areas, however, most of the marine litter comes from shipping, and high concentrations of plastic debris are found near busy shipping lanes and fishing areas. Most of the litter in the sea comes mostly due to primary and secondary packaging commonly plastic bags, cups, bags, glass pieces, beverage cans, plastic footwear, and so on. The plastics found in the oceans are not just limited to the above-mentioned objects, what is more dangerous is microplastics in the oceans. Small particles of Polyethylene, Polypropylene, and in some cases, Polystyrene which are about 3-4 millimetres in diameter are widespread across the oceans, these small particles are weathered fragments of larger plastic articles (Clark, 2011). However, a large amount

is plastic pellets, which are raw materials for the plastic industry and reach the oceans either through accidental spillages from ports or factories close to the rivers, ingestion of a small amount these micro-particles may not cause much harm to the organism, however, the accumulation of these particles in the gut may be extremely harmful, knowing that many fish species consume planktons in their diet and micro-plastics can get mixed with planktons in the oceans.

Plastics in the oceans are inert to marine organisms and while floating at sea acquire a fauna of encrusting organisms such as algae, barnacles, hydroids, and tunicates, this is the fate of the smaller organisms. For the larger organisms, however, their fate is much more grim, large fish and beach turtles are found with plastic particles inside their digestive systems, and these fishes later go for human consumption. Another major problem when it comes to marine litter is discarded trawl nets, rope, plastic straps buoy ropes where many marine organisms get entangled, marine organisms especially mammals like Dolphins, whales, and so on have been found entangled in discarded fishing nets, marine bird species are also affected, seabirds such as Gannets, Guillemot, Ducks, Geese, Ospreys and various wading birds become entangled and killed by the trawling nets.

Although when we talk about marine pollution, only the above-mentioned comes to our mind, however, there are many more forms of marine pollution which pose a serious threat not only to the marine ecosystem but also to the terrestrial life as well including Human Beings. These include pollution by metals, radioactive pollution, and so on, some of these pollutants are hardly talked about or given the limelight by governments, activists, or the general public.

**Actions undertaken to prevent marine pollution:** in recent years measures in place to reduce oil pollution, some of these are the **load-on-top** system, **segregated ballast,** and so on. Tanker accidents are one of the major reasons for oil pollution, although reduced in the past 20 years, it is still a regular occurrence and happens every year, a damaged tanker may be salvaged or its cargo may be off-loaded into other tankers, however is not the case for large tankers who have been lost in the ocean due to hull failure , or fire or explosion, in this case the oil disappeared in the sea without coming ashore and had no detectable impact, if the wrecked tanker is on fire than the damage to the sea is much less compared to if it is not, the oil may be burned out. Oil Shipping hazards are greatest close to land and in choke points where the density of shipping is very high (Clark, 2011, pp. 16-17).

In Oil Pollution, the water-soluble components of crude oils and refined products include a variety of compounds that are toxic to a lot of marine organisms, this again depends on the nature of the oil and what level of toxicity it carries. One of the highest risks of oil pollution causes harm to Plankton populations, oil and oil fractions are toxic to a wide range of Plankton species and since many marine organisms consume these plankton species, it leads to the decline of other marine organisms as well further leading to the decline in the food chain. Furthermore, the damage is not limited to organisms living inside the water, sea vegetation such as Sea Grass, Mangroves, and so on are also affected. Low-energy areas are likely to trap oil, and the plants that form the basis of these ecosystems suffer accordingly. Sea Birds are also victims of oil pollution, they are harmed by the physical properties of floating oil, if liquid oil contaminates a bird’s plumage, then its water-repellent properties are lost and if the bird remains in the sea, then water penetrates the plumage and displaces the air trapped between the

feathers and the skin. This air layer provides buoyancy and thermal insulation (Clark, 2011).

When it comes to India, oil pollution is taken care of by the Oil and Natural Gas Co-operation (ONGC). The ONGC focuses on preventive measures to minimize oil spills. Every offshore installation and pipelines are designed as per International Standards which are API, ISO, IMO and so on which have safety systems built at the design stage itself. In addition, regular inspection and maintenance of equipment, pipelines, and offshore structures are carried out as per maintenance protocol. All offshore wells are fitted with Sub Surface Safety Valves (SSSV) and Surface Safety Valves (SSV) which can be remotely operated from the control room in case of emergency situations in wellhead platforms. All the offshore installations can be shut down with emergency shutdown systems. When it comes to spill response, the Indian Coast Guard is the central coordinating authority in India for matters regarding spillages.

As per NOSDCP, Oil pollution preparedness and response requirements are categorized into a total of three 'Tiers'1,2,3 the tiered approach to oil contingency planning identifies resources for responding to spills of increasing magnitude and complexity (ONGC, n.d.). The ONGC closely monitors its operations, including pipelines, offshore installations, and offshore drilling platforms to detect any signs of spills or leaks. Standard Operating Procedures for offshore drilling platforms to detect any signs of spills or leaks. The ONGC has been undertaking Offshore Environment Monitoring of the western offshore through credible organizations since 1994 and in Eastern Offshore since 2014 (ONGC, n.d.).

The waste and sewage disposal in India is regulated under The Water (Prevention and control of pollution) Act, 1974 (most recently amended in 2024). Chapter V of the act emphasizes on the 'Prevention and Control of Water Pollution'. Section 24 of the act

prohibits the disposal of polluting matter into streams. Section 25 prohibits the disposal of industrial wastes and sewage treatments. Section 26 which states provisions for sewage disposals and trade effluent. The penalties for the offenses of the above sections are mentioned in Chapter VII of the act sections 44 to 50, which are sections relating to offenses by various government and non-government organizations, and the punishments and penalties for these offenses can last up to six years of imprisonment or/and fines (The Water (Prevention and Control of Pollution) Act, 1974, n.d.). There are various projects undertaken by both government and private organizations for the cleaning of the rivers, one of which is the.

With a budget of Rs 20,000 crore, the **Namami Gange Programme** (Government of India, n.d.). This is an integrated conservation campaign that was started in June 2014 with the dual goals of effectively reducing pollution and conserving and revitalizing the Ganga River. As of 2024, 99 sewage projects have already been finished in 9 states, 48 sewage management projects are being implemented, 27 sewage projects are undergoing tenders, and 8 new sewage projects have been begun in these states, demonstrating the relative success of the Namami Gange (Government of India, n.d.).

The project also includes riverside development, including pond and crematory construction, rehabilitation, and modernization. River Surface cleaning for the collection of floating solid waste from the surface of the crematoria and river and its disposal are afoot and pushed into service at 11 locations (Government of India, n.d.). Afforestation along the river is also undertaken for the rejuvenation of the river Ganga, as per a report by the Forest Research Institute (FRI) a total area of 1,34,106 hectares for afforestation in the Ganga River bank in five states (Government of India, n.d.). Industrial Effluent Monitoring along the Ganga is also one of the main priorities of the Namami Gange project, the number of Grossly Polluting Industries (GPIs) as of April

2019 were 1072. Under this project regulation and enforcement through regular and surprise inspections of the GPIs are carried out for compliance verification against stipulated environmental norms (Government of India, n.d.).

Private organizations such as the Isha Foundation is the Rally for Rivers launched in 2017, it aims to rejuvenate the depleting rivers of India mostly by means of afforestation and raising awareness ( Rally for Rivers, 2022). When it comes to the oceans India is a party to the MARPOL convention, which addresses the prevention of pollution from ships caused by oil, noxious liquid substances, packed dangerous goods, sewage, rubbish, and air pollution, among other things. The treaty is divided into six annexes, numbered I through VI. Chapter XIA of the Merchant Shipping Act of 1958 deals with the prevention and control of oil pollution of the sea. This provision is applicable to all ships registered under this act and compliance is monitored and regulated by the Directorate General of Shipping (DGS). Under this act, ships are subjected to initial inspection and once they are constructed to ensure that the ships are fitted with all necessary equipment to prevent the pollution of the seas. Once the ship is put into operation it is subjected to periodical inspections at regular intervals of time to keep in check and prevention of pollution (Ministry of Ports, Shipping and Waterways, n.d.).

**Coral Reefs Protection and Maritime Protected Zones (MPAs): -** In India, there are very few laws that safeguard the coral ecosystem in the country. There is no specific act that covers the protection of the coral reefs, therefore coral reef protection comes under the Environment Protection Act, 1986, and the Coastal Regulation zone notification 1991. Under the Environment Protection Act. Coral protection also comes under the Wildlife Protection Act, 1972, and all coral reefs are protected under this act, however under the Wildlife Protection Act, coral reef areas have no separate legal status, and short-comings of WPA in providing protection to coral reef ecosystems are discussed

subsequently. Other acts that contribute to the safeguarding of coral reefs are the Indian Forest Act, 1927, the Forest Conservation Act, 1980 and the Indian Fisheries Act.

The Marine Protected Areas (MPAs) of India have coral reefs in them, they come under the charge of the Ministry of Environment and Forests. Overall, the laws that claim to protect coral areas are inadequate as they are not area-specific and do not distinguish 'coral' reef areas from other islands, coastal and marine areas. There is one law, however that explicitly outlaws coral mining is the Coastal Regulation Zone (CRZ) under the Environment Protection Act (Ministry of Finnce,n.d.).

The government of India has notified around 130 MPAs across the coastal states and islands, apart from that 106 coastal and marine sites have been identified and prioritized as Important Coastal and Marine Biodiversity Areas (ICMBAs) to care for the marine species conservation. The Indian Wildlife Protection Act 1972 has a list of threatened marine species which have been listed as scheduled animals. The government of India has given priority to certain endangered and threatened marine species such as species of marine turtles, Humpback Whales and Dugong for assessing country-wide population status and checking under the scheme of Integrated Development of Wildlife Habitat (IDWH).

Under the Endangered Species Recovery Program (ESRP), The Dugong has received special attention when it comes to their conservation, about 450 square kilometres area in the Palk Bay have been declared as Dugong Conservation Reserve to conserve the Dugongs (Provisions for Conservation of Marine Species, n.d.). The government has also released a National Marine Turtle Action Plan to conserve marine turtles and their habitats in India, in addition to this, under the Project Dolphin, the government is expanding to include marine dolphins for species monitoring and conservation of

marine biodiversity. In addition to this, more species including marine invertebrates will be added for population monitoring/recovery under the IDWH or Endangered Species Recovery Programme.

**Coastal Regulation Zone (CRZ):** - The Coastal Regulation Zone (CRZ) notification, 2019, promulgated under Environment (Protection) Act 1986, has a special focus on conservation and management plans Ecologically Sensitive Areas (ESAs) such as Mangroves, Seagrasses, Sand Dunes, Corals and Coral reefs, Biologically active mudflats, Turtle nesting grounds and Horseshoe crab habitats and prohibit developmental activities and disposal of wastes in the fragile coastal ecosystems (Provisions for Conservation of Marine Species, n.d.).

# Chapter V

# Challenges to India's Blue Economy

## Climatic Conditions and Blue Economy

Although the sole purpose of this research is to examine the contribution of the Blue Economy the counter to climate change, climate change is already a major challenger to the blue economy; a rise in temperatures could result in oceans becoming over-heated and de-oxygenated could negatively affect coral reef environments which are habitats of many fish species, rise of ocean temperatures already have destructive effects on coral reefs, as seen in the global mass bleaching of 1988 which mainly affected the coral reefs of the Indian Ocean which later led to the average decline of 46 percent of the coral ecosystem in the region (Vivekananda International Foundation, n.d.). Rise of temperatures in the ocean surface also effects the composition of Zooplankton and Phytoplankton, thereby leading to the decline of fish production. (Vivekananda International Foundation, n.d.). A rise in temperatures leads to Sea Level Rise (SLR).

### Sea level Rise

Sea Level Rise (SLR) is one of the most alarming challenges because of the following reasons

1. SLR is irreversible through natural processes on timescales of centuries or even millennia
2. There is no practical, economically possible course to protect the coastlines from SLR

3. There are many ‘tipping points’ in the Cryosphere which, when exceeded, would commit to multiple metres of global SLR over a course of time
4. The current rate of SLR is already far larger than ever observed in recent Paleo-Climatic history

It is inevitable that sea-levels will rise as long as global warming exists, what is more concerning is that is that it is difficult to project the magnitude and rate of SLRs in future.

According to a special report by the UN’s Intergovernmental panel on climate change (IPCC) on ‘The Ocean and Cryosphere in in a Changing Climate’, foresaw that the Global Mean Sea Level (GMSL) would possibly rise by around 0.84 metres by the year 2100 if action is not taken (Ganeshan et al., 2021). As of today, the global average temperature is 1.1-1.2 $^{o}$ Celsius above pre-industrial levels which signifies that it is nearing closer to global warming targets which is 1.5-2 $^{o}$ Celsius which was agreed upon by over 190 countries signed at the Paris Agreement signed at the 21$^{st}$ conference of Parties (COP 21) of the United Framework Convention on Climate Change (UNFCC) in 2015 (Ganeshan et al., 2021). A slight rise of sea-levels can prove damaging, as witnessed around 129-116 thousand years ago, wherein the global average temperature increased by 0.5-1$^{o}$ Celsius the sea-level rose by 6-9 metres higher than present levels. It is estimated that there is a likelihood that it will cross the Paris Agreement target by the middle of the 21$^{st}$ century (Ganeshan et al., 2021).

When the global temperature approaches 3$^{o}$ Celsius or higher above pre-industrial levels, we might experience climate that was experienced around 3.3-3.0 million years ago during the Pliocene Era when the sea levels was 25 metres higher than today (Ganeshan et al., 2021). If the temperature keeps on increasing at 1.5$^{o}$-2$^{o}$ C or 3$^{o}$ C than

the sea levels will slowly increase by 6-9 metres to 25 metres in the future. SLR will impact India tremendously, moreover due to the huge dependency of the oceans on the Indian population and massive population residing along the coasts. In the short-term, the relatively small amounts along with the increasing cyclonic storms and surge in storms pose great threat to the infrastructure and population along India's coastline. In the long-term, even an increase of a metre could lead to major disruptions in not just national but even global order, overall it would even reconfigure the coastlines. According to estimates conducted by a study in 2019, By 2050, nearly 35 million Indians will be exposed to annual flooding, and that number is projected to increase to 51 million by 2100, excluding 21 million Indians permanently flooded by mid-century and 38 million by the end of the year. century. The SLRs will furthermore result in tidal flooding, storm surges and erosion, SLRs also affect India's food and water security, with coastal populations suffering the most, salt water pollution in rural areas a major challenge. Two important low-lying coastal crops are sugarcane and rice, which are very sensitive to soil salinity, and saltwater intrusion into aquifers can damage an important source of fresh water (Ganeshan et al., 2021).

SLRs impact on Blue Economy could be grave as Fish and Shellfish species may be affected by different stresses and physiological effects, leading to their increase in vulnerabilities towards diseases and infections, while a number of suitable sites for aquaculture such as inter-tidal mudflats for shellfishes can decline. Many species have various salinity levels and if their environment becomes too saline than they might not survive, this will have enormous implications when it comes to production. Other negative impacts include damage to coastal ecosystems such as mangroves and salt marshes which are crucial for maintaining wild fish stocks and supplying seeds for

aquaculture. Saline water also effects ponds, cages tanks and pens particularly in lowland regions.

There have been certain cases wherein Aquaculture has also contributed in rise in sea levels, research shows that China's Yellow Delta found that groundwater extraction for fish farms makes land sink at a quarter of a metre per year, which is nearly 100 times faster than global average. Although land loss and frequent flooding will be inevitable, especially in low-lying coastal areas, however some farms may be positively impacted, the farms that benefit can be the brackish water culture of species such as Shrimp and Mud Crab aquaculture may rise as a result of Sea Level Rise. However, it should be taken into consideration that just because a small section of aquacultural produce can be secured through SLR, the damage would be far worse than its benefits, hence suitable policies need to be in place to avoid over-exploitation (Global Seafood Alliance, 2022).

**Changing extreme weather patterns**

Climate change is making weather events more and more extreme. Increasing atmospheric temperatures have immensely changed the natural water cycle. With every 1º C rise in temperature, the atmosphere holds around 7 percent more water vapour, leading to increasing likelihoods of both droughts and heavy precipitation (Ganeshan et al., 2021). Rising ocean temperatures and heat content are enabling the occurrence of more intense marine heat waves and tropical revolving storms. Abrupt warming in the Arctic compared to lower latitudes is changing the behaviour of the jet stream which may be the main reason for the freakish extreme weather events in the past years, particularly in mid-latitudes.

Against the backdrop of gradual but continuous SLR, these patterns pose great threat to maritime India. Extreme weather events results in heavy Socio-Economic losses over a short period of time, while taken in combined over time they could lead to long-term on the economic and the social order. India has seen various examples of the above (Swati Ganeshan et al., 2021). Between the years 1970 and 2019, there were a total of 117 tropical cyclones that made landfall in the Indian coast which claimed over 40,000 lives (Global Seafood Alliance, 2022). In 2020, the cyclone 'Amphan' caused wide-scale destruction to residential, commercial and municipal infrastructure to West Bengal amounting to over 1.02 lakh crore. The next year, the west coast witnessed cyclone 'Nisarga' which was the strongest tropical cyclone since 1981. Apart from this since the 2020s other major cyclonic storms made landfalls, such as 'Tautkae' and 'Yass' (Ganeshan et al., 2021)

The impact of storms on the and its damage upon marine life depends on its 'force', weaker cyclones only disturb life forms residing in shallow waters such as crabs and sea-grasses, however in the case of tropical cyclones can uproot kilometres of vegetation and sea life from seafloor and along the coasts, mobile organisms such as fishes and even sharks and whales can move away from the cyclone without getting damaged or hurt, sedentary forms like corals or plants bear the most brunt. Coral reefs, seagrass beds and mangroves are among the most affected ecosystems due to their proximity to the coasts, strong currents and storm surges can physically break or dislodge corals, leading to its extensive damage, the debris and sediment stirred up by the cyclone can also smother corals, further affecting their health and growth.

In 2017, Tropical cyclone Ockhi, which originated near Sri Lanka, moved north in the Arabian Sea, passing through several coral atolls in Lakshadweep, after the cyclone passed over the corals in the area, tissue damage was shown and the strength of the

cyclone even uprooted many stable reefs from the ocean depths. Another example is from 2023, when visitors to Malpe Beach in Karnataka found piles of noodle-like material on the beach, later identified as cellophane tubeworm shells found on the seabed. This was observed after tropical cyclone Biparjoy. Ocean eddying and the addition of fresh water from rain and floods lower ocean salinity, as scientists studied the effects of a Tropical Cyclone Fan in the Bay of Bengal and also found a drop in dissolved oxygen that can suffocate marine life. Even mangroves that defend coastlines from storm surges and coastal flooding suffer the wrath of tropical cyclones, it was seen in case of tropical cyclone Nisarga that it damaged mangrove habitats and increased shrubby vegetation along the coast (Raman, 2023).

Extreme weather patterns and strong winds can cause thermal destratification of the water bodies even in the tropics. The deeper waters, which may be completely depleted dissolved oxygen, will be mixed with oxygenated surface waters diluting the dissolved oxygen concentration. The deeper waters also may contain a large amount of organic matter and other reduced substances which remove dissolved oxygen from the surface waters when the two layers are mixed by destratification. This effect has led to numerous spectacular fish kills in cage aquaculture farms in lakes apart from that we do not need to forget that storm surges can damage cages and net pens which can lead to the escape of farmed fish and strong winds can also lead to fish kills in cage aquaculture farms in lakes.

As mentioned earlier extreme weather patterns also leads to drought. Droughting can pose serious problems in aquaculture and especially in the facilities depending upon surface sources of freshwater. Ponds filled by overland flow or storm runoff may decrease greatly in volume. This crowds the culture animals into less volume and also concentrates nutrients which can lead to excessive Phytoplankton blooms and dissolved

and particulate organic matter concentrations increase, resulting in a greater oxygen demand being exerted by microbial decomposition. When it comes to estuaries, with restricted connection to the sea and little tidal flushing, drought reduces freshwater inflow and salinity increases at a very high rate in response to evaporation. This salinity may exceed the optimal salinity range of culture species (Global Seafood Alliance, 2020).

## Human Conditions and Blue Economy

### Illegal, Unreported and Unregulated (IUU) Fishing

One of the biggest man-made challenges to Blue Economy is Illegal, Unreported and Unregulated (IUU) Fishing. IUU fishing has been seen as food and economic threat by coastal states. According to the Food and Agriculture Organization (FAO), IUU fishing accounts to around 26 million tons of fish per year and the economic value has been placed between $ 10 billion to $ 23 billion annually (Bhatt, 2020.). IUU fishing directly impacts the food, economic and health security of coastal states including India, IUU fishing further distresses the marine environment, IUU fishing is not only limited to illicit fishing activities but also inter-connected with key societal issues such as drug trafficking, piracy and illegal trade adding to a myriad issue faced by underdeveloped and developing coastal states in the Indian Ocean region. IUU fishing in India is not as prominent as Southeast Asia. However, nations should view IUU fishing not only as a food, economic and societal threat but a threat to national security as a whole as addressing the issue of IUU can inevitably address the India’s legal maritime infrastructure to safeguard its sovereignty and maritime interests. The dangers posed by

IUU fishing is not to India, however they have been largely absorbed with other non-traditional security threats.

Transnational organized terrorist groups use IUU fishing in the commission of other crimes such as smuggling of drugs, arms, and human trafficking. Most Indian Ocean states have underdeveloped economies marred by poorly developed and implemented government policies, administrative systems plagued by corruption which forces local fishers to adopt illegal fishing practices and get involved in criminal activities. Sometimes government policies aimed for the betterment for the lives of fishers often backfire and lead to IUU fishing, international organizations often make allegations of misuse of government subsidies such as fuel subsidies with the aim to alleviate them from poverty and provide economic assistance, however this often results in IUU fishing, however these subsidies are necessary for the fishers, the government of India argued that if the subsidies ended than up to four million fishers could be negatively impacted.

Another pressing issue when it comes to IUU fishing is the presence of foreign fishing vessels in Indian waters, this could be because of the confusing maritime borders between India and its neighbours, there have been frequent arrests by authorities between India-Pakistan maritime border in the Rann of Katchh, India-Sri Lanka border in the Palk Strait and India-Bangladesh border in the Bay of Bangal. Although in the above cases the problems lie only between borders, there have been cases of shipping vessels from distant lands encroaching in the Indian waters. For example in June 2019, 10 fishing vessels belonging to the Fu Yuan Yu fleet, owned by the Dongxinglong Ocean fishing company based in Fujian province of China entered the Indian maritime territory off the coast of Maharashtra, it is said that the fishing vessels entered Indian waters under the customary international law concerning vessels in distress from the Indian

Coast Guard for asylum in the Ratnagiri port during the cyclone Vayu, upon investigation it was revealed that these vessels had engaged in IUU fishing in the Indian EEZ and may have harvested up to 80,000 tons of marine life every month, the fleet also carried with itself illegal gear and illegal equipment and devices which many national fisheries commissions have banned (Bhatt, n.d.).

**Unsustainable Blue Economy practices**

While this paper mentions how blue economy is beneficial in a lot of ways and promotes sustainable development, however unsustainable practices can lead to more harm than good and can even negatively impact the environment, something that completely contradict the purpose of not only this paper, but also the efforts by various government and private agencies, NGOs, corporates to curb environmental destructions. Activities such as Aquaculture faces its own set of environmental challenges, ranging from destroying important ecosystems and habitats to the use of harmful chemicals and anti-biotics, and the reliance of wild-caught fish and other unsustainable ingredients in the feed. The environmental impact of aquaculture is completely dependent upon the species being farmed, the intensity of production and the location of the farm (Moore, 2023).

In fish farms disease outbreaks are common, because fish in large pools live very close to each other hence allowing the disease to spread quicker and whole schools of fishes can be infected within a matter of days, many of fish farms are located in shallow river beds and the sea, which leads the contagion to spread to wild fishes. Farm owners often overuse anti-biotic and anti-parasitic drugs, this can result in the development in the resistant strain in the bacteria which is even more dangerous to wild populations.

Waste discharged from these farms usually ends up in local streams or rivers, these discharges contain chemicals, growth factors, anti-biotics and uneaten food, this can have massive effects on local ecosystem, such as products from fish metabolism such as nitrogen can increase Ammonia levels in nearby rivers which is dangerous to wild species. Perhaps one the most concerning factor is invasive species, farming of non-native species wherein certain specimen can escape into the wild and breed can change the demography of the region, they will out-compete for resources and pose a threat to the wild species. Apart from that the construction of fish farms often lead to the destruction of eco-sensitive zones such as mangrove forests (Qadir, 2023).

The Blue Economy activity which has far more destruction compared to any other unsustainable Blue Economy activity is unsustainable Deep-Sea Mining, extracting minerals from the seabed could negatively impact biodiversity by 25 times more than that of terrestrial mining and fixing the destruction would cost twice as the extraction, deep-sea mining mainly aims to extract cobalt, nickel, and manganese from modules the size of potatoes which are found in the seafloor at depths of 4-6 kilometres and are habitats to various marine species. The nodules take millions of years to forms, there are petitions to replace the natural nodules to artificial ones, however they are not very cost effective (Reuters, 2023).

# Chapter VI
# Conclusion

The value and prospects of the Blue Economy are vast, and if we dive deeper, then we may find new prospects for it. Throughout the chapters, we learn about the blue economy and its correlation with sustainable development. India, having its vast coastline and massive maritime zone, still does not seem to utilize its maritime resources to the fullest, if done, it can catapult India into a major maritime power. Henceforth, as this research concludes, there need to be certain aspects that have to come to order for that we need to ask the questions: -

## What to Do?

As mentioned in the above chapters, India's Blue Economy policies in terms of sectors such as Aquaculture, Fishing, and so on, as well as the many projects undertaken by India to enhance its blue economy. However, India needs to enhance global cooperation when it comes to this sector. A sector such as the Blue Economy, whose prospects and activities are as massive as the oceans itself, cannot sustain itself solely with regional cooperation. During its G20 presidency, the vision for a resilient and green maritime sector was given the limelight; on September 2023, India's presidency highlighted the need to build a sustainable and resilient blue economy (Khan, 2023).

India-France made a joint statement which was adopted on 22nd August 2019, on the occasion of the Indian Prime Minister's visit to France; the statement was "*India and France agreed that oceans play an important role in combating climate change,*

*preserving biodiversity, and development and acknowledging the link between environment and security, decided to enlarge the scope of their maritime co-operation to address these issues. For a sustainable use of marine resources, the sides will work towards ocean governance, including through coordination in relevant international bodies. Blue Economy and coastal resilience are a common priority for India and France. In this regard, both sides agreed to explore the potential for collaboration in marine science research for the better understanding of oceans, including the Indian Ocean*" (Ministry of External Affairs, n.d.).

With the above said India and France encourage a high-quality dialogue on maritime security, which helps them to raise strategic issues in the Indo-Pacific. Furthermore, an MOU was signed between the Ministry of Ecological Transition (MTE) and the Ministry of Environment, Forest and Climate Change (MoEFCC) in 2018, which aims for a working group on the environment, which raises issues such as climate change, biodiversity, and so on. India and France are also focused on promoting cooperation between the European Union and blue economy and ocean governance in its framework "EU-India Strategic Partnership: A Roadmap to 2025" (Ministry of External Affairs, n.d.).

Now, with the increasing importance of the Indo-Pacific region and India's strategic location along the region, it is inevitable that India will play a major role in Indo-Pacific geopolitics. Many powers who are interested in having their presence in the region see India as a major 'power hub,' and India needs to leverage this opportunity to enhance its maritime prospects.

## The Question of Sustainability

If sustainability is so virtuous, why don't corporations and organizations adopt it? some companies claim to be sustainable but are nowhere close to using sustainable practices, and even if they show sustainability, their sustainability is not 'up to the mark.' The question that arises is, why don't they adopt it? The answer is simple, and not all sustainability meetings, gatherings, talks, and conferences discuss it. Most of the time, sustainable practices compromise with the profits generated by the firm. In many cases, sustainability and profits can't go along well, hence compromising one of the above. More research and efforts need to be made to facilitate the growth of both and see how sustainability and profits can go side-by-side.

With a coastline of more than 7500 kilometres and a maritime territory of over 2 million square kilometers (Saha, n.d.), is one of the greatest blessings bestowed upon India. Multiple economic and social problems faced in India on land can be solved if we only focus adequately on the oceans, as mentioned in Chapter 4, the blue economy can help not only in SDG14 but in fulfilling other SDG goals as well. As land resources are getting scarcer and scarcer and economic activities in the oceans are increasing, if given due importance then certain land-based activities have their alternatives in the sea.

Activities such as aquaculture and fishing under schemes such as the PMMSY have helped many fish farmers to start their enterprises as well as increase their produce, provide infrastructure provision, and so on, the government should also provide land on lease so that aspiring fish farmers and breeders who do not possess land can find it easier to conduct their business. There also needs to be more numbers of MPAs wherein fishing and allied activities are completely banned within the MPAs; this will improve the fishing catch, which will enhance the fisheries sectors as fishes that are caught

outside the MPAs are replenished by the fish population thriving inside the MPAs. The fish population inside the MPAs breed flourish and breed peacefully since fishing within the MPAs is banned; they breed, and the fish grow to adulthood successfully, then they venture outside the MPAs, hence in many cases, the outskirts of the MPAs have the best fish population. Oceans' contribution to greenhouse gases is one of the highest; the government should increase its focus on the seaweed industry as they can regulate the ocean temperature; seaweed farming is also a super-crop and has many Nutritional, Pharmaceutical, and Industrial benefits. Hence, it can act as a means for combating climate change and boosting the economy by creating many industrial products. Although not extensively discussed, industrial-scale waste management can also be profitable. If the scale of waste dumped in the oceans is collected and recycled to get new products, it can also be highly profitable and will contribute to SDG 14. India also needs to examine each coastal state and what it can offer in terms of clean ocean-based energy, as every state's coastline is different with unique characteristics; their prospects when it comes to ocean-based renewable energy also vary; ocean-based renewable energy is necessary for mainly three reasons.

1. Coastal towns and cities should avoid their dependency on land-based energy supplies, as it can be used for settlements far from the coast since landlocked settlements might not have access to any other energy source, whereas coastal settlements have access to the sea, which can be used for wind energy, tidal energy, wave energy and so on.
2. ocean-based energy supplies would enable and enhance other blue-economy industries; in some cases, these would be cheaper than land-based sources of energy.
3. The coastline is home to around 171 million people (M&M, 2023), with major cities such as Mumbai, Chennai, Kochi, etc., being along the coast; it will provide energy

to the major cities and will enhance the functioning of the industries and daily life of the people living along the coast.

There is adequate data that shows that blue-economy practices are carried out with massive success under government schemes. However, the data on how sustainable those practices are is very limited; as mentioned in Chapter 5, practices in the blue economy are sometimes unsustainable which would cause more harm than good, hence apart from policies to promote blue economy there also should be government provisions in place which help check the pollution levels in the water bodies. At the national level, there are policies in place, and both central and state governments have been putting various efforts into strengthening the blue economy, henceforth there are efforts in the national level, however where India lacks is at the international level, as mentioned above where India has MOUs with France, there haven't been much follow-ups. India has to cooperate with countries that have gained success in their blue economy, countries such as Chile and the Nordics. India should encourage foreign investments from these countries to perform their business in Indian waters, apart from that exchange programs and scholarships for Indian students in these countries to learn the processes of how they carry out their blue economy.

## Final Research Analysis

The research aims to answer certain questions asked at the beginning. I have been fortunate that, thanks to the guidance and the available sources, I can provide the necessary answers. The answers to the questions are the following: -

**How does the Blue Economy contribute to India's GDP, and what are the key sectors driving this economic impact?**

The contribution of India's Blue Economy to India's GDP is mentioned extensively in Chapter III and Chapter IV, where the various sectors and their share in the Indian as well as the global market are mentioned. India is leading in sectors such as Fisheries and Aquaculture; when it comes to aquaculture, the industry is growing at a rapid rate with a mean of around 6 percent annually, which in the coming years will increase its production. The Marine Transportation industry is also expected to increase with the various government policies such as Sagarmala and updating the infrastructure of existing ports, which will help India in terms of its logistics capacity building; India has one of the largest shipping industries in the world, accounting for around 30 percent of the total tonnage. Ship-building and Ship-breaking are also very prominent industries in India, with India accounting for around 25 percent of the global share in Ship-Breaking.

**How can India enhance fisheries management to ensure the long-term health of marine resources and achieve SDG 14 targets?**

As mentioned in Chapters III and IV, the fish and fish products sector is one of India's largest export sectors. With over 8% of the world's total fish production, India ranks third in the world for fish production through aquaculture and fishing. To enhance fisheries management and to ensure the long-term health of marine resources, control on IUU fishing needs to be implemented. This can be achieved if certain forms of fisheries subsidies that contribute to overcapacity and overfishing are restricted. Also, it is necessary to eliminate subsidies that contribute to Illegal, unreported, and unregulated fishing (IUU) and avoid the introduction of new subsidies, as mentioned in Chapter II; Chapter V gives us an insight into how IUU fishing impacts the ocean

environment and the economic impact it has in the global market. In chapters I, II, III, IV, and even in this very chapter, there was an emphasis on the importance of Marine Protected Areas, which prohibit fishing activities in the designated areas, which will allow fish within the areas to flourish. This will allow the fish population to increase and a healthy fish population will lead to a better catchment when these fishes venture out of the MPAs. India should increase its number of MPAs, and there needs to be a new legislative act to govern these MPAs; there also needs to be certain areas designated as 'reserves' like we have the 'tiger reserves', especially for endangered species living in these areas.

**How can India leverage Blue Economy initiatives to contribute to climate change mitigation, specifically in the context of ocean-based renewable energy sources?**

With a coastline of over 7500 kilometers, India has huge potential for offshore renewable energy; as mentioned in Chapter III, the efforts taken by the Indian government, along with international support, made efforts to exploit India's renewable offshore energy. Tidal and Wave energy emerge as the two most sustainable forms of offshore renewable energy. In this chapter, under the section 'The question with Sustainability', I have elaborated on why every coastal state should focus on renewable offshore energy and find which type of offshore energy is best per their geography. The problem with offshore renewable energy is an investment; the cost of setting up and maintaining these infrastructures is very high; overall, there needs to be specific geographical and climatic conditions that would enable utilize these energies to their fullest.

**What policy measures are necessary to strengthen India's role in regional and global collaborations for the sustainable management of oceans?**

When it comes to aquaculture, the PMMSY is one of the most successful schemes launched by the government of India; the scheme is mentioned in Chapter III, and its implementation is mentioned in Chapter IV. It provides assistance in a number of fields, there is however something that the scheme lacks; the scheme must also help provide land for any aspiring fish farmer who is landless then the scheme should give provisions for land lease or rent, which would make it easier to conduct business, secondly to ensure that this aquaculture is sustainable, there needs to a constant check and inspection, otherwise unsustainable fishing practices would prove disastrous as mentioned in chapter V. Apart from this there needs to be laws to stop the rise of IUU fishing and increase the numbers of MPAs along with laws to govern them. There needs to be a list of threatened aquatic organisms, and their main habitats must be identified and demarcated in that particular area as an MPA. Since MPAs do not consist of one particular geographical characteristic and range from coral reefs to mangrove forests, laws of demarcation of these MPAs should also vary according to the nature of the ecosystem.

Regarding Hypothetical Analysis, the research has partially proved my **Hypothesis**. There are cases where increased investment in sustainable fisheries management has enabled an increase in production where aquaculture is concerned; in terms of sustainability, as mentioned above, checks and inspections need to be in place to ensure these practices are sustainable.

Secondly, strengthening international and national collaborations with stakeholders for effective maritime governance and enforcement of regulations in India's maritime zones will contribute to combating illegal, unreported, and unregulated fishing practices and promoting sustainable fisheries. India lacks international collaboration when it comes to IUU fishing. India should also collaborate with coastal countries to monitor the movement of migratory aquatic organisms to avoid them getting fished illegally.

# Bibliography

## Books


- Alvares, C. (2002). Fish, Curry and Rice: a sourcebook on Goa, it's ecology and lifestyle (4th ed.). Ecoforum.
- Ayyapan, S. (Director). (2019). Handbook of Fisheries and Aquaculture (2nd ed.). Indian council of Agricultural Research.
- Banerjee, S. (2018). Maritime Power through Blue Economy: in the Indian context. Vivekananda International Foundation, 31–50. https://DOC-20240222-WA0007..pdf
- Chaturvedi, M.C (2011). India's waters: Environment, Economy, and Development. CRC Press
- Clark, R. B. (2011). Marine pollution (5th ed.). Oxford University Press.
- Mitra, A., Mukhopadyay, N., & Agarwal, S. (2021). Blue Economy: A Road Map for the Future Planet (1st ed.). New Milenium Graphics.


## Articles, Websites and Newspaper articles


- Addis, D. (n.d.). The protection and preservation of the marine environment. International Court for the Environment Foundation. https://www.vliz.be/imisdocs/publications/288227.pdf
- Aggarwal, M. (2021, September 20). India's tidal power potential hampered by high costs and environmental risks. Mongabay-India.

https://india.mongabay.com/2021/08/indias-tidal-power-potential-hampered-by-high-costs-and-environmental-risks/?amp=1

- Baker, D.J., Bowman, T., Byrne, J., Connor, M., & Cortina, J. (2009). Marine Ecosystems and Fisheries; balancing ecosystem sustainability and the socio-economics of fisheries. Aquarium of the Pacific. https://www.aquariumofpacific.org/images/mcri_uploads/Marine-Ecosystems.pdf

- Benzaken, D. (2017). 10 Blue Economy in the Indian Ocean Region: Status and Opportunities Status and Opportunities from Asean and the Indian Ocean: The Key Maritime links. http://www.jstor.com/stable/resrep05888.14

- Blue food partnership, World Economic Forum, & Friends of Ocean Action. (n.d.). Road to Sustainable Aquaculture: on current knowledge and priorities for sustainable growth. https://www3.weforum.org/docs/WEF_The_Road_to_Sustainable_Aquaculture.pdf

- Bhatt, P. (2020). IUU Fishing as a national security threat: revisiting India's domestic framework and compliance with International Regimes. International Law Studies.

- Buys, A. (2018). China Japan, India and The East Africa Blue Economy. www.jstor.org. https://www.jstor.org/stable/resrep25986

- Committee reports. (n.d.). PRS Legislative Research. https://prsindia.org/policy/report-summaries/tidal-power-development-in-india

- Cpcb (n.d). The Water (Prevention and Control of Pollution) Act, 1974. (n.d.). https://cpcb.nic.in/upload/home/water-pollution/WaterAct-1974.pdf

- Dasgupta, S. (n.d.). Indian shipping industry. Iimidr. https://www.iimidr.ac.in/wp-content/uploads/Indian-shipping.pdf
- District South Andaman, Government of Andaman and Nicobar, India. (n.d.). https://southandaman.nic.in/tourism/
- Down to Earth. (2023). Standing Committee asks MNRE to apprise it of efforts to assess tidal energy potential. https://www.downtoearth.org.in/news/renewable-energy/standing-committee-asks-mnre-to-apprise-it-of-efforts-to-assess-tidal-energy-potential-91055
- FAO Fisheries & Aquaculture. (n.d.). https://www.fao.org/fishery/en/countrysector/in/en
- Goal 14: Life below water – The Global Goals. (2024, January 23). The Global Goals. https://www.globalgoals.org/goals/14-life-below-water/
- GOI. (n.d.). Pradhan Mantri Matsya Sampada Yojana, Department of Fisheries, MOCIT, https://pmmsy.dof.gov.in/
- Government of Goa. (n.d.). Beaches. https://www.goa.gov.in/what_to_see/beaches/
- Government of India (n.d). Centrally sponsored scheme on development of inland fisheries and aquaculture. https://dahd.nic.in/related-links/centrally-sponsored-scheme-development-inland-fisheries-and-aquaculture
- Government of India. (2020). Blue Economy: A draft Policy framework. Government of India. https://incois.gov.in/documents/Blue_Economy_policy.pdf
- GTDC. (n.d). Forts of Goa. https://goa-tourism.com/history/lesser-known-pib,forts/

- Guercio, T. (2023). Advantages and disadvantages of living in coastal areas - The Florida Agents. The Florida Agents. https://www.thefloridaagents.com/advantages-and-disadvantages-of-living-in-coastal-areas/
- Gujarat Tourism. (n.d). Experiences of Gujarat tourism. https://www.gujarattourism.com/experiences.html?cid=9
- India - Submarine networks. (n.d.). https://www.submarinenetworks.com/en/stations/asia/india
- India Data Insights. (2022). Life below water: Data on India's conservation efforts. IDR. India Development Review. https://idronline.org/article/water-sanitation/life-below-water-data-on-indias-conservation-efforts/
- Infra, E. (2023, October 17). PM Modi launches maritime projects worth Rs 23,000 cr. https://infra.economictimes.indiatimes.com/amp/news/ports-shipping/pm-modi-launches-maritime-projects-worth-rs-23000-cr/104495405
- Kar, B. A. (2023, January 8). Indian undersea cable landing stations increase their capacity by nine times between 2016-2021: TRAI report. BusinessLine. https://www.thehindubusinessline.com/info-tech/indian-undersea-cable-landing-stations-increase-their-capacity-by-nine-times-between-2016-2021-trai-report/article66353161.ece
- Khan, A. (2023, November 18). Can India spearhead the Global South's blue economy?, FairPlanet. https://www.fairplanet.org/story/can-india-spearhead-the-global-souths-blue-economy/
- Khanna, B. (2023, November 1). Inside India's 'Deep Ocean Mission', a challenge harder than going to space. The Hindu.

https://www.thehindu.com/sci-tech/science/deep-ocean-mission-matsya6000-seabed-mining-blue-economy/article67457379.ece

- M, P. K., & M, P. K. (2023, December 25). Data indicates greater coastal erosion on the east coast of India. FACTLY. https://factly.in/data-indicates-greater-coastal-erosion-on-the-east-coast-of-india/
- Meyer Turku shipyards. (2021). Sustainable shipbuilding: sustainability report. https://www.meyerturku.fi/en/05_sustainability/meyer_turku_sustainability_report_2021_web.pdf
- Miller, M. C. (2023, July 18). India's efforts to strengthen Indian Ocean security. Council on Foreign Relations. https://www.cfr.org/blog/indias-efforts-strengthen-indian-ocean-security
- Ministry of Earth Sciences (2023) G20-Principles for a Climate Resilient and Sustainable Blue Economy. https://moes.gov.in/sites/default/files/2023-01/G20-Principles-for-a-Climate-Resilient-and-Sustaianble-Blue-Economy.pdf
- Ministry of Earth Sciences. (n.d) MoES & RIIG. G20: Research and Innovation Initiative Gathering (RIIG). https://moes.gov.in/g20-india-2023/riig?language_content_entity=en#:~:text=The%20outcome%20of%20the%20G20,coastal%20and%20marine%20spatial%20planning
- Ministry of External Affairs. (n.d). India-France roadmap on the blue economy and ocean governance. Ministry of External Affairs, Government of India.
- Ministry of External Affairs. (n.d). Question No-1510 Mission Sagar. Ministry of External Affairs, Government of India. https://www.mea.gov.in/lok-sabha.htm?dtl/36934/QUESTION+NO1510+MISSION+SAGAR

- Ministry of New and Renewable Energy. (n.d.). offshore wind. https://mnre.gov.in/off-shore-wind/
- Ministry of Ports. (2023). Sagarmala: new dimensions in coastal economy. Ministry of Ports, Shipping and Waterways. https://shipmin.gov.in/sites/default/files/sagarmala-eng.pdf
- MyBMC – Welcome to BMC's website. (2021.). https://portal.mcgm.gov.in/irj/portal/anonymous/qlprjdtlcs1
- Nandi, J. (2023, July 28). At G20 meet, consensus on nine principles of 'blue economy.' Hindustan Times. https://www.hindustantimes.com/india-news/g20-adopts-chennai-high-level-principles-for-sustainable-blue-economy-fails-to-reach-cons
- National Geographic (n.d). Sustainable fishing. https://education.nationalgeographic.org/resource/sustainable-fishing/
- National Geographic. (n.d). The importance of Marine Protected Areas (MPAs) https://education.nationalgeographic.org/resource/importance-marine-protected-areas/
- National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation, Government of India. (n.d.). https://nmcg.nic.in/NamamiGanga.aspx
- NTNU. (n.d.). Sustainable hydropower development and reservoir management as an enabler of the renewable energy transition and an accelerator to meet the UN Sustainable Development Goals (SusHydro) - NTNU. https://www.ntnu.edu/sustainability/sushydro

- ONGC – Carbon Management – en – ongcindia.com. (n.d.). En. https://ongcindia.com/web/eng/oil-spill-management
- ORF. (2023). Hydropower in India: An update. *https://www.orfonline.org/expert-speak/hydropower-in-india-an-update#:~:text=India%20had%20about%204745.6%20MW,stages%20of%20investigation%20and%20construction.&text=Globally%2C%20hydropower%20is%20the%20dominant,thirds%20of%20all%20renewable%20electricity*
- Outlook Web Desk, & Outlook Web Desk. (2024, January 18). East West Metro Corridor: India's first underwater tunnel in West Bengal will be a 45-sec ride. Outlook India. https://www.outlookindia.com/national/east-west-metro-corridor-india-s-first-underwater-tunnel-in-west-bengal-will-be-a-45-sec-ride-news-249396
- PIB (2022). "Sagar Parikrama" a program by Ministry of Fisheries, Animal Husbandry and Dairying, saluting our great freedom fighters, sailors and fishers, beginning from Gujarat. Ministry of Fisheries, Animal Husbandry & Dairying. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=189708
- PIB (2023) India Ranks Third in net gain in average annual forest area in last decade: economic survey 2022-23. Ministry of Finance. https://pib.gov.in/PressReleasePage.aspx?PRID=1894898
- PIB (2023). PMMSY under Department of Fisheries envisages to generate direct and indirect employment opportunities to about 55 lakh personnel in fisheries and aquaculture sector by 2024-25. Ministry of Fisheries, Animal Husbandry & Dairying.

- PIB (2023). Ministry of Environment, Forest and Climate Change. Provisions for conservation of marine species. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1987749
- PIB. (2020). Ministry of Ports. Steps taken for prevention and control of pollution from ships. Ministry of Ports, Shipping and Waterways. https://pib.gov.in/PressReleasePage.aspx?PRID=1605383#:~:text=The%20MARPOL%20Convention%20has%20six,Air%20pollution%20from%20ships%20respectively
- PIB. (2022). Samudrayaan Mission. Press Information Bureau Government of India Ministry of Earth Sciences. https://pib.gov.in/Pressreleaseshare.aspx?PRID=1845765
- PIB. (2023). Ministry of Fisheries, Animal Husbandry & Dairying. Fisheries sector provides livelihood, employment and entrepreneurship to more than 2.8 crore fishers and fish farmers at primary level: Shri Parshottam Rupala. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1936017
- PIB. (2023). Year End Review 2023 : Department of Fisheries (Ministry of Fisheries, Animal Husbandry and Dairying). (n.d.). Department of Animal Husbandry and Dairying. https://pib.gov.in/PressReleasePage.aspx?PRID=1986155
- PIB. (2023.), Animal Husbandry & Dairying Department of Fisheries allocated an amount of Rs. 2584.50 crore for financial year 2024-25. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2001498#:~:text=2584.50%20crore%20for%20financial%20year%202024%2D25%20which%20is%20highest,budgetary%20support%20for%20the%20Department

- PIB. (2023). Ministry of Fisheries, animal husbandry and dairying. Fisheries sector plays a significant role in Indian economy. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1924524

  PIB.(2023). Improve coastal infrastructure. Ministry of Ports, Shipping and Waterways. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1947747

- PIB.(2023). Department of Fisheries launches 'Sagar Parikrama' program on occasion of 75th Azadi Ka Amrit Mahotsav. https://pib.gov.in/Pressreleaseshare.aspx?PRID=1896170
- Rally for Rivers. (2022). Rally for Rivers. https://consciousplanet.org/rally-for-rivers/#site-navigation
- Sakhuja, V. (2015). Harnessing the blue economy. https://www.jstor.org/stable/45341010
- Sattva Consulting. (2023, April 17). Life below water: Data on India's Conservation Efforts – Sattva Consulting. https://www.sattva.co.in/news-media/life-below-water-data-on-indias-conservation-efforts
- Shipping. (n.d.). Mospi. Gov. In. Retrieved December 13, 2023, from https://www.mospi.gov.in/sites/default/files/Statistical_year_book_india_chapters/Shipping.pdf
- Shridhar, R. (2017, May 21). Missing the coastal growth opportunity, Mint. https://www.livemint.com/Opinion/z1S62cSOhIyTLw3DljD6oI/Missing-the-coastal-growth-opportunity.html?facet=amp#amp_tf=From%20%251%24s&aoh=17115161415696&csi=1&referrer=https%3A%2F%2Fwww.google.

- UN News. (June 20, 2023). Beyond borders: Why new “high seas” treaty is critical for the world. https://news.un.org/en/story/2023/06/1137857
- United Nation (2009). Interactive Dialogue 2: Managing, protecting, conserving, and restoring marine and coastal ecosystems. United Nations Ocean Conference. https://sdgs.un.org/sites/default/files/2022-05/ID_2_Marine_and_coastal_ecosystems.pdf
- United Nations Statistics Division. (n.d.). SDG Indicators — SDG Indicators. https://unstats.un.org/sdgs/indicators/indicators-list/
- Van Beijnen, J. (2024, January 3). Is the aquaculture of invasive and non-native species worth the risk? The Fish Site. https://thefishsite.com/articles/is-the-aquaculture-of-invasive-and-non-native-species-worth-the-risk
- World Economic Forum. (2022, November). What Ocean Sustainability means for business:white paper. Retrieved December 10, 2023, from https://www3.weforum.org/docs/WEF_What_Ocean_Sustainability_Means_for_Business.pdf


## Videos


- CaspianReport. (2018, April 1). *Review: Sea Power by James Stavridis* [Video]. YouTube. https://www.youtube.com/watch?v=8pYfBz0Ukm0
- Student Energy. (2015, May 17). *Tidal Power 101* [Video]. YouTube. https://www.youtube.com/watch?v=VkTRcTyDSyk
- StudyIQ IAS. (2022, June 23). *How Blue Economy will make India $5 Trillion Economy? India's Blue Diplomacy. UPSC GS3 Economy* [Video]. YouTube. https://www.youtube.com/watch?v=_iHsH81cHxk

## Unpublished Source


- Prabhudessai, A., Andrade, A., Colaço, C., Godbole, A., Colaço, A., & Gomes, S. (n.d.). O tesouro do legado colonial: Goa, Damão and Diu (No. 25–50).