

Blue Economy: A Sustainable Development Paradigm

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ABSTRACT

The ocean's womb carries treasures of resources that sustain trillions of livelihoods. The ocean envelops nearly 71% of the earth's surface. The blue economy has huge potential for diversification, enhancing the economies of coastal countries. The study aims to identify the role of the blue economy in achieving sustainability in India's context. India has the seventh longest coastline in Asia, which measures about 8118 kilometres, and exclusive economic zones of 2.3 million km can be the catalyst for growth through the Blue economy. Blue economy aims to harness the ocean's resources for sustainable development to meet growing demand. The paper studies ocean resources like Fisheries and Aquaculture, Minerals, Hydrocarbons and renewable energy. The study found that ocean resources significantly contribute to the country's economy and have tremendous economic growth prospects.

Keywords: *Blue Economy; Ocean; Resources; Sustainability*

Introduction

The ocean is quintessentially a 'common pool of resources' (Ostrom *et al.*, 1994). The ocean's womb carries treasures of resources providing both renewable and non-renewable resources that support trillions of livelihoods. The ocean covers nearly 71% of the earth's surface and contains 97% of the earth's water. It is the source of 50% of the oxygen available and absorbs 25% of humankind's Carbon dioxide (CO₂). It also absorbs 90% of heat emitted from greenhouse gases. Ocean resources are food, transportation, livelihood, and extractive resources like minerals, hydrocarbons- oil, gas, and other rare earth elements. Other resources include energy from wind, tidal, thermal and biomass. In recent past the pace of industrialization and exploitation of the ocean has evidenced growth worldwide. (McCauley *et al.*, 2015). The current scenario of vigorous resource exploitation and the increasing pollution rate has a detrimental effect on the dynamic ocean ecosystem. Efficient use of ocean resources can ensure social, environmental, and food security by enhancing the livelihood of coastal communities, reducing environmental degradation and alleviating poverty and hunger.

Blue Economy

Professor Gunter Pauli first propounded the idea of a "Blue economy" in his book "The Blue Economy: 10 Years, 100 Innovations and 100 Million Jobs", submitted to the 'club of Rome'

in 2009. It reflected the need for sustainable future growth and prosperity, along with the threats posed by global warming. The core objective behind this economic philosophy is the development of sustainable models for the marine ecosystem. The idea of the Blue economy took centre stage during the United Nations (UN) Conference held to discuss Sustainable Development, also known as the Rio+20 (Agarwala, 2022).

The United Nations' Sustainable Development Goals for the Ocean (SDG 14) are a universally ordained directive for the conservation and sustainability of resources in water bodies. Its motto is to conserve, protect, and sustainably use these resources for sustainable development. It recognizes the ocean's role in future economic, social and ecological development. It also focuses on small island states' progress and promotes small-scale fishermen. According to SDG 14, about 40% of the ocean is affected by human activity. The Blue economy is in line with the UN's SDG-14. Under Blue, the Economy Ocean is a 'developmental space' committed to preserving, conserving, restoring and sustaining activities like resource extraction, energy generation, bio-prospecting and marine transport (UNEP, 2012). It is essential to develop a balance between economic development and environmental development. The aim of the Blue economy is to harness marine resources for sustainable development to meet growing demand.

Blue Economy : Key Definitions

The Blue economy is a broader conception that identifies the ocean not just for economic development but also for environmental and social development. It comprises aspects of ocean governance, economic development, environmental conservation and protection. UNEP, 2012 stated the Blue economy is a means to tackle climate change by promoting low-carbon emissions, focusing on the energy-efficient shipping and marine renewable energy industries. It also focuses on sustainable marine tourism.

The Indian Ocean Rim Association (IORA) is a regional governance organization that strongly advocates for the Blue Economy's cooperation and governance to preserve the ocean's resources for future generations. According to IORA, "Blue Economy will contribute towards food security, poverty alleviation, the mitigation of and resilience to the impact of climate change, enhanced trade and investment, enhanced maritime connectivity, enhanced diversification, job creation and socio-economic growth".

According to the World Bank, "Blue economy aims for sustainable utilization of resources found in oceans for economic growth, improved livelihood, creation of jobs, and maintaining the health of ocean ecosystems."

The World Wildlife Fund defines the "Blue economy as a marine-based economy that works for social and commercial benefits for present and future generations by contributing to food security, poverty eradication, livelihood enhancement, income generation, providing employment opportunity, health, security, equity, and political stability; reinstates and upkeeps the diversity, productivity, resilience, and intrinsic value of marine ecosystems - the natural capital upon which its prosperity depends; is based on clean technologies,

renewable energies and circular material flows for economic and social stability in a time span while keeping within the limits of one planet.”

Literature Review

Bax *et al.* (2021) highlighted the political and environmental complexity of adopting the Blue economy. The study conducted case studies in maritime countries like New Zealand and Myanmar to demonstrate obstacles and pathways in moving forward from the Business as Usual Model (BAU) to the Sustainable Development Goal (SDG). The study highlighted that the conflict resolution model transformed into a new form of social interaction and governance.

Lee, Noh and Khim (2020) studied the interdependence the Blue economy with United Nations’ Sustainable Development Goals (UN SDG). The study demonstrated the complexity and diversity of the “Blue Economy” in connection to the UN’s SDGs. The study highlighted the importance of the Blue Economy Strategy for safeguarding ocean resources. The study argued that the Blue economy is related with the UN’s SDGs 14-17. The study showed that stakeholders of SDG could play crucial roles in the Blue economy SDG.

Cisneros-Montemayor *et al.* (2021) examined the extent to which worldwide ocean economies can achieve equitable and sustainable benefits. The study points out that establishing a Blue economy not just depends on the availability of resources but also on the social condition and governance capacity. The study used the fuzzy logic model to integrate equitable, viable, sustainable blue economy indicators. They found that factors such as national stability, infrastructure, and corruption affect the Blue economy implementation outcome. The study suggests that policymakers must engage researchers and stakeholders in promote-evidence-based strategy to achieve the goals of the Blue economy.

Soma *et al.* (2018) noted that the European Union has adopted a Blue growth policy to achieve sustainability and growth on the European seas. The article discusses the strategy of social innovation to achieve the goals of Blue development. The study suggests changing the behaviour of groups of actors within a network to find enhanced means of collaboration for the use and management of resources.

Silver *et al.* (2015), in their study, tracked the new terms ‘global environmental governance’ and ‘Blue economy. The study discussed the relationship between the ocean and humans in four crucial segments: the ocean as natural capital, the ocean as good business, the importance of the ocean for Small Island Development States and livelihood for small-scale fishing communities.

Kathijotes (2013) argued Blue Economy Model targets from scarcity to abundance of resources. He highlighted the importance of management decisions and investment for the well-being of the ocean. He pointed out in his study that the unsustainable use of resources can lead to the depletion of the marine environment.

National Studies

Agarwala (2022) highlighted the need for technological development in energy generation from the ocean. The study also pointed to the need for environmental impact assessment as associated technologies impact the biological elements of the environment. The study stressed the need for public-private partnerships as well as international participation to efficiently use the unexplored areas of marine renewable energy.

Ghoshal *et al.* (2019) studied the relevance of brackishwater aquaculture and its role in the blue economy. The study stated that brackishwater aquaculture has a role in increasing fish production and supporting the livelihood of the coastal community.

Modayil (2019) highlighted the growing importance of ocean resources with the depletion of territorial resources due to urbanization and the soaring population. The study pointed out the adverse effects of climate change on aquaculture and pressed the need for the ocean for resource extraction for survival and growth. The study stated that the Blue economy is an agent of change and economic growth.

Atmanand *et al.* (2018) stated that the Blue economy could catalyze the robust growth of the Indian economy. The study pointed to the requirement for technologies to protect the coast from cyclones and Tsunamis by innovating an early warning system. It also stated the need for technology for monitoring coastal ecosystems, like coral habitat monitoring.

Sarker *et al.* (2018) developed a conceptual framework for blue growth. The study stressed that to promote blue growth and achieve sustainable development goals (SDGs), a joint effort is required by all the stakeholders in the marine-based economy.

Research Gap

Blue economy is a new topic that started gaining momentum in the twenty-first century. There are many studies on the Blue economy at the international level in marine biology, marine technology, marine chemistry, geology, shipping, oceanography, etc. Also, many studies have been carried out at the national level. But there still appears to be some lacuna in understanding the scope and relevance of the Blue economy in India's context.

Objective of the Study

- To highlight the role of the blue economy in achieving sustainability
- To understand the relevance of the blue economy for India

Methodology

The study adopts a qualitative research technique. Data is primarily from secondary sources, including various journals, books, newspapers, financial, and government reports. Besides various statistical reports available on the websites of the Ministry of earth science, Ministry of Shipping, Ministry of New and Renewable Energy, Ministry of Fisheries, Animal Husbandry and Dairying, Ministry of Petroleum and Natural Gas and Sagarmala.

Discussion

Blue Economy from India's Perspective

India is one of the mega biodiverse country, with the presence of a record 7.8% of the global species, which includes 45,500 recorded species of plants and 91,000 species of animals (MoEF, 2014). India's Marine ecosystem includes a wide range of mangroves, coral reefs, seagrasses, salt marshes, mud flats, estuaries, lagoons and unique coastal flora and fauna. India has the seventh longest coastline in Asia, which measures about 7516.6 kilometres, out of which 5423 km is in the peninsular region, and 2094 is in the Island region of Andaman and Nicobar Island and Lakshadweep Island. Nine states and four Union territories have coastlines and 1382 islands (EAC report: India's Blue Economy, 2020). The coastlines are distributed among nine states: West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Gujarat, Maharashtra and Goa and four Union territories- Andaman and Nicobar Island (Bay of Bengal), Lakshadweep Island (Arabian Sea), Daman and Diu and Puducherry. Indian coastlines face the Bay of Bengal in the East, the Indian Ocean in the South and the Arabian Sea in the West. Three mega cities viz. Calcutta, Chennai, and Mumbai lie near these coastlines. Around 250 million people reside in towns and cities within 50 km of the coastline.

The coastline environment is vital in the Indian economy for connectivity, resources and biodiversity. It supports several economic activities like oil and gas extraction, establishing ports, hinterlands and harbours, functioning power plants, fishing, tourism, mining, etc.

Table 1: Length of Coasts and Fishing Villages of States and Union Territories

State	Coastal Length (in Km)	Fishing Villages
Gujarat	1600	260
Andhra Pradesh	974	555
Tamil Nadu	1070	608
Maharashtra	720	456
Kerala	590	220
Odisha	480	739
Karnataka	300	162
West Bengal	158	171
Goa	104	60
Union Territory	Coastal Length (in Km)	
Andaman and Nicobar Island	1912	169
Lakshadweep Island	132	10
Puducherry	45	39
Daman and Diu	27	12
Total	8118	3461

Source: Annual Report of Ministry of Fisheries, Animal Husbandry and Dairying, Period- 2021

The Indian government's vision of 'New India-2030', articulated in February 2019, recognized the Blue Economy as one of the core pillar to achieve the goal.

Ocean Resources

Fisheries and Aquaculture

Fisheries can be sub-categorized in two: Marine fisheries and inland fisheries. Fisheries have contributed Rs. 46,663 crore to the economy through exports in 2019-20. In the past decade, aquaculture production has evidenced tremendous growth. In 1950-51, fish production amounted to 0.75 MMT (million metric tonnes), and in 2019-20 it was 14.2 MMT. Out of 14.2 MMT production, Marine Fish production was 3.7 MMT, and inland fish production was 10.4 MMT (Annual Report of the Ministry of Fisheries, Animal Husbandry and Dairying, 2021). More than 14.5 million people depend on fishing activities. The national average annual consumption of fish and fish products is 7.85 kg/capita. In 2019-20 fish was consumed the most in Tripura, with 29.29 kg per capita/ year. Department of Fisheries, Government of India, had launched a flagship program called Pradhan Mantri Matsya Sampada Yojana (PMMSY) for diverse intervention in the fisheries value chain from production to consumption and everything in between. The PMMSY proposed an investment of Rs. 20,050 crores with Rs. 12,340 crores in beneficiary oriented activities and Rs. 7,710 crores towards infrastructure and regulatory framework (Annual Report of Ministry of Fisheries, Animal Husbandry and Dairying, 2021). There is fear of depletion of the natural reserve of major fish species with growing demand for consumption and increased capture due to technological advancements.

Minerals

The continental margins of India congregate an extensive variety of terrigenous, biogenous and homogenous mineral deposits (Gujar, Nath & Banerjee, 1988). Terrigenous heavy minerals like ilmenite, magnetite, monazite, zircon and rutile were reported from beaches of Indian coastal states. These minerals at beach placers are estimated to be about 630 million Tonn (MT) within a radius of 2 million km² of the exclusive economic zone (EEZ) (Cronan, 1999). Biogenous sediments are reported from shallow offshore areas of Laccive islands, the Gulf of Kutch, the outer shelf of Mumbai and the backwaters of Kerala. Chemogenous deposits like phosphorites are reported from the Southwestern and Western continental shelves (Gujar, Nath & Banerjee, 1988). Manganese crust is found in the Andaman Islands. Evidences have been found of reserve of Manganese, cobalt, and hydrothermal sulphides in the deep ocean in the Central Indian Ocean Basin (CIOB). The southern Indian Ocean contain a huge reserve of nickel and copper (Cronan, 1999). Also, marine gypsum is found in salt pans during the processing of common salt in the coastal region of Gujarat and Tamil Nadu. Ocean also contains huge rare earth minerals. These minerals are the crucial raw materials for manufacturing electronic chips crucial for Industries like electronics, automotive, etc.

Indian deep ocean exploration launched in October 2021 was India's first human-crewed mission, 'Samudrayan' to explore at a depth of 1000 to 5500 meters to harness the resources like polymetallic manganese nodules, gas hydrates, hydrothermal sulphides and cobalt crusts.

Hydrocarbons

The sea beds are the major source of hydrocarbons. India has 26 sedimentary basins, spreading across a total area of 3.4 million square kilometres. Of the total sedimentary area, 49% of the total sedimentary area is located inland, 12% in shallow water with depths upto 400 meters and 39% in the deepwater area extending farther up to the Exclusive economic zone. There are 16 inland basins, seven located both inland and offshore and 3 completely offshore India hosts about 34 MMT of oil and 33 BCM of gas production (Directorate General of Hydrocarbons Annual report 2021). The current annual oil and natural gas consumption are about 1.3 billion barrels and 65 billion cubic meters, which is not met with the internal resources raising dependence on Imports.

Renewable Energy

Renewable energy includes energy from natural phenomena like sunlight, Onshore wind, Offshore wind, hydroelectric, tides, waves, etc. The generation of oceanic renewable energy has tremendous scope. India is working with countries like Canada, the UK, the USA, China, France, Japan and South Korea regarding the harnessing and commercialization of tidal energy. The commercialization of tidal energy has gained momentum in the past few years. The Technologies like tidal lagoons, tidal reefs, tidal fences and tidal barrages are used for tidal energy generation.

Services

India has a network of 12 major ports and 187 non-major ports. The Indian Maritime Industry plays a crucial role in the logistics sector. Approximately 95% of the country's trade by volume and 68% by value is moved through Maritime Transport (EAC report: India's Blue Economy, 2020). The Indian Maritime Sector comprises Ports, Shipping, Marine biotechnology, Shipbuilding and Ship repair and Inland Water Transport Systems. Other riparian industries, namely fishing, aquaculture, tourism, net manufacturing, and aquaculture technology, contribute to the country's economy. Other marine services include marine insurance.

Coastal tourism is seen as a vibrant segment of the Blue economy. Coastal tourism includes activities like cruise travel, boating, restaurants, scuba diving, bird watching, dolphin watching, swimming, sea angling and other activities. Tourism has certain potential as a source of income for the local community, but tourism on a large scale can have an adversative impact on the marine ecosystem.

Sagarmala Project

The current Indian government initiated the Sagarmala Project in 2015 to endorse 'port-led development' in India. It aims to modernize the ports, facilitate port-led industrial clusters and hinterlands, and boost infrastructure to facilitate transporting goods via ports. The project strives to harness the 8100 km long coastline of the country to explore its economic potential. Under this project, a certain geographical region has been identified as Coastal Economic Zones (CEZ), which has growth potential. The government aims to raise the living standard of the people of CEZ through the Sagarmala project. The government has

identified over 600 projects entitling a corpus investment of USD 120 billion (Rs 8 lakh crore). These projects will help in the reduction of logistic costs, proposed to save upto USD 6 billion annually and create 10 million new employment opportunities and increase port capacity by 800 Million Metric Tonne per Annum (MMTPA) (PTI, 2018)

Coastal Economic zones (CEZ) are targeted for development under the Sagarmala project with an allocation of funds up to USD 150 million for each location to develop the location economically by establishing industries and townships. The Sagarmala project also aims to enhance the livelihood of the coastal communities through skill development programmes, teaching modern fishing techniques and making them aware of the sustainable use of marine resources. Additionally, various initiatives are carried out under the Sagarmala project to generate renewable energy, like 31MW of solar power generation at ports, harnessing wave and tidal energy, etc. Other initiatives include oil spillage response facilities and wastewater and water treatment utilization in the harbour (PTI, 2018).

The Ministry of Earth Science (MoES) has undertaken the Deep Ocean Mission, which aims to harness deep-oceanic resources under the Umbrella scheme of the Blue economy. The government of India has sanctioned a budget of Rs. 4077 crores for the mission in November 2021 (Ministry of Earth Science, Annual Report, 2022).

India has an umbrella scheme called O-SMART, which regulates the use of oceans and marine resources for sustainable development.

Recent Initiatives are Taken by the Ministry of Earth Science (MOES) under Ocean Services, Modelling, Application, Resources and Technology (O-SMART)

Ocean observation systems maintain a fleet of Agro floats, buoys, Tsunami buoys with bottom pressure recorders, equator current moorings, Acoustic Sroppler Current Profiler (ADCP) moorings, eXpendable Bath Thermograph (XBT) transects, tide gauges, Wave Rider Buoys, and Automatic Weather Stations in collaboration with INCOIS and relevant academic and research institutes.

The Indian National Centre for Ocean Information Services (NCOIS) provides flagship service advisories on the Potential Fishing Zones (PFZ) each day of the year except during the fishing ban period and adverse sea-state conditions.

The Earth System Science Data Portal (ESSDP) was launched on July 27, 2021. The OMNI-RAMA Indian Ocean DATA Portal was launched on August 9, 2021. The ESSDP hosts metadata records for different programs implemented by MoES. ESSDP aims to serve the needs for data discovery of various users, including industries, research institutions, operational agencies, the academic community, strategic users, policymakers and the public.

Two pilot projects for an underwater mining system was successfully conducted in the central Indian ocean at 5270 m depth from March – April 2021.

Two gliders were deployed and recovered in the Bay of Bengal to monitor the deep ocean's physical and biogeochemical parameters to understand the temporal and spatial variability of the Oxygen Minimum Zone (OMZ).

A water quality buoy was deployed in July 2021 by the National Centre for Coastal Research (NCCR) in the coastal water off Puducherry with an aim to monitor the variation in the water quality and productivity of the coastal waters.

One new species of polychaete, two new species of deep-sea eels and six new species of decapod crustaceans were discovered by Resource Exploration and Inventorization Systems (REIS).

Six indigenous technologies were developed and transferred to M/s L&T for commercialization. Patent was granted the innovative technology titled 'Real Time Tsunami Monitoring System' in June 2021.

Environmental Protection

The Protected Marine Areas network has been identified and designated to protect marine resources in four legal categories: National Parks, Wildlife Sanctuary, Conservation Reserves and Community Reserves. India has created a network of 690 protected areas, including 102 national parks, 527 wildlife sanctuaries, 57 conservation reserves and four community reserves as of 2014. The Protected Areas are regions that fall either partially or entirely within the band area of 500m from the high tide line hosting the marine environment and are termed Marine Protected Areas. There are approximately 124 MPAs in India, consisting of 24 MPAs in peninsular India and 100 MPAs on the country's islands.

The ocean needs protection from harmful economic activities that adversely affect the marine ecosystem. Activities like overfishing, bottom trawling, seabed mining, offshore industries (oil and gas extraction), pollution from marine industries (shipping industry), urbanization of coasts, pollution from land sources, global warming, etc., are causing the grave deterioration of the ocean. According to the report by USEPA (United States Environmental Protection Agency, 2022), the Shipping industry emits 2-3% of global Green House Gases. Ships, while burning fuel, emit harmful pollutants like Black Carbon and tiny black particles. Pollution like Plastic debris, chemical runoff, and oil spillage in oceans is a serious concern. These have significant adverse effects on the marine ecosystem. The degradation of the coastal and marine ecosystems is the biggest threat. The problems like ocean acidification, Piling of debris and litter, and over-fishing have resulted in the depletion of biological fish stocks. Nations must adopt a strategy for the sustainable use of ocean resources.

For a long world has misused the ocean by extracting free resources and dumping their litter. Marine debris consists of tenacious, manufactured or processed solid material discarded or abandoned in the marine environment (UNEP, 2012). Land-based debris is a significant source of pollution which destroys the marine ecosystem. Marine litter and marine debris is a major pollutant in the marine environment. The International Coastal

Clean-up day is conducted in various parts of the world during the third week of September each year under the auspices of the United Nations Environment Programme (UNEP). Similar program is carried out by the South Asia Co-operative Environment Programme (SACEP) in the South Asian Region. Under the ongoing campaign, 'Swachh SagarAbhiyan' mass cleanliness and sensitization campaign was conducted in all coastal areas on 18 September 2021 by the Indian Coast Guard. The event was conducted to educate and motivate people to maintain cleanliness in coastal areas to protect the marine environment.

Table 2: Marine Debris and Litter Collected under the 'Swachhsagarabhiyan' Campaign

State	Debris and Litter Collected (September 2021)
Gujarat	8663
Andhra Pradesh	5050
Tamil Nadu	186
Maharashtra	4410
Kerala	2825
Odisha	575
Karnataka	1125
West Bengal	3060
Goa	964
Union Territory	
Andaman and Nicobar Island	3150
Lakshadweep Island	2050
Puducherry	4450
Daman and Diu	1500

Source: India coast guard report, Ministry of Defence

The major source of pollution is wastewater treatment plants, agricultural runoff, urban runoff.

Conclusion

Blue economy can be a possible solution for sustainable development. The paper attempted to show the current scenario of India's ocean resources. It could be seen that India's ocean resources, namely Fisheries and Aquaculture, Minerals, hydrocarbons, etc. has a huge contribution towards the economy. The Indian government is focussing on the ocean and trying to harness its resources through its flagship programs like Sagarmal, O-SMART and SAGAR. The Blue Economy aligns the Indian government's endeavour to accomplish its key goal of alleviating hunger and eliminating poverty with the sustainable utilization of marine resources.

Resource scarcity is a crucial concern for nations. As more and more countries are exploring and claiming marine resources and at times, these claims overlap. This highlights the need for strong diplomatic and governance initiatives. It is the need of high priority to establish a governance mechanism for the sustainable management of marine resources.

Ocean resources must be efficient and sustainable use for the growth of a nation. Territorial resources have been exploited vastly by nations for a long period of time. Ocean resources must not have the same fate as land resources. An action plan must be devised from the beginning for the sustainability of resources and the survival of humankind.

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