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India and the Blue Economy: Challenges and Way Forward

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Introduction

Historically, rivers and oceans have played a major role in the survivability of ancient civilisations through sustainable agriculture and facilitating trade and commerce. Globalisation has further enhanced humanity's dependency on the oceans. The worldwide ocean economy is roughly valued at around US $ 1.5 trillion per year. Nearly 40 per cent of the world's population lives near coastal areas, more than 3 billion people utilise the oceans for their livelihood, and 80 per cent of world trade is achieved using the seas.[1] This exploitation of marine resources has created complex sustainability challenges and compelled the United Nations (UN) to address the issue of balancing economic profit and preventing environmental degradation.

The UN's 17 Sustainable Development Goals (SDGs) has included blue economy in its charter, and Goal 14 deals explicitly with the conservation and sustainable use of the oceans, seas and marine resources for sustainable development. India also has recognised the potential of blue economy and is one of the few countries that has published a draft policy framework.

The term blue economy was first introduced by the UN at a Sustainable Development Conference in Rio de Janeiro, Brazil in 2012. The motivation was to build an economy based on conservation of oceanic environment, often termed as 'sustainable ocean-based economy'. Considering that the earth's resources are limited, there is a need to protect the oceanic flora & fauna from pollution, greenhouse gases, unregulated fishing, etc. UN accordingly stated that the blue economy should "promote economic growth, social inclusion, and the preservation or improvement of livelihoods while at the same time ensuring environmental sustainability of the oceans and coastal areas".[2] Thus, all this has broadened the scope of blue economy, which now comprises - marine food, oceanic renewable energy, seabed mining and blue biotechnology, shipping, tourism, blue carbon sequestration and many other multisectoral activities which have the potential to generate employment. The UN's 17 Sustainable Development Goals (SDGs) has included blue economy in its charter, and Goal 14 deals explicitly with the conservation and sustainable use of the oceans, seas and marine resources for sustainable development.[3] India also has recognised the potential of blue economy and is one of the few countries that has published a draft policy framework. This paper highlights the significance of blue economy, the various challenges faced, and the global approaches. Further, it discusses, in

brief, the policies of Bangladesh and Australia before undertaking an in-depth analysis of blue economy of India.

Significance of Blue Economy

Considering oceans cover three quarters of the earth's surface, managing oceanic resources is a civilisational necessity as marine biodiversity is critical for sustenance of our planet. The UN in its SDG-14 also deals with conserving and sustainably using the oceans, seas and marine resources. Some of the salient features of this document are as follows[4]:

- Prevent and significantly reduce marine pollution of all kinds, particularly from land-based activities, including marine debris and nutrient pollution.
- Sustainably manage and protect marine and coastal ecosystems.
- Minimise and address the impacts of ocean acidification.
- Effectively regulate harvesting and end overfishing.
- By 2030, increase the economic benefits to small island developing states and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism.
- Increase scientific knowledge, develop research capacity and transfer marine technology.
- Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS.[5]

In addition, due to finite resources of land-based minerals,in future, there will be greater exploitation of sea bed for extraction of minerals, especially, minerals like zinc, cobalt, copper etc, which are in great demand and hence will consequently increase deep sea mining. Further, apart from offshore oil and gas exploration, there are efforts to use offshore wind resources.

Thus, the oceanic activity ranges from harvesting the livestock to extractions of non-living resources, tourism, trade etc.[6] In addition, there are also certain indirect activities like carbon sequestration, habitat protection, endangered species, industrial waste disposal, etc. Further, the oceanic service includes the seafood industry, the marine biotechnology and also extraction of minerals and energy, both renewable and non-renewable. Thus, the economic sector ranges from aquaculture, fisheries, pharmaceuticals, oil & gas exploration, to sea bed mining, tourism, shipping, coastal development like port development, and restoration of the habitat. In addition, due to finite resources of land-based minerals,in future, there will be greater exploitation of sea bed for extraction of minerals, especially, minerals like zinc, cobalt, copper etc, which are in great demand and hence will consequently increase deep sea mining. Further, apart from offshore oil and gas exploration, there are efforts to use offshore wind resources. All this has resulted in the increase of market value of marine and coastal resources and industries and is estimated to be at $ 3 trillion per year or about 5 per cent of global GDP, and marine fisheries directly or indirectly employ over 200 million people.[7] However, the many fold increase in the demand for seafood has led to Illegal, Unreported and Unregulated Fishing (IUUF).

The futuristic trends depict that most of the oceanic activities are going to increase, whether it is the demand for seafood, or extraction of seabed minerals, or oil and gas exploration. This will increase phenomenally the maritime freight transport and according to the

Organisation of Economic Cooperation and Development (OECD) report the seaborne trade is expected to grow 4.0 per cent per year on average over 2020–29.[8] To handle the cargo, there will be a surge in port infrastructure projects as also the coastal urban areas. In most regions, one finds that the coastal regions have grown faster than the inland areas. Sectors like trade and transport will improve as also due to enhanced recreational activities, tourism will get a boost. So, if there has been an upsurge in the marine economy, the flip side is that there are various challenges which need to be addressed for sustainable growth.

Challenges

The extent of marine protected areas has significantly increased, with 2020, the coverage has reached 7.74 per cent of global coastal waters and oceans. Further, the mean percentage of key biodiversity areas (KBAs) covered by protected areas grew from 28 per cent to 44 per cent.[9] Considering that the ocean economy is often found to be higher in coastal and island states, where the livelihood critically depends on marine activities, the ocean economy and the national economy are indistinguishable in these littoral coastal states. This acute dependency on oceans has often resulted in unsupervised exploitation of marine resources. Further, the industrialisation on land has created its own dynamics which are impacting the marine life. Additionally, exploration of oil and gas, transportation of seafood and aqua products and such other activities have increased the shipping traffic immensely. The challenges, therefore, are twofold. Primarily, the unsupervised marine exploration is damaging the oceanic flora and fauna, IUUF is one such example. Secondly, in coastal areas, which are home to 40 percent of humans, there is a problem of marine pollution due to human activities like excessive industrialisation, use of plastics and pesticides, unregulated sewage treatment, and agricultural run-offs. These are the major causes and nearly constitute 80 per cent of marine pollution, resulting in eutrophication, acidification and resulting in creating Oceanic Dead Zones. Further, they are impacting the oceanic health as coastal habitats like mangroves, coral reefs, seagrass/kelp beds, salt marshes are getting depleted.

The challenges, therefore, are twofold. Primarily, the unsupervised marine exploration is damaging the oceanic flora and fauna, IUUF is one such example. Secondly, in coastal areas, which are home to 40 percent of humans, there is a problem of marine pollution due to human activities like excessive industrialisation, use of plastics and pesticides, unregulated sewage treatment, and agricultural run-offs.

Oceans absorb carbon dioxide produced through greenhouse/industrialisation. The large production of this makes the oceans acidic and also increases the temperature resulting to heat waves and, ultimately, leading to climate change. This is a major cause for coastal inundation. The number of people living in low-lying coastal zones has increased and the coastal inundation has created migration problems.

Therefore, addressing the anthropogenic pressures on marine ecosystems and their impacts requires effective cross-sectoral coordination and extensive cooperation among states at global, regional and bilateral levels, including through intergovernmental organisations.[10]

Thus, sustainable development requires efficient management as well as conservation of marine resources. This requires a scientific knowledge pool which can be shared by nations through transformative informed policies. Along with the development of technical skills through application of marine science, public

awareness is also equally important as without which the success will be limited. A number of global measures have been adopted where diverse stakeholders extending from head of nations to grassroot organisations, NGOs and private sector have participated to address these challenges.

Global Measures to Strengthen the Blue Economy

The blue economy requires sustainable management and conservation of marine resources on a larger scale, and this will require global collaborations from multisectoral and diverse stakeholders.

Marine research forms an important part but sadly, the funds associated with this are miniscule in most of the nations. On average, only 1.2 per cent of national research budgets were allocated for ocean science between 2013 and 2017, with shares ranging from around 0.02 per cent to 9.5 per cent.

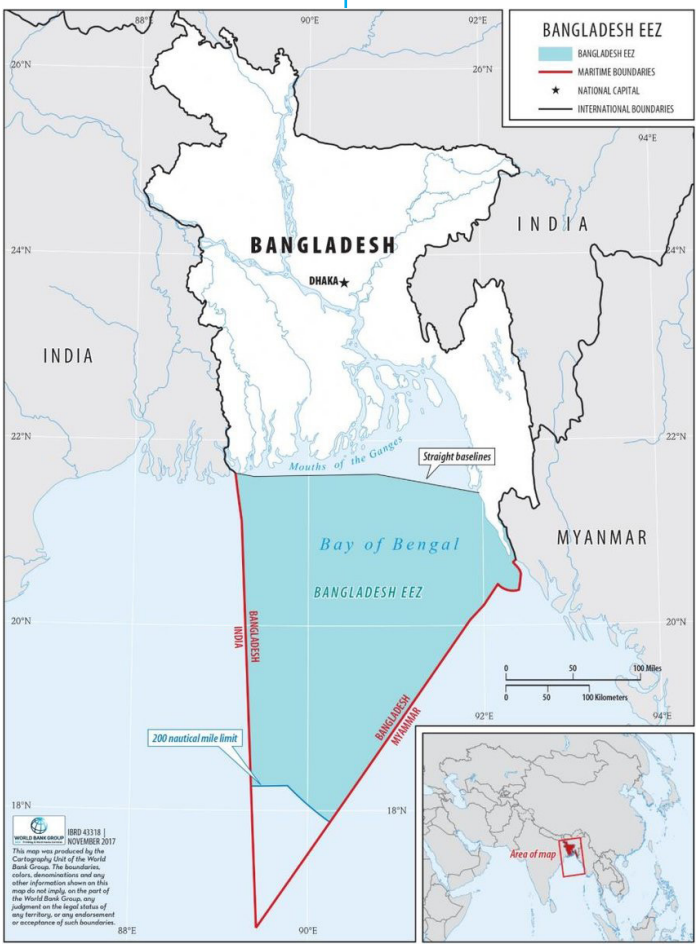
In 2018, the first Sustainable Blue Economy Conference was held in Kenya. This provided an international forum for advancing global conversation on two important pillars of the blue economy: one, sustainability, climate change and controlling pollution, the other, production accelerated economic growth, jobs, and poverty alleviation.[11] Before that in 2017, a UN Ocean Conference was held to discuss the declining health of the oceans under which nine 'Communities of Ocean Action' were created to address problems of Coral Reefs, Mangroves, Marine Pollution, Scientific Knowledge, Research Capacity Development and Transfer of Marine Technology, Sustainable Fisheries, Ocean Acidification, Sustainable blue economy, Marine and Coastal Ecosystems Management, Implementation of International Law as Reflected in United Nations Convention on the Law of the Sea.[12] Thus, all these were trying to implement the core principles of SDGs-14. Apart from these, there are many other laws which have been created like the 'Agreement on Port State Measures to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing', the Voluntary Guidelines, which are an internationally agreed instrument that promotes improved governance of small-scale fisheries, including in value chains, post-harvest operations and trade.[13] Further, the United Nations Convention on the Law of the Sea (UNCLOS) provides the legal framework where along with the technical definition; there are also rules applicable for smooth transit of ships. Marine research forms an important part but sadly, the funds associated with this are miniscule in most of the nations. On average, only 1.2 per cent of national research budgets were allocated for ocean science between 2013 and 2017, with shares ranging from around 0.02 percent to 9.5 percent.[14] Thus, despite global initiatives, a lot still needs to be done though several countries have started debating blue economy and many of them have released draft papers. We undertake two case studies before addressing in detail the Indian perspective of blue economy.

Blue Economy Scan: Bangladesh

Bangladesh, within the Bay of Bengal, is one of South Asia's five maritime states with a 710-kilometre-long coastline and a 200-nautical-mile-long Exclusive Economic Zone (EEZ). It was only after the resolution of the maritime border delineation issue with Myanmar (2012) and India (2013) that Bangladesh initiated the concept of a national blue economy (2014). Thus,blue economy has only recently gained traction in spite of the fact that Bangladesh's oceanic wealth had played a remarkable role in the country's overall socio-economic growth through the promotion of economic activity,

particularly in the Southern Coastal Zone. Bangladesh, as a littoral nation, is heavily reliant on the Bay of Bengal for economic development, and Dhaka's blue economy policy has risen as a pivotal developmental agenda for the ideal utilisation of the seas, oceans and marine assets. With global realities transforming the engines of economic boom, Bangladesh has consistently made impressive strides in the oceanic economy. These include significant reforms in the blue policy, adopting contemporary theories and practices, and balancing economic opportunities, keeping in mind the environmental limitations.

The marine fishing industry is a seminal organ of Bangladesh's blue economy. Marine fisheries account for 19.40 per cent of the country's overall fish production. By the same token, Cox's Bazaar in Bangladesh is flocked by 81.0 per cent of international tourists on an average, thereby lucratively multiplying tourism revenue.[15] Moreover, the Bay of Bengal is seen as a possible breeding site for a variety of fish, which account for 52 per cent of Bangladesh's animal-based protein supply. Thus, with a view to supplement fisheries, there is a pressing need to conduct comprehensive survey of the Bay of Bengal piscaries. Accordingly, the government has initiated dialogues with stakeholders to subsume untapped potential of the marine environment and conduct potent actualisation of food security, as also create jobs, alleviate poverty, enhance health, and industrial profiles while furthering biodiversity health and also implementing regional peace and security.[16] In addition to fish resources, Bangladesh's seabed is rich in minerals. One of the most crucial resources for meeting everyday demands is salt, which is produced abundantly especially in Chittagong and Cox bazaar.[17] According to the Minerals Resources Program of the



Map 1: Exclusive Economic Zone of Bangladesh[22]

United States Geological Survey (USGS), Bangladesh's salt output has been stable at 350 TH MT since 2003. Gas, copper, magnesium, nickel, and precious metals, including cobalt, are among the other mineral resources that are helpful to Bangladesh's economy. Similar to many other developed nations, Bangladesh can generate renewable energy from the sea. Furthermore, businesses, such as shipbuilding and ship breaking, as well as medicines, can invariably profit from maritime resources.

The Government of Bangladesh has held several discussions and workshops on the blue economy since 2015. In addition, Bangladesh's Seventh-Five Year Plan (7FYP) lists twelve actions for a successful and sustainable blue economy, which includes fisheries, renewable energy, human resources, trans-shipment, tourism, and climate change.[18] Furthermore, the blue economy cell was framed in 2017 under the Department of Energy and Mineral Resources, failed to lay out coordination between the 17 services and 12 organisations.[19] Given this situation, marine experts now call for a separate ministry to avail unrealised fiscal assets around the sea.[20] The Ministry of Foreign Affairs has identified twenty-six potential blue economy sectors for growth in Bangladesh, including fisheries, maritime trade and shipping, energy, tourism, coastal protection, maritime safety and surveillance.[21] However, the immediate concern for the state is to conduct a feasibility tests on the thriving marine sectors and then plan a priority based blue expeditions.

Amongst other challenges, in the recent years, the Bay of Bengal's environment has been severely damaged due to extensive cultivation. To feed a rising population, agriculture must be expanded; this has put the environment's long-term viability in jeopardy. Also, blue Capital Laws in Bangladesh, for example, are not as strong as those governing agriculture or other industries. Further, though Bangladesh, Maldives, and Sri Lanka have significant geographical advantage over their neighbours, but they lack systematic application of blue economy initiatives to the full potential. Hence, it is recommended that they increase resourcefulness by exploring their blue economy interests sustainably.

Further, the socioeconomic, political, and cultural characteristics of the 'Bay Nations' vary greatly and their national goals may shift as a result of this variance. Hence, Bangladesh must collaborate with their neighbours. To find solutions to the challenges that they share.

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Blue Economy Scan: Australia

Australia, as a maritime nation, is positioned in one of the most complicated littorals, and archipelagic marine zones in the world. Unlike the other inhabited continents, Australia is an insular landmass surrounded by oceans devoid of islands for the most part. It has an EEZ and Continental Shelf, which covers 16 million square kilometres and includes tropical islands and potentially dangerous Antarctic seas. If one factors the enlarged continental shelf and access to the seabed's resources, the total area exceeds 20 million square kilometres. Apart from that, marine life has become an instrument of lifestyle for over 85 per cent of the population living within 100 km of the coast. The value of these 'ecosystem services' has been estimated at

more than $25 billion and is expected to rise in the future. They include moderating carbon dioxide levels in the atmosphere through ocean absorption, recycling necessary nutrients, and pest and disease management, as well as social and cultural advantages such as sport and recreation, as well as inspiration for art, design, and education.[23] In a recent webinar titled 'Australia's Sustainable Ocean Economy', former Prime Minster Scott J Morrison estimated that by 2025 Australia expects its ocean industries to contribute $100 billion to their national lives in consecutive years.[24]

Professor Colin Buxton and Mr Peter Cochrane, who led the Bioregional Advisory Panel, and Associate Professor Bob Beeton, who chaired the Expert Scientific Panel, presented detailed reports to the Australian Government in 2016 highlighting observations on marine reserves zoning, networks, regional stakeholders and socio-economic decision-making plans.[25] An official Australian document titled 'Marine Nation 2025: Marine Science to support Australia's Blue Economy', prepared by the Oceans Policy Science Advisory Group (OPSAG) in March 2013, focuses on an interesting interpretation of the blue economy, which, in its primary context, emphasises on 'oceans as a driver of innovation', and pays lesser attention to 'oceans as a business prospect'. Further, the salient role of Marine Spatial Planning as a governance tool was to expand and bolster oceanic growth. However, that has not given productive results in Australia. Similarly, the development of maritime clusters and innovation hubs linked to the ideation of 'oceans as a driver of innovation' has not fully materialised. Even today, the participation of the private sector is miniscule in Australia's oceanic growth. One of the challenges is in integrating the competing blue economic discourses as defined by Canberra's blue vision. Other issues include the tremendous environmental concerns due to waves and storm surges, cyclones and other natural hazards impacting blue economy. Climate change is expected to exacerbate coastline erosion and storm surge as well as raise threats to marine activities and infrastructure. Correspondingly, increases in storm frequency and intensity may have far-reaching social and economic consequences for ecosystem functioning. Thus, it is clearly in the Australian national interest to secure the maritime estate's economic, environmental, and cultural resources. Only by putting more emphasis on marine research to influence industry development, policy, and management can this challenge be accomplished.[26]

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Overview of India's Approach to the Blue Economy

"To me, the blue chakra or wheel in India's national flag represents the potential of Blue Revolution or the Ocean Economy. That is how central the Ocean Economy is to us."

- Prime Minister Narendra Modi

India's tryst with its new sunrise sector – the blue economy hails from the Blue Revolution or the 'Neeli Kranti Mission' (1985-1990s) in the course of the 7th-Five-Year Plan under the leadership of Mr. Hiralal Chaudhuri and Dr Arun Krishnan.[27] From the

mid-1960s, the Blue Revolution indicated a time of intense developmental growth in the Indian aquaculture industry.[28] India is the world's seventh-largest country by area with the world's second-largest population. As a result, she is extremely reliant on the seas for food, transportation, electricity, and tourism. Moreover, India is topographically rich in fresh water resources such as rivers, lakes, dams, reservoirs, tanks, and ponds. All these shares equal responsibility for meeting her blue economy needs.

For India, the blue economy entails a wide ocean of economic prospects that play an equal role in producing and maintaining livelihoods. With a 7,500-kilometer coastline spanning nine coastal states, four Union Territories (UTs) - two of which are island UTs, twelve major, and two hundred smaller ports, India's blue economy supports 95 per cent of the country's commerce through transportation and provides an estimated four per cent of GDP.[29] Fortunately, the sector has stood strong despite the challenges caused by the Covid-19 pandemic. India is also the world's third-largest fish producer and the second-largest aquaculture fish producer (NFDB 2020).[30] As a result, the blue industries have the ability to recruit a huge workforce, which it has done so for decades, at least in areas like fishing, aquaculture, fish processing, maritime tourism, shipping, and port operations. Further, engagement in new enterprises such as offshore wind, marine biology, biotechnology, and other shipbuilding and ship breaking operations is also growing. By 2035, the modal share of coastal shipping holds the potential to increase by 33 per cent, approximately 6 per cent today.[31] Most of India's oil and gas is shipped by the seas, making the Indian Ocean an exigent region for oceanic growth, and the dependence is expected to only increase by 2035. Notably, the rising Indian reliance on marine trade makes investments in the blue economy all the more critical, as with the creation of employment and rising gross value addition, the national economic capabilities, capacities, and skills automatically improve. India's policy framework for developing a blue economy will unquestionably boost the GDP in the long-term.

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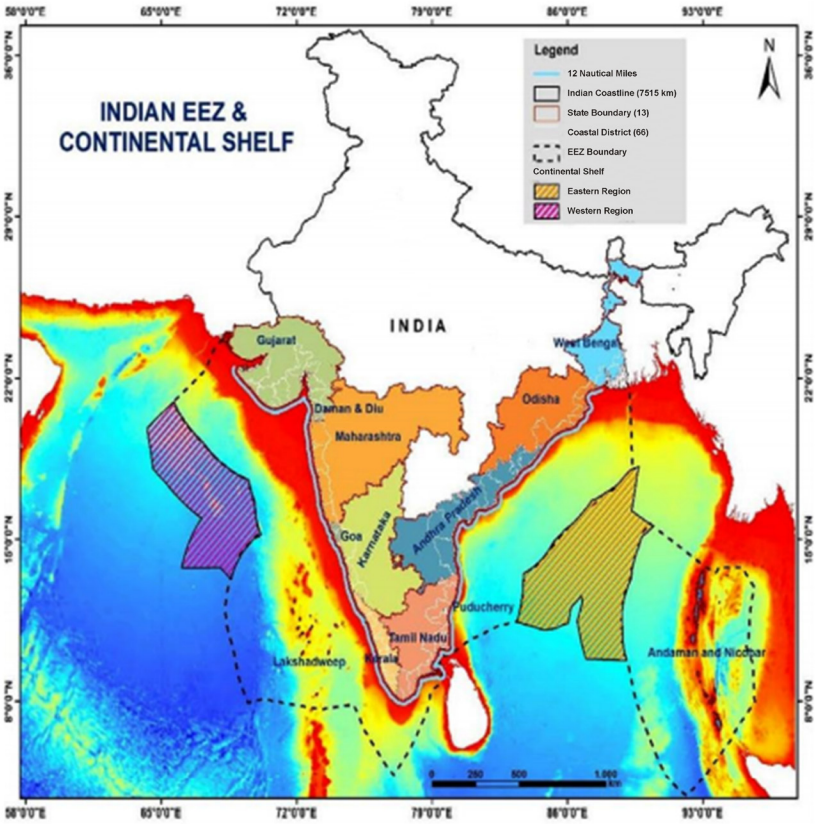
In terms of transportation, the state's '*Sagarmala* Project', which aims to connect the oceans with the Indian interior, includes five of the 111 inland rivers. Inland rivers are significantly more critical in other nations than in India. For example, inland rivers account for up to 24 per cent of China's freight transit.[32] However, a river excursion on the Brahmaputra River needs similar infrastructure and luxury as Kerala's backwater tours. Similarly, Rhine freight traffic, Yangtze River cruises, and canal water-bridge of Magdeburg in Germany tend to emphasise that inland water businesses cannot be separated from their economic contribution to the nation's blue economy. In India, the efforts are on to develop this sector and recently, the first containerised freight successfully passed through India-Bangladesh Protocol.[33]

India's maritime development owes its plausibility to solid growth of physical infrastructure, oceanic resources, coastal management, and marine amenities. The two imperative components of blue economy minerals and fisheries are of immense commercial significance to India.



Map 2: Indian EEZ & Continental Shelf

Source: Indian Ministry of Earth Sciences, 2019[38]

In this context, polymetallic sulphides and polymetallic nodules are two viable minerals chiefly essential to Indian developers. The latter are ball sized nodules embodying cobalt, iron, nickel and manganese which take over millions of years to burst forth seabed and are often uncovered at 5-6 km in water depths.[34] In 1987, India attained the exclusive rights to perform deep sea explorations by the United Nations in the Central Indian Ocean Basin wherein it instituted two mines and explored five million square miles.[35] India ranks amongst the top eight nations to establish long-term schemes for the utilisation and exploration of polymetallic nodules. This exploration programme is inclusive of technological studies, environmental development, research in extractive metallurgy, and mining, amongst several other germane areas.

The Indian aquaculture industry harbours one of the fastest-growing sectors at an average rate of 10 per cent between 2016 and 2020.[36] India unequivocally is among the top players in the blue economy arena, whose policies on sustainability and growth are diligently discussed, and even adopted, especially in the South Asian context. With nine coastal states containing one thousand three hundred and eighty-two islands, India credits itself with maintaining one hundred ninety-nine ports along with its rich marine environments, the busiest one being the Mormugao port in Goa.[37] The holistic scope of oceanic currency in India can be understood as a subset of the country's economy that includes the ocean resources system as well as building of maritime infrastructure in onshore coastal zones.

India fully recognises the immense vitals of its ocean economy and its impact on security and livelihood. Resultantly, over the years, India has become exponentially serious about the betterment of its blue economy by encouraging

better stewardship of its oceans and transforming into a definitive global economic corridor. However, as a traditional state, India continues to tackle sustainable and economic challenges pertaining to seasonal constraints, environmental strains, unsustainable fishing practices, resource depletion, climate change, the fishing sector's tussle with international waterlines, habitat degradation, and unstable political structures. Thus, in order to achieve holistic growth of India's marine potentiality for sustained economic benefits and security, an incremental approach to the blue economy is to be adopted. With a deep focus on cooperation in tourism, trade, infrastructure developments, marine technology and conservation of the marine environment, India is seeking an integrated future for the Indian Ocean Region (IOR).

Internationally, India holds a strong foothold in the Indo-Pacific through various diplomatic treaties and commitments under the United Nations Convention on the Law of the Sea (UNCLOS), namely, seabed mining, search and rescue, and counter piracy. Consequently, India enjoys the friendship of significant blue players such as Australia, especially in the areas of aquaculture, mitigation over illegal fishing; with Bangladesh India shares knowledge and expertise on capacity building, and skill development.[39] Further, India is also collaborating with France. India is prioritising sustainable potential for collaboration in marine sciences, institution building and partnerships.[40] India and France have also pledged to liaise with the European Union (EU) in the framework of the joint road map "EU-India Strategic Partnership: A Road map to 2025" and the EU strategy for cooperation in the Indo-Pacific.[41] More recently, India released an extensive road map on blue economy. India's blue initiatives, thus, not only promote geo-strategic motivations but also nudge nations to acknowledge the undiscovered potential that could be utilised through mutual cooperation.

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Decoding India's Draft Blue Economy Policy

The Ministry of Earth Science (MoES) has produced a policy framework on the blue economy and solicited various stakeholders' feedback and proposals. Its goal is to develop a vision and plan for the country's marine resources. The proposal is in keeping with New India's 2030 Vision, and along with blue economy, it fleshes out various sectors for the Indian economy's holistic growth. However, after evaluating the proposals, a legislative framework for blue economy will be established later. Meanwhile, the framework outlines goals like developing governance capabilities such as Coastal and Marine Spatial Planning (CMSP) and formulating a National Blue Economy Council (NBEC) to expand the skills.

Thus, India's 'Blue Economy' draft is seen as a critical foundation stone for realising the country's economic and environmental welfare. The ten essential characteristics of growth are included in the Indian Government's Vision for New India by 2030. These documents, notably, echoed a unified approach to enhance the lives of coastal communities. The draft document pivots on seven thematic areas namely, marine fisheries, aquaculture, and fish processing; national accounting framework for the blue economy and ocean governance; manufacturing, emerging industries, trade,

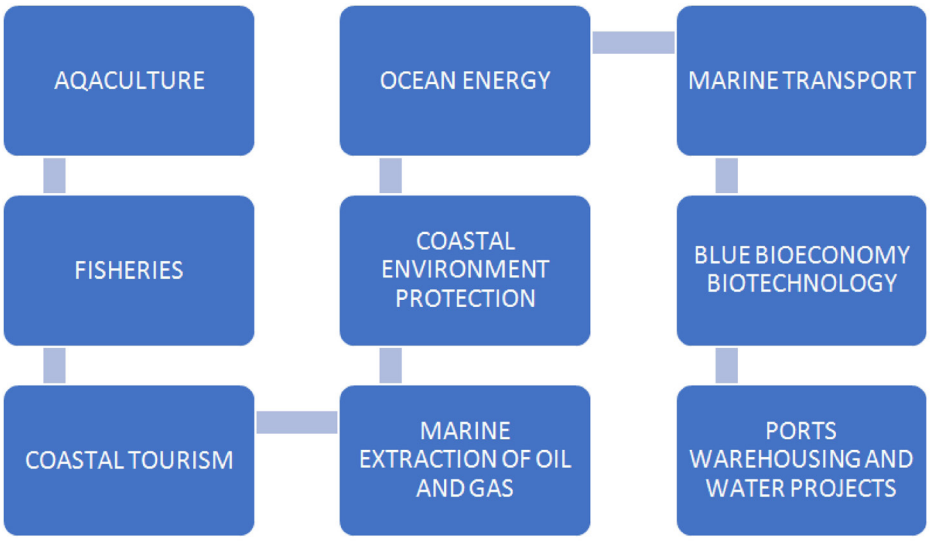

Figure 1: Components of Blue Economy in India

technology, services, and skill development; coastal marine spatial planning and tourism; logistics, infrastructure and shipping including trans-shipment; security, strategic dimensions, and international engagement; and coastal and deep-sea mining and offshore energy. Apart from these, logistics, infrastructure, shipping including transhipment; coastal and deep-sea mining and offshore energy are also considered. India has demonstrated landmark success through the following government-led dynamic initiatives:

- ***Sagarmala* Project:** First launched in 2016, the concept of *Sagarmala* was conceived while keeping in view the vital role ports play in India. As a logistical project, *Sagarmala* hopes to apply cost saving systems for adjacent Indian coastlines and waterways. The strategic thought behind the port-led development project is to harness the prospects of India's long coastline through neo-infrastructural and operational structures.[42] As part of the national plan for port-industrialisation, the government has opted for 14 Coastal Employment Zones (CEZs) and 12 leading ports with manufacturing facilities and industrial clusters in each CEZ. Hence, India must endow in similar port-led clusters along its east and west coasts, where the chunk of shipbuilding industry and coastal community resides. This will, in turn,advance skill development and ancillary manufacturing under the MSMEs scheme.

- **Integrated Coastal Zone Management:** Demand for infrastructure has noticeably increased as a result of rapid urban-industrialisation, maritime transport, marine fishing, tourism, coastal and sea bed mining, offshore oil and natural gas production, aquaculture, and the recent institution of special economic zones. This has led to the exploitation of natural resources. Therefore, with projected help from the World Bank, India's Integrated Coastal Zone Management project is developed to launch programme for marine conservations. The initiative aids in enhancing national and three pilot state capabilities for implementing integrated coastal zone management.

- **Deep Ocean Mission:** The MoE Saims to study the ocean bed with a similar approach as adopted by ISRO for space explorations. For this purpose, the Matsya 6000 deep-submergence vehicle was developed by India. On 27 October 2021,

the 'personnel sphere' was lowered off the coast of Chennai to a depth of 600 metres for the vehicle's first unmanned trial. The experiment was a success, and it was certified for further progression. Later, the 'Samudrayaan' programme was formally started on 27 October 2021, following the trial's success.

- **Ocean-Services, Modelling, Application, Resources and Technology (O-SMART):** India hatched an umbrella stratagem by the name of O-Smart that strives to modulate the consumption of marine resources, setting up early weather warning signals, develop state-of-the-art ocean observation systems, coastal research vessels, establishing ballast water treatments, etc,.[43] The curated schemes mostly anchor their vision on employing niche technologies in harnessing aquatic resources.

- **National Fisheries Policy:** Primarily, the National Fisheries Policy endorses the 'Blue Growth Initiative' that offers a strategised future path to responsibly and sustainably develop, harness, manage, control, capture and culture fisheries.[44] The policy's main objectives are the centre-state and interstate collaboration, socioeconomic advancement, and economic success of fishermen and fish farmers, mainly traditional and small-scale fisheries. Respectively, the policy reflects societal aspirations and the nation's developmental objectives.

The draft policy, thus, entails considerable reforms in the blue sector, which offers India a promising way forward**.** While India has laid impressive groundwork in the blue arena, still there are areas which need to be addressed.

Policy Recommendations

With an aim to raise quality of coastal life, increase GDP, and preserve marine biodiversity, India needs to adopt sustainable strategies both at the centre as well as at the state level. Further, India must aim to perform industry-focused, collaborative training and research that bolsters the rise of the blue economy through increased offshore sustainable aquaculture and renewable energy production. The intention here is to discuss every aspect of the blue transformation and consider how the global framework translates to regional and national contexts across a subset of issues. The following recommendations may merit consideration:

- **Blue Bonds:** Introduction of blue bonds could be a crunch point for the Indian water management concerns. Blue bonds are essentially bonds whose revenues support water infrastructure, which might assist in directing funding toward water security and guiding India's transition to a sustainable economy. Blue bonds are likely to raise revenue for projects pertaining to irrigation management systems employing cutting-edge technology and adapting sustainable methods to local conditions. For instance, blue bonds might be used to finance initiatives like the National Mission for Clean Ganga that involve sewage control, water capture and storage infrastructure, and freshwater source expansion. Interest in the bond concept as a crucial instrument for building water infrastructure that is climate-resilient throughout the world has already risen. Though the market for green bonds in India has steadily increased to USD 2.7 billion since YES bank issued the country's first green bond in February 2015, same is not seen in case of blue bonds. This has a significant opportunity to become a customary financing option for water-related projects.[45]

- **Blue Governance:** The Indian Ministry of New and Renewable Energy (MNRE) has endeavoured to launch operational institutions specialising in leasing,granting of permissions, monitoring, evaluation of offshore activities, transport, storage, etc. However, India still lacks a comprehensive organisational framework to govern the aforementioned bodies. Therefore, there is a high-priority need to introduce a scalable and seamless governing body for ocean resource minerals, deep-sea fisheries and environmental management. This evolution will seal India's international interactions with various regulatory approaches and secure effective coordination amongst its domestic ministries.
- **Ocean Health Management:** India must assume ocean health monitoring, management and assessment as its top priority. In doing so, it can use niche technologies to prevent and mitigate marine degradation ranging from plastics to micro plastics. Additionally, engineer high-quality mechanisations to restore aquatic decay and subsequent retrogression of sensitive wetlands, mangroves and coral reefs. In the fisheries department, India must revitalise water quality near coral reefs, rally for low carbon fisheries and place tracking-map based information to identify and shield marine protected areas.
- **Marine Research and Training:** India's financial stake in traditional pillars of research and technology: experimentation, modelling, and observation will generate excellent value in governing the seas. The scientific assessment methods require infrastructure, from observation technologies to platforms such as research boats, sustained observing systems, experimental equipment, as well as data management, storage, manipulation, and visualisation tools. To guarantee that the initial investment in new infrastructure generates long-term and sustainable advantages, a consistent, ongoing, and predictable commitment to maintaining, upgrading, and transforming infrastructure, as well as the people resource to administer it, is paramount. Training, skill development, processes, and collaboration incentives are all essential human capabilities investments. Finally, generous funding for scientific communication is required to increase science's application and acceptability in policy, law, and regulation. This will need dissemination of information on the importance and necessity for marine research and the advantages received from prior and current investments in this domain.

Conclusion

India envisages a promising future of sustainable energy through tirelessly investing in the blue economy and formulating relevant policies. While the blue industry's opportunities are manifold, so are the challenges. There are various vertical challenges especially in the natural ecosystem of the oceans. India attempts to overcome these by defining the yardstick for national aspirations and then integrating a multisectoral approach through a more people-centric, nature-centric and poly-centric blueprint. Thus, Indian initiatives create a marine organisation based on modernisation and sustainable development. In doing so, India must stand by its fundamental principles of true innovation, sustainable development, and sincere climate change adaptations to preserve its interests and emerge as a chief policy-maker of the blue economy.

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