POLICY SUPPORT AND
INSTITUTIONAL ARRANGEMENTS FOR

BLUE ECONOMY OF BANGLADESH

General Economics Division (GED)
Planning Commission
Government of the People's Republic of Bangladesh

Institutional Arrangements for

THE BLUE ECONOMY OF BANGLADESH

General Economics Division (GED)
Planning Commission
Government of the People's Republic of Bangladesh

Editor

Dr. Md. Kawser Ahmed
Member (Secretary)
General Economics Division (GED)
Bangladesh Planning Commission
Ministry of Planning

Writing Team

Dr. KM Azam Chowdhury
Chairman
Department of Oceanography
University of Dhaka

Dr. Seema Rani
Senior Scientific Officer
Bangladesh Oceanographic Research Institute (BORI)
Ramu, Cox's Bazar

Mr. Makidul Islam Khan
Lecturer
Department of Fisheries and Marine Bioscience
Bangabandhu Sheikh Mujibur Rahman Science and Technology University
Gopalgonj-8100

Mr. Aminul Arifeen
National Project Manager
Social Security Policy Support (SSPS) Programme
UNDP

The document is prepared with technical and financial support from UNDP Bangladesh and Social Security Policy Support (SSPS) Programme.

TABLE OF **CONTENTS**

LIST OF **FIGURES**

LIST OF **TABLES**

ACRONYMS AND **ABBREVIATION**

ABNJ - Area Beyond National Jurisdiction

ADB – Asian Development Bank

AIGAs - Alternative Income Generating Activities

AIMS – Australian Institute of Marine Science

ASEAN - Association of South East Asian Nations

AU - African Union

AUC - African Union Commission

BARI - Bangladesh Agricultural Research Institute

Bcf – Billion Cubic Feet

BCSIR – Bangladesh Council of Scientific and Industrial Research

BEC - Blue Economy Cell

BERI - Blue Economy Research Institution

BHP - Brake Horse Power

BIWTA - Bangladesh Inland Water Transport Authority

BJRI – Bangladesh Jute Research Institute

BLRI – Bangladesh Livestock Research Institute

BPDB - Bangladesh Power Development Board

BRRI – Bangladesh Rice Research Institute

BTRC - Bangladesh Telecommunication Regulatory Commission

BTRI – Bangladesh Tea Research Institute

CEP - Citizens Engagement Platform

CMSP – Coastal and Marine Spatial Planning

CMT - Coastal and Marine Tourism

COP - Conference of the Parties

COSME - Competitiveness of Enterprises and Small and Medium-sized Enterprises

CSIRO - Commonwealth Scientific and Industrial Research Organization

DCF - Data Collection Framework

DSP – Demand-side Platform

DWT - Deadweight Ton

EBM - Ecosystem-based Management

EC – European Commission

ECA - Ecologically Critical Area

EEZ – Exclusive Economic Zone

EFZ - Extended Fisheries Zone

EIA - Environmental Impact Assessment

EMRD - Energy and Mineral Resources Division

ERL - Eastern Refinery Limited

EU – European Union

FAO - Food and Agriculture Organization

FPV - Floating Photovoltaic

GDP – Gross Domestic Product

GED – General Economics Division

GIFT – Genetically Improved Farmed Tilapia

GNP – Gross National Product

GSB - Geological Survey of Bangladesh

GSP - Geological Survey of Pakistan

GVA - Gross Value Added

ICDDRB - International Centre for Diarrheal Disease Research, Bangladesh

ICES - International Council for the Exploration of the Sea

ICM - Integrated Coastal Management

ICT – Information and Communication Technology

IEA – International Energy Agency

IMTA - Integrated Multi Trophic Aquaculture

IOPTF - Interagency Ocean Policy Task Force

IOR - Indian Ocean Region

IORA – Indian Ocean Rim Association

IOTC - Indian Ocean Tuna Commission

ISBA - International Seabed Authority

ISL - International Shipping Lanes

ITLOS - International Tribunal for the Law of the Sea

ITU - International Telecommunication Union

LDCs - Least Developed Countries

LDTs - Light Displacement Tons

LEO - Low Earth Orbit

LNG - Liquefied Natural Gas

MAU - Maritime Affairs Unit

MMcfd – Million Cubic Feet per Day

MMscfd – Million Standard Cubic Feet per Day

MoFA - Ministry of Foreign Affairs

MPA - Marine Protected Area

MSFD - Marine Strategy Framework Directive

MSP - Marine Spatial Planning

MSs – Maritime States

NEP - National Energy Policy

NGH - Natural Gas Hydrate

NGOs – Non-governmental Organizations

NIB – National Investment Bank

NOC - National Ocean Council

NZE2050 - Net Zero Emission by 2050

ODA – Official Development Assistance

OECD - Organization for Economic Co-operation and Development

OECS - Organization of Eastern Caribbean States

ONGC - Oil and Natural Gas Corporation

OTEC – Ocean Thermal Energy Conversion

PCA - Permanent Court of Arbitration

PEMSEA - Partnership for the Environmental Management of the Seas of East Asia

PPE - Personnel Protection Equipment

PPP - Public-Private Partnership

PSCs - Production Sharing Contracts

SAARC – South Asian Association for Regional Cooperation

SBE - Sustainable Blue Economy

SDGs - Sustainable Development Goals

SDS - Sustainable Development Scenario

SIDS - Small Island Developing States

SMA - Seychelles Maritime Academy

SMEs – Small and Medium-sized Enterprises.

SPARRSO - Space Research and Remote sensing Organization

SPF – Specific Pathogen Free

SREDA - National Solar Energy Roadmap

SSF - Small-Scale Fisheries

STA - Seychelles Tourism Academy

Tcf - Trillion cubic feet

TEUs – Twenty-foot Equivalent Units

UN – United Nations

UNCLOS - United Nations Convention on the Law of the Sea

UNCTAD - United Nations Conference on Trade and Development

UNEP - United Nations Development Programme

VMS – Vessel Monitoring System

WBHPP - Wind Battery Hybrid Power Plant

WIO - Western Indian Ocean

WTO - World Trade Organization

WTP - Willingness to Pay

WWF - World Wide Fund for Nature

EXECUTIVE **SUMMARY**

The Blue Economy is a catch-all term that is used to describe a wide variety of development approaches and priorities in the ocean and coastal areas, and it seeks to promote economic growth, social inclusion, and improvement of livelihoods while at the same time ensuring environmental sustainability. To harness the full potential of the Blue Economy to achieve the SDGs, the Bangladesh government needs policy support and policy development ideas and suggestions from the relevant stakeholders of the country. Thus, a roundtable policy dialogue titled 'Institutionalization of the Blue Economy in Bangladesh' was held at the Carnival Hall of the Bangabandhu International Conference Center, Sher-e-Bangla Nagar, Dhaka at the initiative of the General Economics Division, Bangladesh Planning Commission of the Government of the People's Republic of Bangladesh where senior officials from different ministries of the government, armed forces, ports authority and research institutions related to the Blue Economy, eminent professors and researchers of different universities, and individuals working in various private and international organizations participated. In the consultative policy dialogue, various activities related to the Blue Economy were divided into eight (8) major thematic areas (Marine Fisheries and Aquaculture, Marine Energy, Marine Biotechnology and Therapeutics, Marine Tourism, Ship and Port Management, Ocean Governance, Marine Finance, and Satellite Oceanography and ICT). The stakeholders participating in the dialogue discussed in detail the present role and prospects of the thematic areas that were further divided into 19 research sectors (for example, Marine Fisheries, Tuna Fisheries, Mariculture, Seaweed Cultivation, Pearl Cultivation, Renewable Energy, Non-Renewable Energy, Energy Mix, Ship Transport, Shipbuilding, Ship Recycling, Deep Sea Port, Marine Spatial Planning, Coastal, and Marine Tourism, etc.) related to the Blue Economy growth and development of Bangladesh. The participants criticized that so far, various activities of the Blue Economy have been conducted fragmentally under different ministries of the Government of Bangladesh, however, no remarkable growth is noticeable. There is a long discussion on what are the obstacles to sustainable growth and development of the Blue Economy and the ways to overcome them. In the dialogue, in-depth explanations and analyzes were given on how the potential of the Blue Economy in Bangladesh can be institutionalized for national progress. Presently, in Bangladesh, 16 ministries are working on different areas of the blue economy in a very uncoordinated manner. Most participants agreed to what Dr. Kawser proposed to institutionalize the blue economy. Different opinions from different corners came out in the discussions but the discussants came to a single conclusion that the institutionalization could be done in a variety of ways- either by establishing a new ministry, a new department under an existing ministry, a separate commission, or a separate council based on their advantages and disadvantages. In his presentation, Dr. Kawser showed how the blue economy was being managed globally and he suggested that in Bangladesh, it would be better if General Economics Division (GED) of Planning Commission came forward to establish a Blue Economy Wing at GED. The GED's role would be somewhat overarching and I would be responsible for formulation and development of the Blue EEconomy-relatedstrategies, policies, action plans etc and the implementing ministries or organisations would follow the sstrategy plans, and policies developed by GED. Now the GED is playing the same overarching role in its Delta Wing for the implementation of the Bangladesh Delta Plan 2100.

ACKNOWLEDGMENTS

The report has been prepared by the General Economics Division (GED) of the Bangladesh Planning Commission (Social Security Policy Support (SSPS) Programme and Support to the Implementation of the Bangladesh Delta Plan – SIBDP) and is supported by the Government of Australia (Australian Aid) and United National Development Programme (UNDP).

Dr. Ahmed Kaikaus, Principal Secretary to the Prime Minister of the Government of the People's Republic of Bangladesh was present as the chief guest. We acknowledged him for his valuable time and speech in the policy dialogue.

Ms. Zuena Aziz, Chief Coordinator (SDG Affairs), Prime Minister's Office was present as Special Guest. We are also grateful for her valuable time joining the program.

Rear Admiral (Retd.) Md. Khurshid Alam, BN, Secretary (MAU), Ministry of Foreign Affairs was present as Guest of Honor. We also would like to greatly acknowledge him for his timely direction and guidance to harness the potential of a Blue Economy in Bangladesh.

We are thankful to Mr. Pradeep Ranjan Chakraborty, Secretary, the Planning Division who acted as the chairperson of the consultative policy dialogue programme.

We are grateful to the critical contribution of the senior officials from different Ministries of the Government of Bangladesh, Armed Forces, Ports Authorities and research institutions related to the Blue Economy, eminent professors and researchers of different universities, individuals working in various private and international organizations who attended the program and provided their valuable observations, thoughts, and suggestions to institutionalize the Blue Economy in the national progress of Bangladesh.

We conveyed our great gratitude to foreign participants who enthusiastically participated in the program and were always available to guide, advise and assist the programme. They extended impeccable efforts for institutionalizing the Blue Economy in the national progress.

We are also grateful to the valuable contribution of the Panel of Experts for their criticism, remarks, and comments on the report contents and the important suggestions to improve those.

Last but not least, we thank the involved other experts who attended the program.

We from GED gratefully acknowledge the efforts of all concerned.

CHAPTER 1

BANGABANDHU AND PRIME MINISTER SHEIKH HASINA'S CONTRIBUTION TO THE BLUE ECONOMY

1.1 Our Ocean Resources

Sheikh Hasina, the honorable Prime Minister of Bangladesh and the proud daughter of the father of the nation, Bangabandhu Sheikh Mujibor Rahman truly realized the necessity and the ample opportunity of capitalizing the ocean resources and so she wholeheartedly concentrated her due attention to the Blue Economy. While addressing in the United Nations General Assembly in 2016, she said, *"Mr. President, we must join ranks to preserve our natural resources for our succeeding generations. Bangladesh reaffirms the need for conservation and sustainable use of marine resources for tapping the potential of a Blue Economy."*

Oceans and seas are the major sources of both finite and infinite resources, covering over two-thirds of the earth's surface. Those are the safe abodes of marine resources, which provide food and minerals and generate oxygen for living things, absorb greenhouse gases, help check global warming, determine weather patterns and work as cheap-cost routes for maritime trade.

Figure 1: Oceans are the Greatest Sources of Human Needs

Many megacities and hubs of trade and commerce have been established on the seashores since the beginning of human civilization aiming to utilize the advantages of maritime routes. In the Sustainable

Development Goal (SDG)-14, the United Nations has informed that more than 3 billion people directly depend on oceans worldwide for their livelihoods, while the value of the global ocean-based economy is estimated to be around US Dollar 3-6 trillion per year.

Figure 2 : The Honorable Prime Minister, Sheikh Hasina

1.2 Bangabandhu: the pathfinder to tap 'Blue Economy' potential

Maritime resources in the twenty-first century are considered a blessing but utilizing these resources is not an easy task if it is not maintained in a pre-planned way. We the people of Bangladesh are blessed by the Almighty with natural resources and also our great leader, Father of the Nation, Bangabandhu Sheikh Mujibur Rahman who not only lead to making a new nation of 7.5 core people within a tiny piece of land but also paved the way of development of the nation in all the sectors for establishing his dream, commonly known as 'Sonar Bangla'. He could understand that Bangladesh was a land

of natural beauty as well as natural resources and was also lucky to have a marine territory in the southern part of the country. He played a pioneering role in the maritime sector of the country because he took the initiative to discover the survey result of the joint commission of NEDECO, an organization of the Netherlands and the East Pakistan government. The survey was conducted in 1965 though they did not disclose it in time. Bangabandhu perceived the importance of the survey to realize our resources in the marine sector.

Figure 3: Father of the Nation Bangabandhu Sheikh Mujibur Rahman

Father of the Nation Bangabandhu Sheikh Mujibur Rahman showed his tremendous farsightedness and sagacity in running the country as he framed 131 important laws, including the landmark "The Territorial Waters and Maritime Zones Act, 1974" during his three and a half years' tenure.

After liberation in 1971, the shipping sector's scenario was miserable. The occupant Pakistani Army took away all the merchant ships and left Chattogram Port with hidden mines all around under the water. Destroyed naval/merchant ships were submerged in the Karnaphuly channel; as a result, the foreign ships were not willing to call here and insurance companies imposed increased premiums on ships calling Chattogram Port. Realizing the huge potential of marine resources, upon return to the new country, Bangladesh on 10th January 1972 (from imprisonment in Pakistan), the Father of the Nation Bangabandhu Sheikh Mujibur Rahman took all possible efforts to build and organize the country in all sectors including shipping; despite all-out national & international resistances against the war-bashed just-born Bangladesh, successes were tremendous during his very short period of 1972-75 (before been assassinated in 1975).

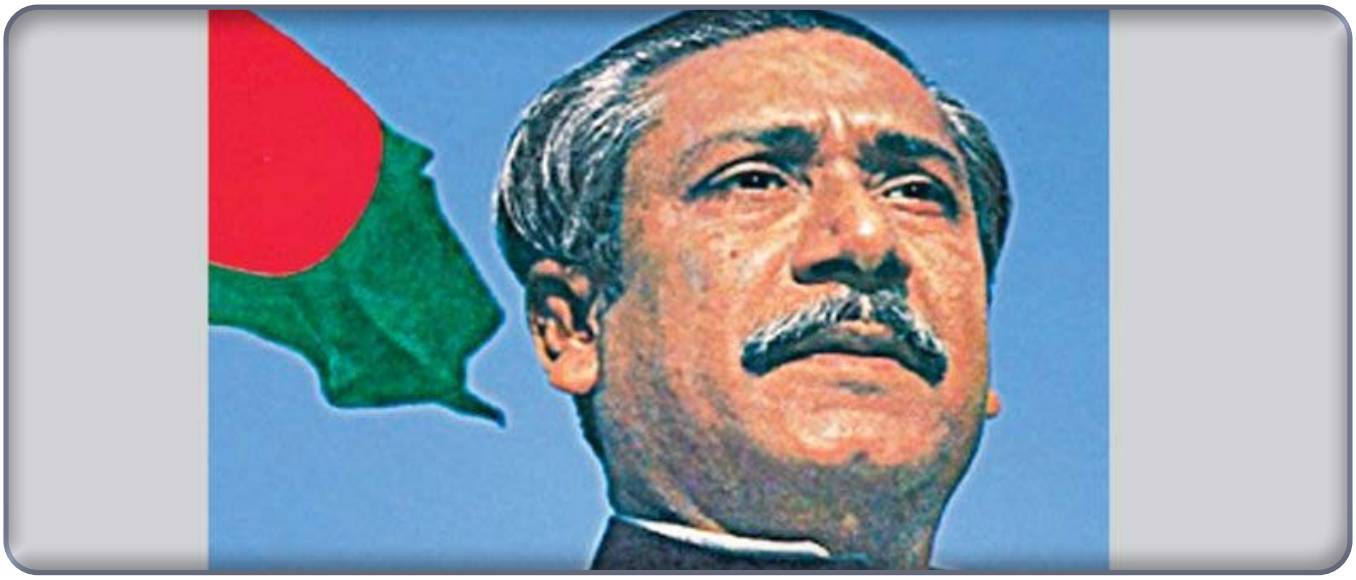


Figure 4 : Our Beloved Leader, Bangabandhu

Bangabandhu passed the "Territorial Waters and Maritime Zones Act" in 1974, marking a turning point in Bangladesh's maritime history as he recognized the potential of the nation's marine resources.

Before the 1982 adoption of the United Nations Convention on the Law of the Sea, some 46 years ago, the Father of the Nation proclaimed the legislative framework for the country's sustainable "Blue Economy." In reality, the country's "Blue Economy" has its roots in the Territorial Waters and Maritime Zones Act of 1974. Following the resolution of long-standing maritime disputes with neighboring India and Myanmar, the Awami League administration, led by Prime Minister Sheikh Hasina, has won a 1,18,813 square kilometer border in the Bay of Bengal.

It is to be mentioned here that as part of Bangabandhu's visionary policy, he upgraded the sea-bound transportation connecting the whole world and rebuilt the seaports of a war-ravaged country. He established the 'Bangladesh shipping Corporation' on 5th February 1972. Upon his request, a group of Russian maritime experts (Soviet Union's Mine Clearance Force) came to Bangladesh and cleared off the hidden/floating mines and submerged hazards from the Karnaphuly channel in 1972. He also managed to procure 19 ocean-going ships at almost free of cost from various friendly countries by 1975; later, by 1983, more 13 ships including 4 brand new ships from Japan (ref: his renowned Japan trip on 18 to 24 October 1973) were added to the BSC fleet out of his initiatives. Despite hard competition in the then-shipping world, the newborn BSC made a distinct profit throughout the 70s. According to the report of the United Nations Commission on Trade and Development (UNCTAD) Review of Maritime Transport-2019 Bangladesh is at the apex of this industry. This becomes possible only through the provision of the great leader of this time.

Bangabandhu felt the severability of creating a waterway for heavy watercraft on the Shela River to protect Sundarbans with his strong previsions. He decided to make a route from Goshakhali of Morolgang Upazila of Bagerhat district to Betbunia of Rampal Upazila. In 1974 this route started and it still serves the Sundarbans.

The Bay of Bengal is situated just in the southern part of the country and we have very cheap manpower in the coastal region. Bangabandhu realized that it could be a good place and time for making and breaking the ship. He started the industry named Narayanganj Dockyard and Engineering Works Limited. Smaller ship construction (up to 1,000 DWT) commenced in Khulna Shipyard in 1972. Bangabandhu commenced the long pending work of the construction of the Chattogram Dry Dock & Heavy Industries

(commissioned in 1983). Now it has become about two hundred in number around Dhaka, Chattogram, Narayanganj, Barisal, and Khulna. Informatively, besides being the Prime Minister, additionally, he was also the shipping minister for a period of 8 July 1974 – 26 Jan 1975.

Marine Academy, established in 1962, was the only Sea study center in East Pakistan. After the great Liberation War Bangabandhu realized the importance of the institute and declared a project named 'Development of Marine Academy-1973', under this project infrastructural development was held for the institute. At Bangabandhu's initiative and request, a group of Russian maritime experts established Marine Fisheries Academy in 1973 in Chattogram. Now it runs under Bangabandhu Sheikh Mujibur Rahman Maritime University, Dhaka, Bangladesh.

He also established the Bangladesh Fisheries Development Corporation (BFDC) under Act-22 of 1973, which find four fishing grounds in the Bay of Bengal territory in the early time. The effect of this work is now estimated. Oil and gas exploration in the Bay of Bengal commenced in 1973.

Foreseeing the country's marine potential, Bangabandhu enacted the 'Territorial Waters and Maritime Zones Act 1974', which was a milestone in the maritime history of Bangladesh. The law was framed in 1974 when there was no such a law in most countries in the world. Nearly eight years after the enactment of "The Territorial Waters and Maritime Zones Act" by Bangabandhu, the United Nations (UN) framed "The UN Convention on the Law of Sea (UNCLOS)" in 1982.

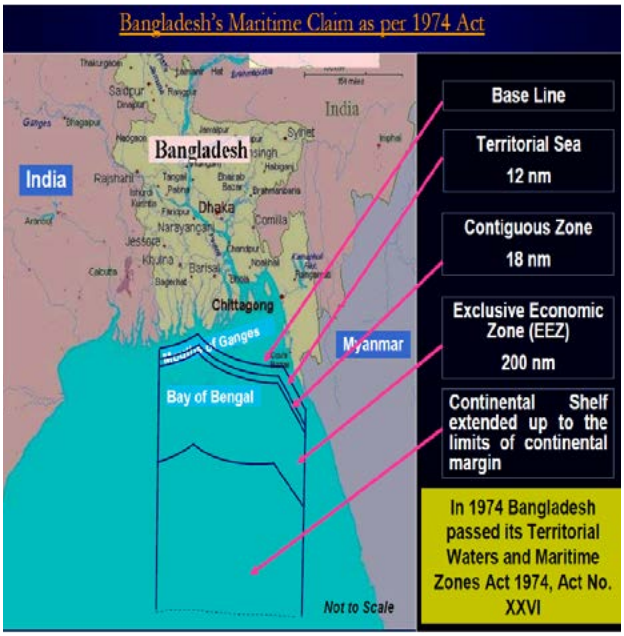


Figure 5: Bangladesh's Maritime Claim as Per Territorial Waters and Maritime Zones Act 1974.

The act provided an excellent roadmap for the demarcation of the country's various maritime zones and a clear indication of its rights and responsibilities in the sea, including regulations for ensuring maritime safety and security.

The law paved the way for the proper management and protection of the country's marine resources, conservation of biodiversity, pollution control, coastal zone management, maintaining the marine-protected areas and shipping, harvesting marine fish, and ensuring maritime governance as well.

Following the foundation laid by the Father of the Nation, Bangladesh is now going to tap the marine potential by turning the Bay of Bengal into a hub of economic development to ensure the optimum use of its maritime resources to widen the country's economic space.

Bangabandhu was the architect of our maritime vision. In 1974, he laid the foundation for future maritime Bangladesh by introducing the Territorial Waters and Maritime Zones Act. On that basis, under the visionary and dynamic leadership of Honourable Prime Minister Sheikh Hasina, daughter of Bangabandhu, Bangladesh settled maritime boundary disputes with Myanmar in 2012 and with India in 2014 through an arbitral method.

Figure 6: Honourable Prime Minister Sheikh Hasina at Inani Beach

The longstanding maritime dispute between Bangladesh and Myanmar came to an end after the International Tribunal for the Law of the Sea (ITLOS) and the final verdict came out on 14 March 2012. The procedure began back in October 2009, when Bangladesh eventually brought the issue before the international tribunal, having exhausted attempts to reach a bilateral agreement.

Bangladesh has now been awarded 1,18,813 square kilometers of exclusive economic zone waters in the Bay of Bengal, almost the same size as Bangladesh, which includes all resources currently available for exploitation and all resources that may be discovered in the future. The tribunal also awarded Bangladesh a 12-mile territorial sea around St. Martin's Island, overruling Myanmar's argument that it should be divided in half. The judgment is final and without appeal, with Bangladesh winning by 21 votes to 1. The biggest advantage for Bangladesh that is likely to stem from this judgment is that it will now be able to utilize the area that had been in dispute for several decades.

Figure 7: The Delegation of Bangladesh: Dispute Concerning the Delimitation of the Maritime Boundary between Bangladesh and Myanmar in the Bay of Bengal (Bangladesh/Myanmar)

Figure 8: The Courtroom: Dispute Concerning the Delimitation of the Maritime Boundary between Bangladesh and Myanmar in the Bay of Bengal (Bangladesh/Myanmar)

On July 7, 2014, the Permanent Court of Arbitration (PCA) in The Hague, Netherlands, delivered its decision to resolve the India-Bangladesh maritime boundary dispute. The dispute, aspects of which dated back to the partition of India in 1947 and to competing claims to a new low-tide elevation in the 1970s, had taken on greater resonance in recent years as countries in the region have sought to develop oil and gas resources in the Bay of Bengal to satisfy growing energy demand in South Asia. The arbitration followed years of failed diplomatic negotiations that ultimately led to naval tensions arising from the surveying of oil-and-gas exploration blocks in disputed waters in 2008. In 2009, Bangladesh initiated arbitration proceedings against India and Myanmar. The decision in the Bangladesh vs India case was a logical follow-on to a March 2012 judgment delineating the adjacent Myanmar-Bangladesh maritime boundary, which made it possible for the PCA to quickly demarcate the adjacent boundary between Bangladesh and India, and Bangladesh was awarded 80 percent of the territory under dispute.

Figure 9: The Tribunal: Bay of Bengal Maritime Boundary Arbitration between Bangladesh and India

Through resolving maritime disputes with Myanmar and India, Bangladesh achieved sovereign rights in the water column, seabed, and subsoil of 118,813 square kilometers in the Bay of Bengal, which is equal to 81% of the mainland. This achievement has opened up new possibilities to take Bangladesh's economic growth to another level by exploiting the Blue Economy. We have been able to identify some areas of the Blue Economy. Initiatives have also been taken to identify the remaining potential areas and utilize them.

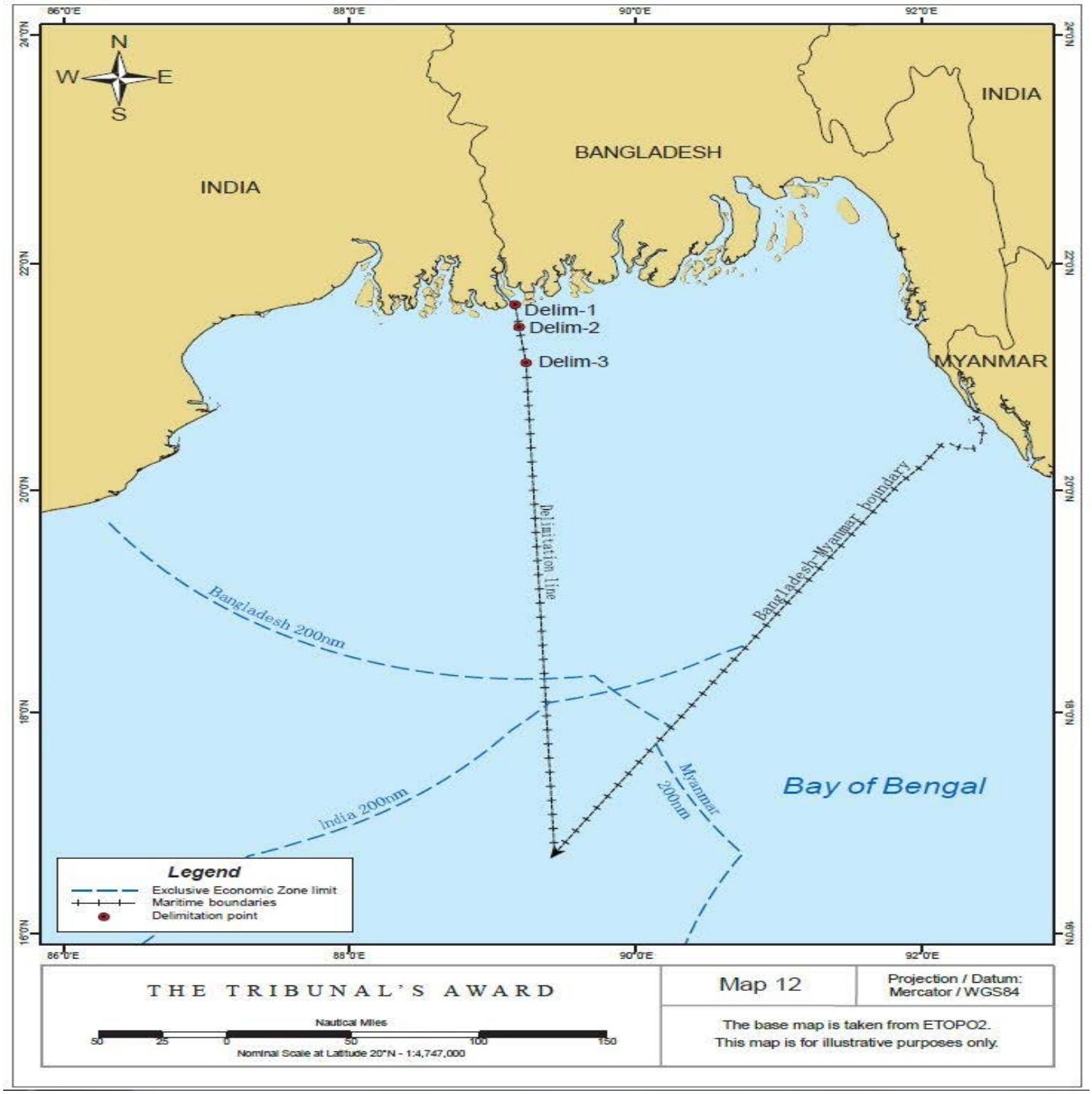


Figure 10: The settled maritime area of Bangladesh

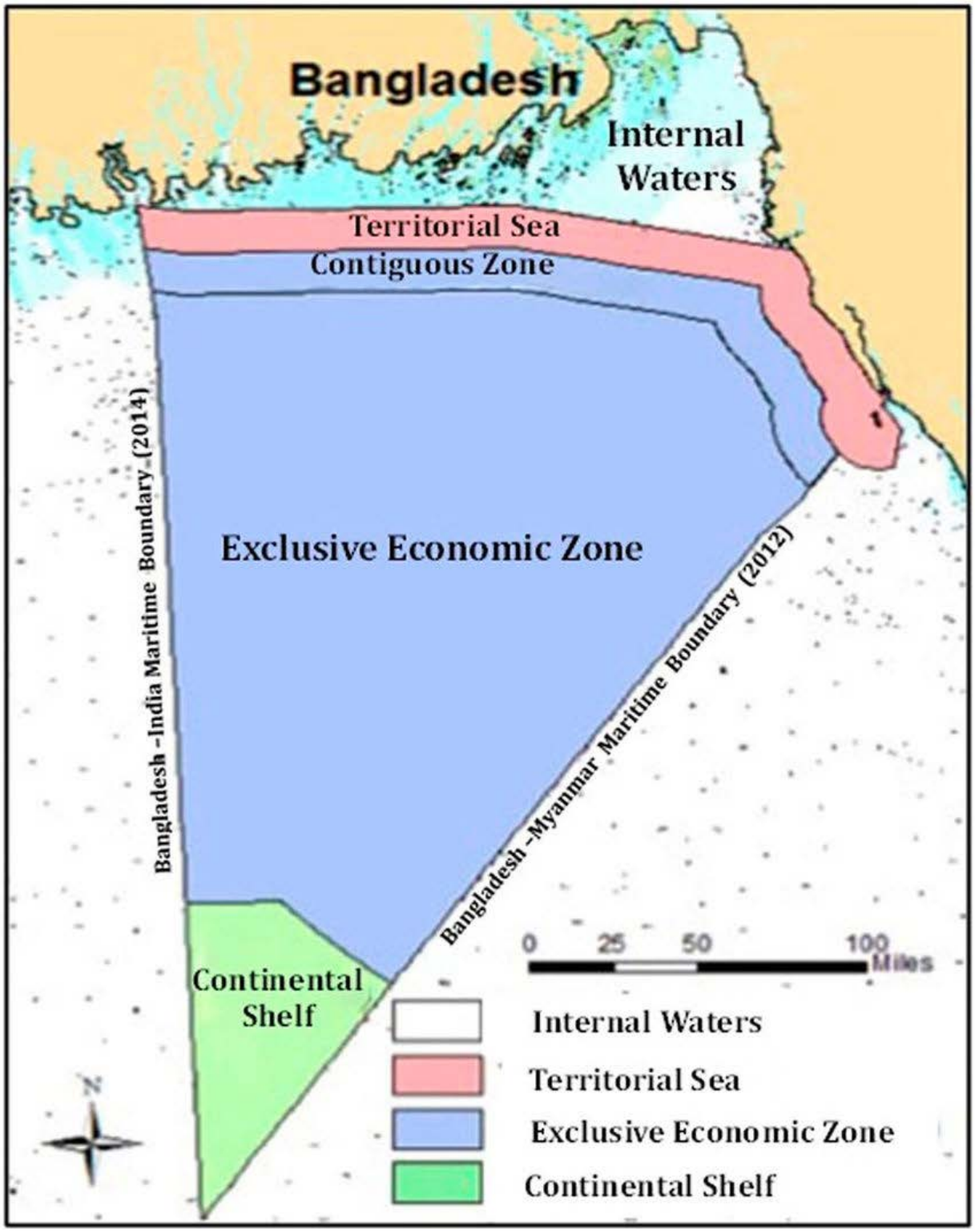


Figure 11: Maritime Area of Bangladesh (MoFA, 2014)

During Bangabandhu's time, the journey of the Bangladesh Shipping Corporation started with 19 ships as mentioned earlier. Then, by going in the opposite direction, in 2010 the number of ships stood at 2. Under the leadership of Honourable Prime Minister Sheikh Hasina, the Bangladesh Shipping Corporation has turned the corner again. There was no deep seaport in Bangladesh. Now, a deep seaport is being constructed at Matarbari in Cox's Bazar, which will cost Tk 17,777.16 crore. Payra port is already a reality

today. Ships from different countries of the world are coming to Mongla port. The foundation of all this has been laid by the father of the nation Bangabandhu Sheikh Mujibur Rahman.

Figure 12: Construction of Matarbari Deep Sea Port

The Father of the Nation Bangabandhu Sheikh Mujibur Rahman initiated the establishment of the ocean research institute in 1973 intending to enrich the country's economy and reduce poverty through exploring, exploiting, and conserving valuable resources of the Bay of Bengal. But after the brutal and tragic killing of Bangabandhu in 1975, that initiative got stopped. In 1996, the Honorable Prime Minister Sheikh Hasina constituted a Review Committee for the establishment of the National Institute of Ocean Science. After receiving the recommendation of the review committee, the decision of establishing the National Oceanographic Research Institute was accepted in 2000. To ensure the proper utilization of marine resources, a project under the Ministry of Science and Technology was adopted in the period from June 2000 to July 2005 for the establishment of the National Oceanographic Research Institute (1st Phase). After a long time in 2009, the visible progress of the establishment of the National Oceanographic Research Institute (NORI) was achieved through the intensive initiative of Honorable Prime Minister Sheikh Hasina. When presenting the proposal for establishing the institute on 4 acres of land in the ECNEC meeting on 02/07/2009, the Honorable Prime Minister extended the amount of land to 40 acres instead of 4 acres. She also ordered to redesign and represent the project including the laboratory, residential building, club building, playground, school building, and the marine aquarium with international quality. The acquisition of 40 acres of land in Jungle Goalia Palang Mouza of Khunia Palang Union of Ramu Upazila of Cox's Bazar district was completed in 2010.

Now the Honorable Prime Minister, Sheikh Hasina works for Blue Economy, for sustainable development in the future time. In the United Nations General Assembly in 2016, the Honorable Prime Minister uttered, *"Mr. President, we must join ranks to preserve our natural resources for our succeeding generations. Bangladesh reaffirms the need for conservation and sustainable use of marine resources for tapping the potential of a Blue Economy."*

To utilize its unexplored marine resources, Bangladesh has already taken initiatives to flourish its Blue Economy. Since 2015, the government has undertaken several consultations and workshops on the issue.

In 2017, the government established the "Blue Economy Cell' with the mandate to coordinate 'Blue Economy' initiatives across sectoral ministries.

Moreover, the government of Bangladesh works for Bangladesh Delta Plan 2100. The Bangladesh Delta Plan (BDP) 2100 is a long-term integrated techno-economic mega plan that integrates all delta-related sector plans and policies, enveloping a Delta Vision and strategies that make it possible to integrate sector plans and policies for the long term and to present actionable interventions with a roadmap for realization.

The government of Bangladesh approved the Delta Plan (BDP) 2100 on September 4, 2018, to secure the future of water resources and mitigate the likely effects of climate change and natural disasters.

Figure 13 : NEC Conference

The Bangladesh Delta Plan (BDP) 2100 is a broad-based long-term vision of the likely changes and necessary interventions to make the Bangladesh Delta safe by the end of the 21st Century. Thus, an integrated, comprehensive, and long-term Delta Vision has been stated as:

"Achieving safe, climate resilient and prosperous delta"

The mission for BDP 2100 is formulated as ensuring long-term water and food security, economic growth, and environmental sustainability while effectively reducing vulnerability to natural disasters and building resilience to climate change and other delta challenges through robust, adaptive, and integrated strategies, and equitable water governance.

The government is going to enact 'The Marine Fisheries Act 2020' which will replace 'The Marine Fisheries Ordinance-1983'.

Regarding different initiatives of the government, the Secretary (Maritime Affairs Unit) of the Ministry of Foreign Affairs Rear Admiral M Khurshed Alam said 26 maritime economic sectors such as shipping, coastal shipping, seaports, passenger ferry services, inland waterway transport, shipbuilding, ship recycling industries, fishery, marine aquatic products, marine biotechnology, oil and gas, sea salt production, ocean renewable energy, blue energy (osmosis) and biomass, aggregates mining (sand, gravel, and others), marine genetic resource, coastal tourism, recreational water sports, yachting and marines, cruise tourism, coastal protection, artificial islands, greening coastal belt or delta planning, human resource, maritime safety and surveillance and maritime spatial planning (MSP) had been identified for development of 'Blue Economy' in Bangladesh.

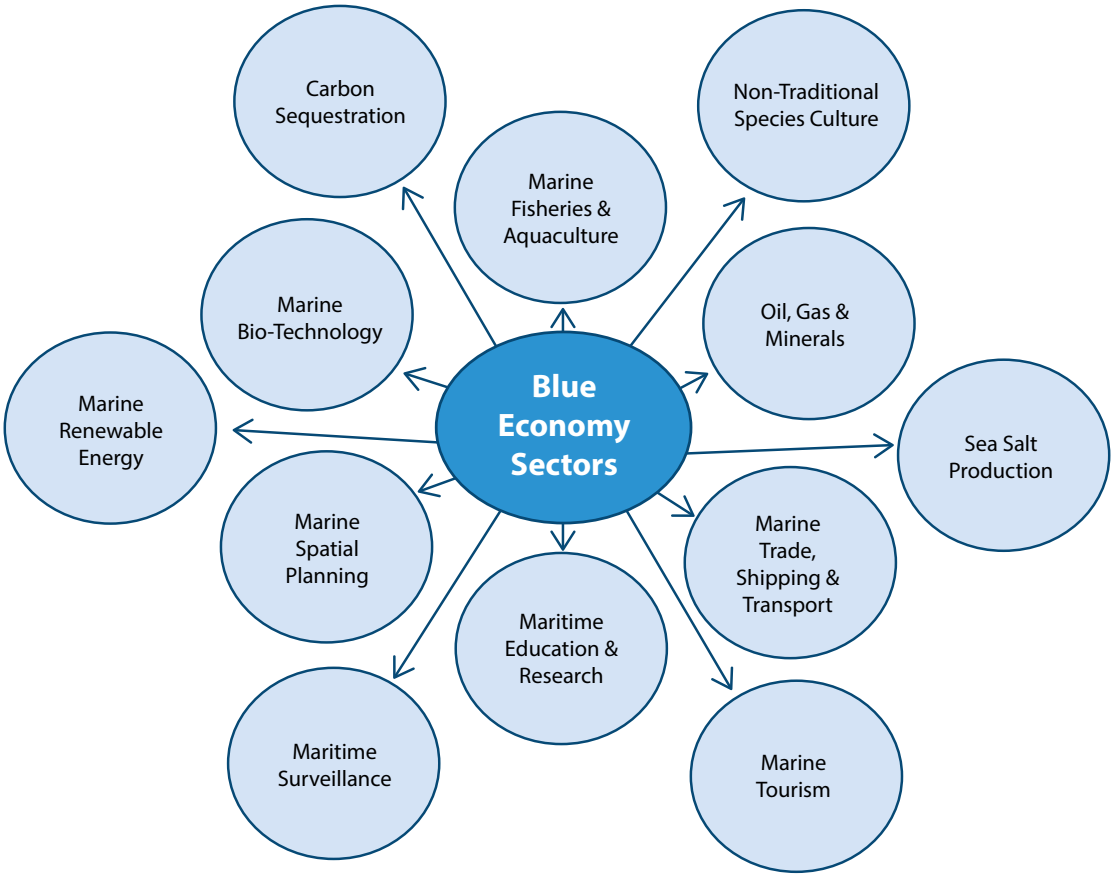


Figure 14: The Blue Economy-Related Sectors in Bangladesh

The full account of each of these functions has been taken of the value chains that are developed across a range of sectors. Well-trained, skilled, and educated human resources are the driving force of the development of an economy and can participate in the globalization of business and the accompanying technological revolution. A thrust in blue economic growth may come from a large army of skilled coastal and offshore engineers, navigators, merchant mariners, fisheries technologists, biotechnologists, and in a variety of other professions.

After winning the sea area, the present government is paying special attention to creating skilled human resources for unleashing opportunities from the Blue Economy. The experts noted that Bangladesh should step up its efforts to tap into the "Blue Economy's" enormous potential to achieve double-digit GDP growth because its marine territory is abundant in priceless natural resources, both living and non-living. However, if the resources are properly utilized, the huge maritime domain has the potential to contribute more to the GDP of Bangladesh than its current $9.6 billion or 6% annual contribution.

Bangabandhu showed us the way to achieve 'Sonar Bangla' and we are walking the way with his daughter Sheikh Hasina. It is our belief, we achieve the Goal and Blue Economy will be a strong weapon to reach it.

1.3 Prospects:

If marine resources can be utilized and exploited effectively, experts believe it will be feasible to earn 12,000 crore taka annually. Economists estimate that 10% of the world's GDP can be generated by the correct expansion of the blue economy. The Sustainable Development Goals section 14 addresses the utilization and preservation of maritime resources (SDGs). Therefore, it is essential to maintain the sustainable use of marine resources if we want to achieve the SDGs by 2030.

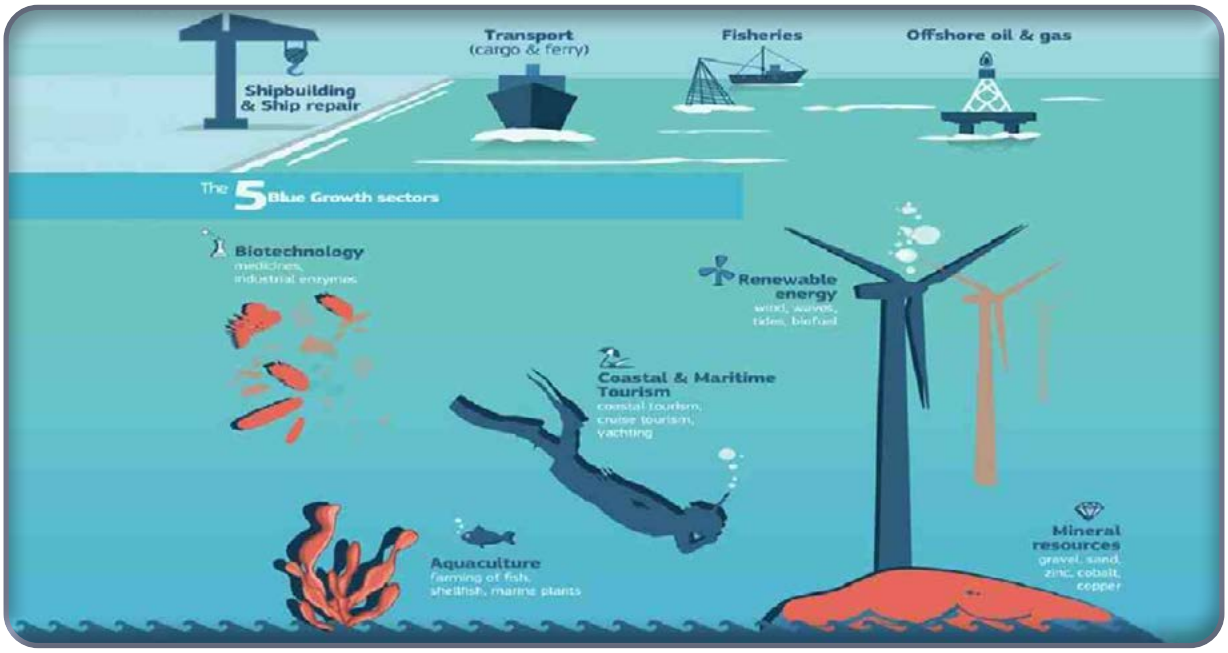


Figure 15 : Prospects of the Blue Economy in Bangladesh

Bangladesh has a sizable population, and its economy is heavily reliant on the resources found on its land. However, harnessing the riches present in our sea is the only option if we are to become a developed nation and meet the aims of sustainable development. Bangladesh has a great chance of becoming a developed country if maritime resources are utilized effectively. The following opportunities are discussed for Bangladesh's blue economy:

1) Exploration of oil and gas: The Bay of Bengal is rich in natural resources. The sole business in Bangladesh is Bangladesh Petroleum Exploration and Production Company Limited (BAPEX).
Bangladesh has received approval to conduct oil and gas exploration and extraction. Significant mineral resources can also be found in the water in addition to crude oil. Bangladesh's prosperity depends critically on the discovery of oil and gas.

2) Marine Renewable Energy: Renewable energy is defined as energy derived from natural energy sources that can be recycled quickly, preventing the depletion of the energy source. Wind, water, waves, and currents in the ocean have all been shown to be reliable sources of renewable energy for Bangladesh.

3) Maritime Professional: The development of maritime professionals is the only option available for

the marine industry. The blue economy may be significantly impacted by our marine experts. The government built the Bangabandhu Sheikh Mujibur Rahman Marine University, which would greatly influence the blue economy by producing qualified maritime experts.

4) Marine trade and shipping: The marine transportation network is one of the key components of Bangladesh's blue economy. Almost 92% of goods moved worldwide are transported by water. Therefore, building class ships would significantly impact the blue economy.

5) Marine tourism: The growth of our nation may be significantly impacted by marine tourism. The world's biggest sea beach is in Bangladesh. The nation also boasts approximately 700 rivers. Therefore, if these maritime regions can be utilized for tourism, Bangladesh will be able to make a sizable profit and add a lot of job possibilities.

Bangladesh has several chances to thrive in the blue economy. But there are still a lot of untapped prospects in this industry in Bangladesh since there aren't enough implementation and safety measures, qualified maritime experts, research activities, and surveys. Bangladesh might quickly become one of the industrialized nations if it can effectively use its vast maritime resources.

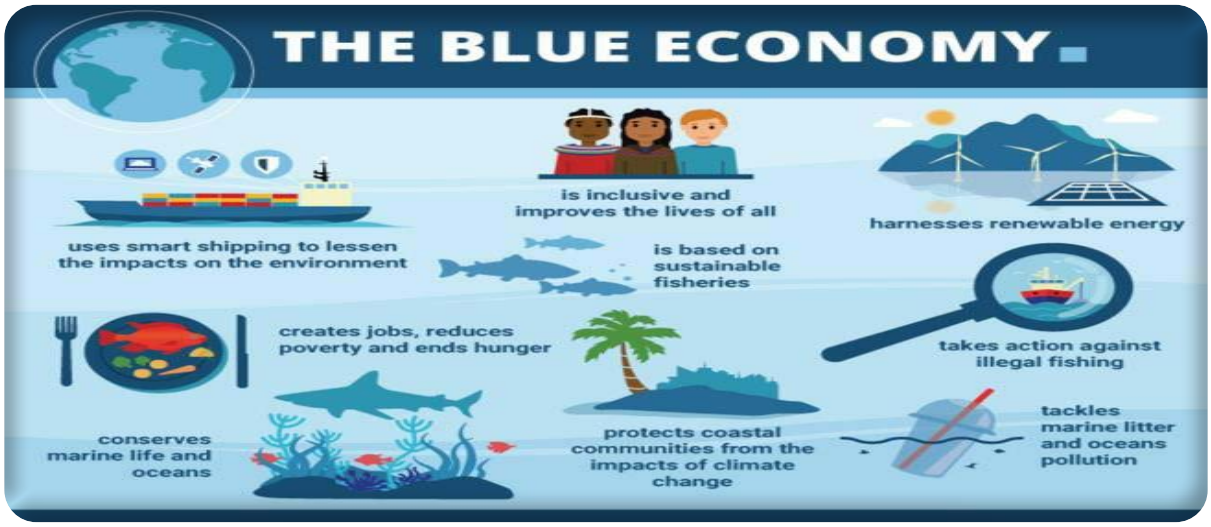


Figure 16: An Illustration of the Blue Economy. (Source: SISP)

1.4 Development of Blue Economy from Sea Resources

Estuarine fishes	Fishing & fish cultivation, post-harvest fish handling & processing
Marine fishes (Capture)	Demersal (bottom-dwelling) fishes, pelagic (free-swimming) fishes
Fisheries and other living resources	Shrimps, crabs, lobsters, mussels, etc.
Mariculture	Sea bass, Grey mullet, Greenback mullet, Pomfret, Hilsa, Crab breeding and farming-Asian green mussel, Indian oyster, Seaweeds, and Marine microalgae cultivation in cages and other enclosures/grow outs
Non-living resources	Salt and brine, potable water by desalination, Fuel oil, gas, and other valuable minerals
Coastal tourism, and marine sports	Cruise-ship, yacht, floating hotel and restaurant, surfing, diving, snorkeling, boating, sport fishing and other water sports etc
Shipping & port operations and use of the ocean in maritime trade	Trade expansion, fleet expansion, port development, transit and transshipment, coastal shipping and improvement and use of riverine routes for containers, etc
Forest resources development and Mangrove ecosystem	Mangrove forests, afforestation, canal, and creeks for spawning, breeding, and pearl cultivation
Shipbuilding & ship recycling	Incentives to be provided. More compliant industries are needed.
Renewable Energy development	Power generation from current, tide, wave, and maritime wind; bio-gas and bio-fuel from marine algae
Land reclamation	Acceleration of char and island formation by engineering interventions
Biotechnology	Marine algae, various marine plants & animals as raw materials for pharmaceutical and cosmetics industries
Maritime professionals	Coastal zone planner & manager, coastal forest manager, marine fisheries manager, tourism manager, maritime lawyer, merchant marine, port manager, maritime trade analyst, shipping liner & entrepreneur, marine pollution & environment expert, marine conservationist, hydrographer, surveyor, offshore engineer, naval architect, marine engineer, aquaculture technologist, biotechnologist and hatchery technologist, remote sensing & optical, marine scientist, marine biologist/ecologist, marine fisheries biologist, maritime meteorologist, climatologist, marine geologist, petroleum geologist, etc.
Marine Scientific Research	BORI should be strengthened with a research vessel
Maritime safety and Surveillance	Marine unconventional products and services Maritime safety and Surveillance may be upgraded
Marine Business services	Marine R&D; general education and ocean literacy; and private partnership

CHAPTER 2

BLUE ECONOMY

2.1 Background

The ocean has been a major source of wealth, creating trillions of dollars in goods and services and providing livelihood and employment to millions of people. Many big cities and centers of commerce have been developed based on access to the sea. According to the United Nations (2017), more than 40% of the global population lives within 100 km of the coast. The ocean is an integral part of the global economy. Submarine cables cross the ocean's floor to carry 90% of the electronic traffic upon which global communications are relied (NOAA, 2022). Oil and gas from the ocean floor provided 30% of global consumption needs in 2014, up from 20% in 1980 (Brakenhoff, 2015). In 2013, sea fishery resources contributed to almost 20% on average of the animal protein consumption of more than 3.1 billion people (FAO, 2016). The estimated 1 to 1.4 million different species that live in the ocean support a growing commercial interest in marine genetic resources that lead to the commercial development of pharmaceuticals, enzymes, and cosmetic products. The rate of patent applications related to marine genetic materials increased at rates exceeding 12% per year from 1999 to 2008. Over 5,000 genes derived from marine organisms had been patented by 2010 (Costello et al., 2010).

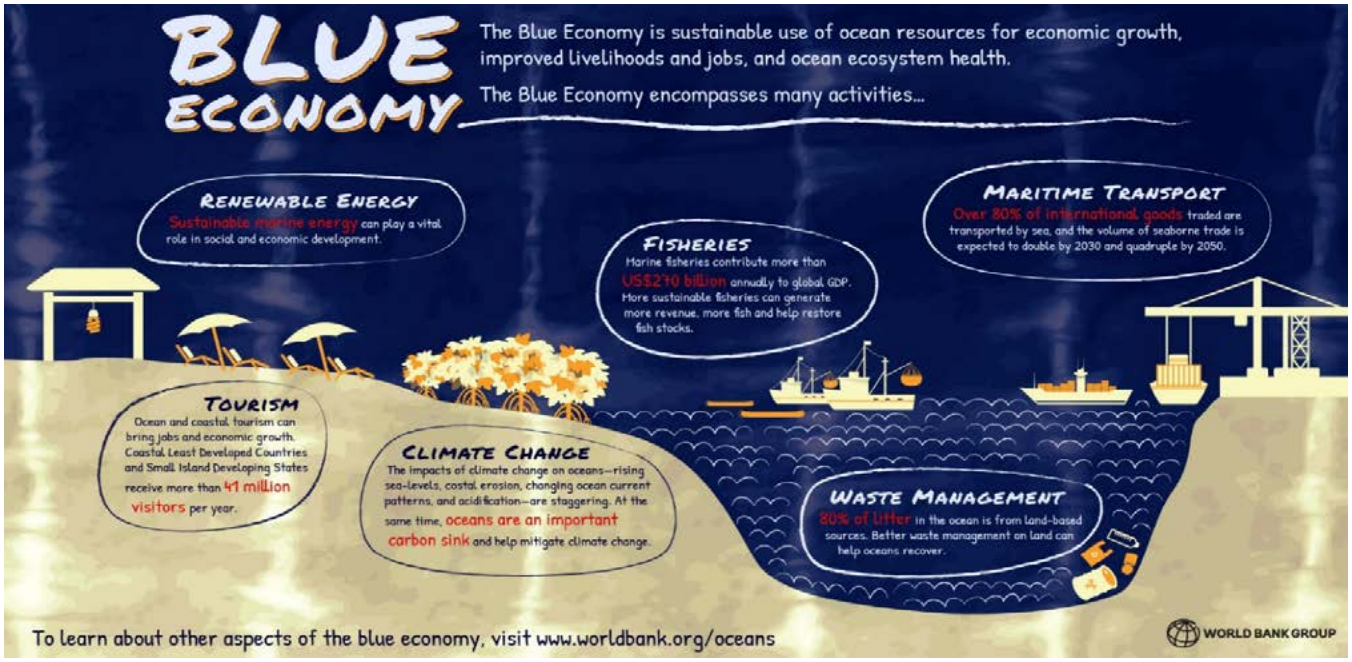


Figure 17 : Blue Economy

At the same time, as the ocean economy has grown, the ecosystems underpinning these activities have undergone significant human-driven changes, in some cases towards ecological collapse (Jackson et al., 2001). In the past decade, as countries around the world have attempted to grapple with these twin trends of accelerating growth in the ocean economy and decline of the underlying ecosystems, they have increasingly used the perspective of the "Blue Economy" emerged rapidly as shorthand for policies that promote sustainable development of the ocean, in which economic growth does not

reduce the aggregate natural capital and conservation of ecological commons contribute to poverty reduction (World Bank, 2017; Colgan, 2017)

The "Blue Economy" is an emerging concept that encourages better stewardship of our ocean or "blue resources." The term "Blue Economy" simply refers to the range of economic uses of the ocean and coastal resources - such as energy, shipping, fisheries, aquaculture, mining, and tourism. It also includes economic benefits that may not be marketed - such as carbon storage, coastal protection, cultural values, and biodiversity. It supports all of the United Nations' Sustainable Development Goals (SDGs), especially SDG - 14 'Life Below Water, and recognizes that this will require ambitious and coordinated actions to sustainably manage, protect and preserve our ocean for the sake of present and future generations.

The term "blue economy" has been used in a variety of contexts, but in this instance, it is understood to indicate the broad range of economic sectors and related regulations that work together to assess whether the use of oceanic resources is sustainable. An important challenge of the blue economy is thus to understand and better manage the many aspects of oceanic sustainability, ranging from sustainable fisheries to ecosystem health to pollution. A second significant issue is the realization that the sustainable management of ocean resources requires collaboration across nation-states and the public-private sectors, and on a scale that has not been previously achieved. This realization underscores the challenges facing the Small Island Developing States (SIDS) and Least Developed Countries (LDCs) as they turn to better management practices for their blue economies.

The blue economy needs compliance with SDG 14, with the attribute, focused on conserving and sustainably using the oceans, seas, and marine resources. The core is to realize socio-economic development and the dynamic balance of resources and the environment. In the United Nations' second preparatory meeting's summary, the UN Commission on Sustainable Development acting as Preparatory Committee highlighted approaches to adopting the "blue economy", and believes it is consistent with the core contents of the Rio+20 Summit (IOC/UNESCO et al., 2011). The green economy mentioned in the Rio+20 negotiations represents a transformation of the economic development model. International society tends to refer blue economy as a green economy or the green development model in ocean and coastal zone development and management (Rio+20 Pacific Preparatory Meeting, 2011). Based on the analysis of marine industrial activities and the health of the marine eco-system, it is compulsory to maintain a healthy marine and land ecosystem, solve pollution related to marine transport, waste, plastic litter, and micro-plastic, mitigate the global climate change effects, and construct a blue economy framework with sustainable management model based on maintaining a healthy ecosystem.

The blue economy is characterized by different organizations:

i. **The Blue Economy is a Strategic Framework.** It is believed that the essence of the blue economy is to promote the development of the marine industry which ecologically, economically, and socially benefits from the marine ecosystem and ensures that the ecosystem-based management model should be the core of the decision-making process of industrial and community development (Australian Government, 2012).

ii. **Blue Economy is a Kind of Policy.** In 2009, Maria Cantwell, United States Senator of Washington State, pointed out in the opening statement of the hearing on "The Blue Economy: the Role of the Oceans in our Nation's Economic Future" that "The Blue Economy – the jobs and economic opportunities that emerge from our oceans, Great Lakes, and coastal resources – is one of the main tools to rebuild the United States' economy."

iii. **Blue Economy is a Part of the Green Economy.** The United Nations Development Programme (UNDP) and other international organizations extract the blue economy from the green economy.

They encourage tackling climate change via low-carbon and resource-efficient shipping, fishing, marine tourism, and marine renewable energy industries (UNEP et al., 2012).

iv. **Blue Economy is a Sustainable Marine Economy.** Wang Hong, Director of State Oceanic Administration under the Ministry of Natural Resources of the People's Republic of China, said in the China Marine Workshop of the United Nations Conference on Sustainable Development in 2012, "The blue economy is a sustainable marine economic development model. It is a new development mindset and its essence is to develop marine economy while protecting marine ecosystem well and finally achieving sustainable utilization of resources."

v. **Blue Economy is a Marine-Based New Technology Economy.** The Commonwealth Scientific and Industrial Research Organization (CSIRO) of Australia mentioned "Blue GDP" stressing in its research report while developing diversified ocean-based industries, the idea of social and environmental sustainability has been implemented in the development under the support of new marine technologies and emerging industries (CSIRO, 2008).

2.2 Definition of the Blue Economy

The Belgian economist Professor Gunter Pauli coined the phrase "Blue Economy" in 1994 to describe his business model for transforming society from one of scarcity to one of abundance "with what is locally available", but it has since gained widespread acceptance as a goal of investment and policy-making. It is also regarded to use marine resources for long-term economic growth. The term 'Blue Economy' has been exponentially used over the last decade (Mulazzani and Malorgio, 2017). Since then, the Blue Economy has drawn more attention globally, however, there has been no widely accepted concrete definition of it (Choi, 2017; Eikeset et al., 2018; Silver et al., 2015; Winder and Le Heron, 2017).

The United Nations defines the Blue Economy in a concept paper that was published in 2014 as an ocean economy that aspires to "increase human well-being and social fairness, while considerably lowering environmental hazards and ecological scarcities" (UNCTAD, 2014, p. 2). **The World Wildlife Fund** (2015, p. 1) defines the Blue economy as a marine-based economy that:

- creates social and economic advantages for both present and future generations by promoting food security; eradicating poverty; improving livelihoods status, income, employment opportunities, health facilities, safety, equity, and political stability;
- restores, protects, and conserves marine ecosystems, which are crucial to its prosperity due to their diversity, productivity, resilience, and inherent value; and
- is built on the principles of clean technologies, renewable energy, and circular material flows to ensure long-term economic and social stability while preserving the boundaries of one planet.

In 2008–2009, a Partnership for the Environmental Management of the Seas of the East Asia (PEMSEA) project culminated in the establishment of the Changwon Declaration, which defined the Blue Economy as a practical ocean-based economic model using green infrastructure and technologies, innovative financing mechanisms and proactive institutional arrangements for meeting the twin goals of protecting our oceans and coasts and enhancing its potential contribution to sustainable development, including improving human well-being, and reducing environmental risks and ecological scarcities' (Whisnant and Reyes, 2015, p. 25).

Figure 18 : Logo of a Partnership for the Environmental Management of the Seas of the East Asia

According to World Bank, the blue economy is the "sustainable use of ocean resourcesfor economic growth, improved livelihoods, and jobs while preserving the health of the ocean ecosystem." 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." The Commonwealth of Nations considers it as "an emerging concept which encourages better stewardship of our ocean or 'blue' resources." Conservation International adds that the "blue economy also includes economic benefits that may not be marketed, such as carbon storage, coastal protection, cultural values, and biodiversity." The Center for the Blue Economy says "it is now a widely used term around the world with three related but distinct meanings - the overall contribution of the oceans to economies, the need to address the environmental and ecological sustainability of the oceans, and the ocean economy as a growth opportunity for both developed and developing countries."

Other definitions of the Blue Economy or Blue Growth have been established by the World Oceans Council, the Australian Government, the Indian Ocean Rim Association, and The Economist Magazine (Mohanty et al., 2015; National Marine Science Committee, 2015; EIU, 2015; Whisnant and Reyes, 2015). Most definitions include a focus on 'triple bottom line objectives of environmental sustainability, economic growth, and social equity, driven by an integrated oceans governance approach and technological innovation (Keen et al., 2018; Smith-Godfrey, 2016)

Perhaps the one universally agreed aspect of the Blue Economy is that it is a fluid concept, employed differently in different contexts and by different actors (Choi, 2017; Eikeset et al., 2018; Silver et al., 2015; Winder and Le Heron, 2017). An analysis of the way the term was employed as part of the Rio+20 Earth Summit proceedings by Silver et al. (2015) highlights the way the Blue Economy was a concept employed by various groups within the negotiation process to prosecute particular ideas and actions. Four dominant discourses were identified based on Silver et al. (2015):

i. **Oceans as natural capital are** predominately employed by environmental NGOs who used the term as a means of arguing that ecosystem services provided by marine environments should be better recognized and accounted for;

ii. **Oceans as a good business** promoted by marine sectors such as fisheries and shipping as well as development agencies, this theme called for greater recognition of the ocean-based industries and the contribution they make to society;

iii. **Oceans as an integral part of Pacific SIDS.** Pacific SIDS were actively engaged in framing the Blue Economy around their livelihoods and development objectives; and

iv. **Oceans as Small-Scale Fisheries (SSF) livelihoods.** This theme focused on eradicating poverty and the function of SSF in providing the world's underprivileged people with a source of protein and a means of livelihood. Development agencies, SIDS, and SSF organizations all played a major role in its growth.

Environmental, social, and economic sustainability are the three pillars of the blue economy (*Figure 1*). Financial concerns are intimately tied to economic sustainability, which also involves several concepts and instruments. The most important things for economic sustainability are resource decoupling and impact decoupling (Figure).

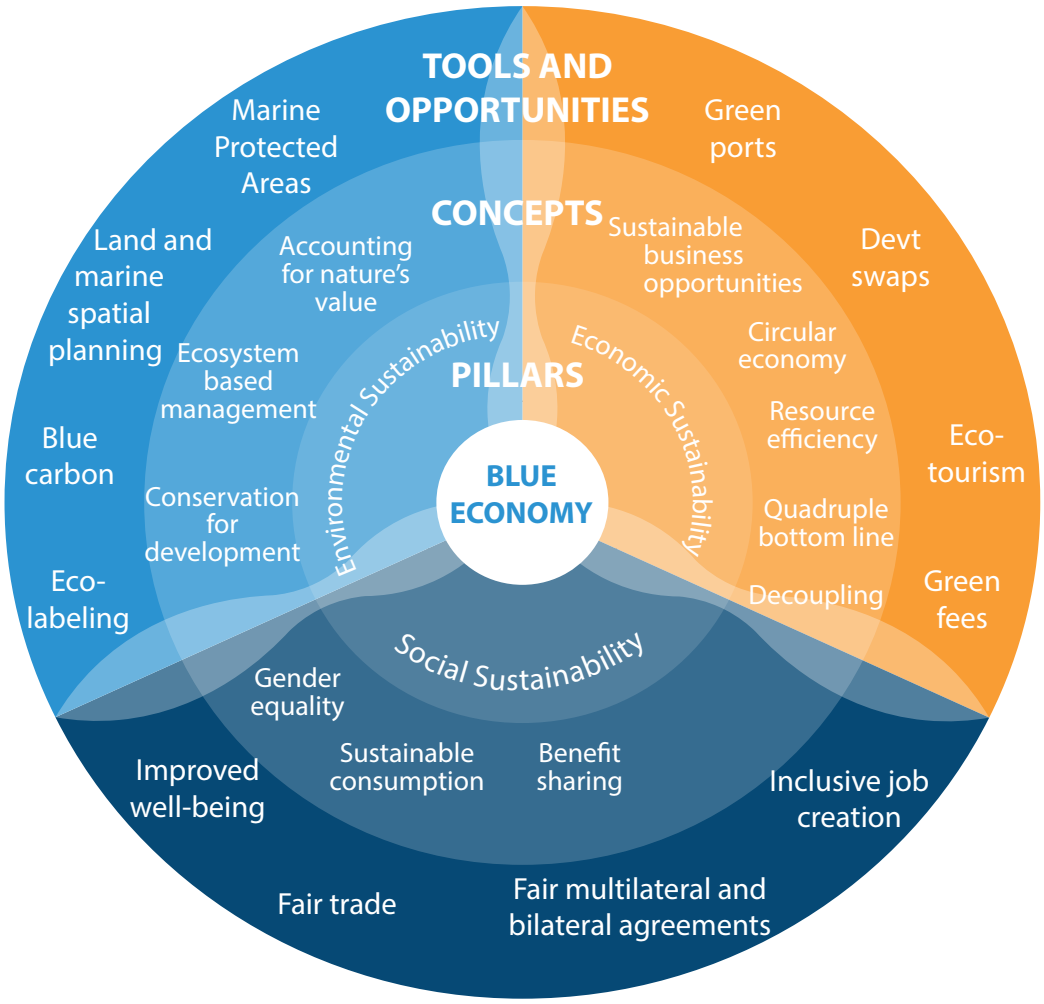


Figure 19: Tools, Concepts, and Pillars of the Blue Economy (adapted from UNECA, 2016).

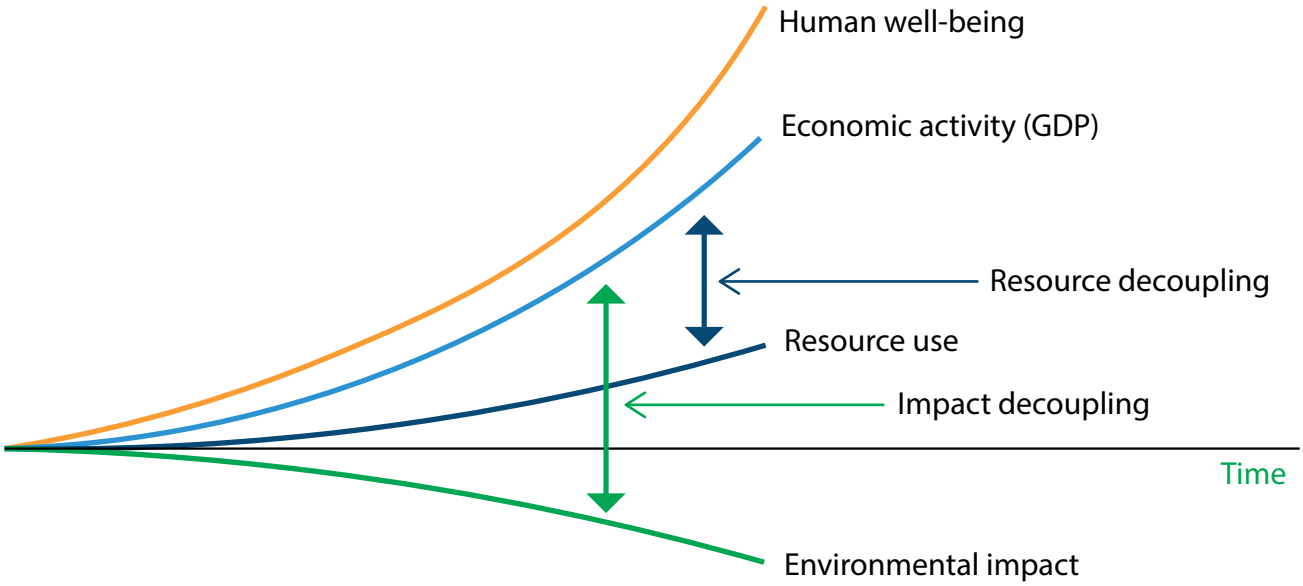


Figure 20: A Stylized Representation of Resource Decoupling and Impact Decoupling (Source: UNEP, 2011).

CHAPTER 3

METHODOLOGY

Methodology

This report was written based on both primary and secondary data. We used blue economy-related secondary data from published peer-reviewed journal articles, reports published by national and international organizations, and newspaper reports (where no published data are available). Relevant studies were reviewed after being identified through Google scholar, Web of Science, and Google searches using the keywords - "Blue economy", "Ocean economy", "Contribution of the blue economy", "Potential of the blue economy", Challenges of the blue economy", and "Institutionalization of the blue economy" in the global and Bangladesh context. Blue economy-related documents of different countries were also reviewed.

As part of this study, we also organized a Roundtable Consultative Policy Dialogue on "Blue Economy: Prospect of Institutionalization the National Progress" where government stakeholders and high profile experts of the country, development partners, academics, scientists, NGO workers, and relevant beneficiaries participated. Their valuable comments, suggestions, critics, and remarks were carefully considered while writing this report.

CHAPTER 4

OVERVIEW OF THE BLUE ECONOMY IN BANGLADESH

4.1 Background

The Bay of Bengal is the northeastern part of the Indian Ocean, bordered by Sri Lanka and India to the west, Bangladesh to the north, Myanmar (Burma), and the northern part of the Malay Peninsula to the east (Figure). It is occupying an area of about 839,000 square miles (2,173,000 km²). It lies roughly between latitudes 5° and 22° N and longitudes 80° and 90° E. The bay is about 1,000 miles (1,600 km) wide, with an average depth of more than 8,500 ft (2,600 m). The maximum depth is 15,400 ft (4,694 m). Several large rivers - the Mahanadi, Godavari, Krishna, and Kaveri (Cauvery) on the west and the Ganges (Padma) and the Brahmaputra on the north - flow into the Bay of Bengal. The Andaman and Nicobar groups, which are the only islands, separate the bay from the Andaman Sea.

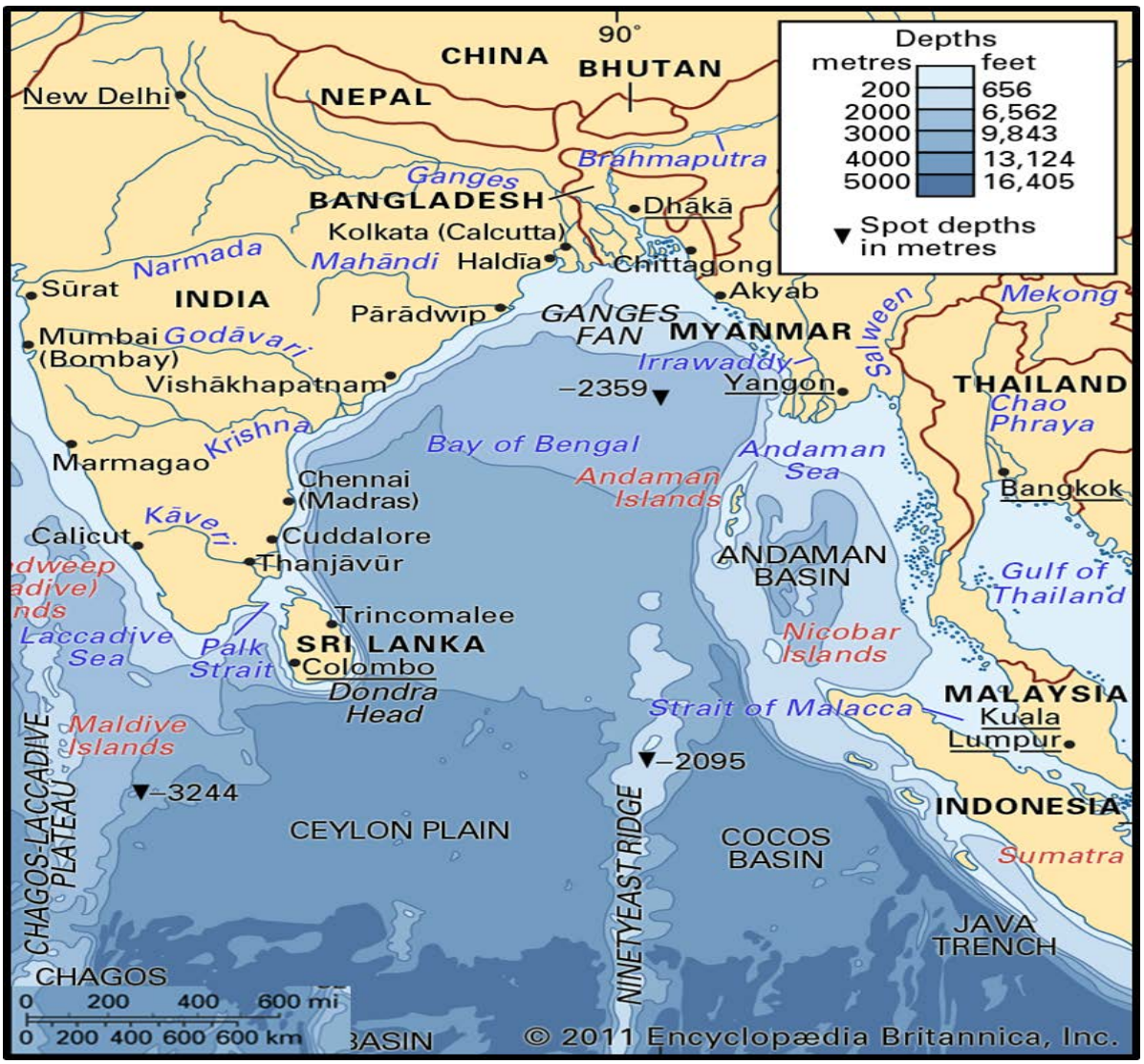


Figure 21: Map of the Bay of Bengal

The climate of the Bay of Bengal is dominated by monsoons. From November through April a continental high-pressure system north of the bay produces northeast winds (the northeast monsoon) characteristic of the winter season. During the northern summer (June - September) the rain-bearing southwest monsoon prevails, as intense heat produces a low-pressure system over the continent and a subsequent air flow from the ocean.

A unique feature of the bay is the extreme variability of its physical properties. The temperature in the offshore areas, however, is warm and markedly uniform in all seasons, decreasing somewhat toward the north. Surface densities are considerably greater in spring than in fall when river discharge is the highest. Surface salinity, normally measuring 33 to 34 parts per thousand (ppt), can fall to nearly half that level and can extend well south of the bay during the fall. Below the surface layer is an oxygen-poor intermediate layer that has high salinity and undergoes only weak circulation. Weak upwelling occurs in the northeast during the northeast monsoon. The sea presents alternately slick and ruffled surfaces over shallow internal waves all along the east-coast shelf. Surface movements of the waters change direction with the season, the northeast monsoon giving them a clockwise circulation, and the southeast monsoon a counter-clockwise circulation. Severe storms occur at the change of the monsoon, particularly to the south in October.

In addition to water-level changes resulting from waves and tides, the average sea level varies throughout the year. Because rainfall and riverine input exceed evaporation, the bay exhibits a net water gain annually. The bay is also subject to occasional tsunamis; one such event, caused by an undersea earthquake near the Indonesian Island of Sumatra in December 2004, devastated extensive coastal areas of the bay, particularly in Sri Lanka and the Andaman and Nicobar Islands.

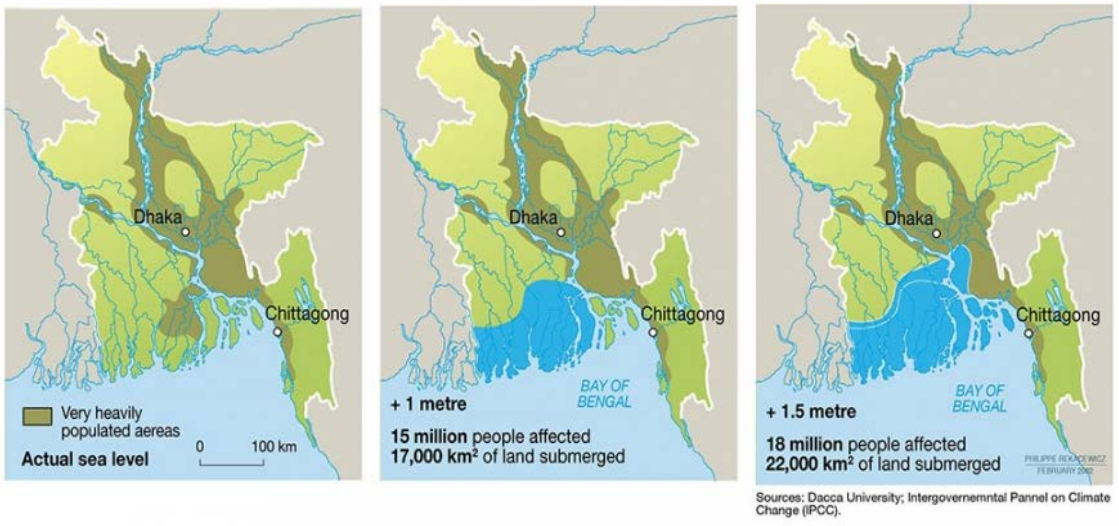


Figure 22: Sea Level Changes in Bangladesh

The Bay of Bengal is bordered to the north by a wide continental shelf that narrows to the south and by slopes of varying gradients on the northwest, north, and northeast, all cut by canyons from the rivers. Most important are the Ganges-Brahmaputra, Andhra, Mahadevan, Krishna, and Godavari canyons. These were former estuaries when the shoreline was at the margin of the continental shelf during the Pleistocene Epoch (about 2,600,000 to 11,700 years ago). The deep floor of the bay is occupied by a vast abyssal (deep-sea) plain that slopes to the south. The main submarine features include the beginning of the long, seismically active Java Trench near the Nicobar-Sumatra mainland and of the aseismic Ninety East Ridge. The fan of sediments of the Ganges River is the widest - 5 to 7 miles (8 to 11 km) - and thickest in the world. The bay itself was formed as the Indian subcontinent collided with Asia within roughly the past 50 million years.

The Bay of Bengal is centrally located in South and Southeast Asia. It lies at the center of three huge economic blocks, SAARC, IORA, and ASEAN. It influences China's southern landlocked region in the north and major sea ports of India and Bangladesh. Some countries like Bangladesh, India, Myanmar, Sri Lanka, and several other countries on the periphery of the Bay of Bengal, including Indonesia, Malaysia, Thailand, and the Maldives are greatly dependent on the Bay of Bengal for their maritime activities.

To understand the importance of the Bay of Bengal, the Father of the Nation, Bangabandhu Sheikh Mujibur Rahman, the great architect of Bangladesh's independence and the best Bengali of the millennium, formulated 'The Territorial Waters & Maritime Zones Act' in 1974 with his extreme foresight. This law was enforced eight years before the declaration of the 'United Nations Convention on the Law of the Sea (UNCLOS), in 1982'. Under the visionary leadership of Hon'ble Prime Minister Sheikh Hasina, Bangladesh established absolute and sovereign rights over the 1,18,813 km^2 area of the Bay of Bengal (Figure) after the reconciliation of maritime boundaries with Myanmar and India through the verdict of the International Tribunal for the Law of the Sea (ITLOS) on 8 July 2012 and Permanent Court of Arbitration (PCA) on 14 March 2014, respectively (MoFA, 2014).

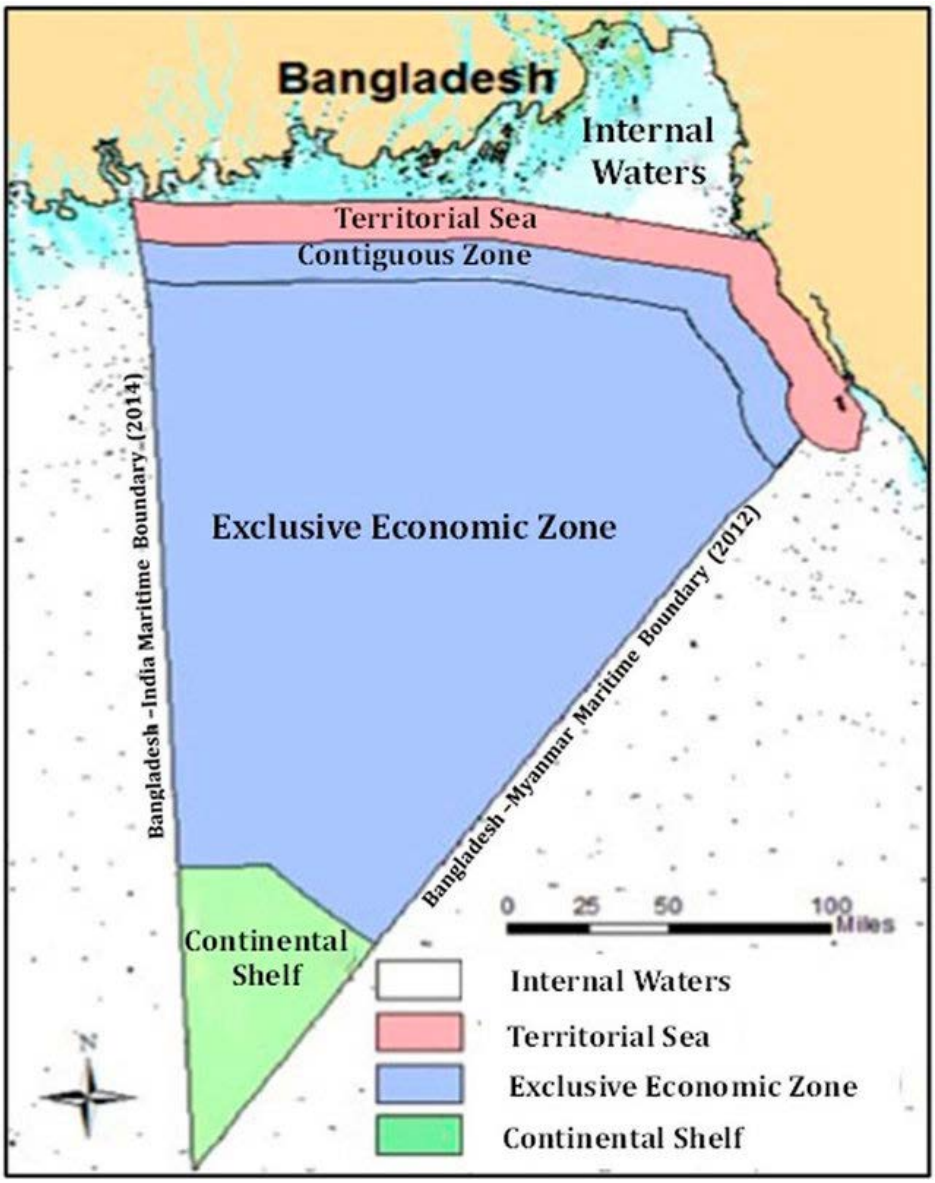


Figure 23: Maritime Area of Bangladesh (Source: MoFA, 2014)

The oceanic economy, popularly known as the 'blue economy, has emerged as a crucial development issue among the SDGs of the UN, where SDG - 14 focuses on the sustainable use of the oceans, seas, and marine resources for sustainable development. The Government of Bangladesh has conceptualized the blue economy as follows: "Blue economy comprises activities that directly or indirectly take place in the seas, oceans, and coasts using oceanic resources and eventually contributing to sustainable and inclusive economic growth, employment as well as well-being while preserving the health of the ocean. It includes activities such as exploration and development of marine resources, appropriate use of ocean and coastal space, use of ocean products, and provision of goods and services to support ocean activities and protection of ocean environment" (GED, 2015).

Since 2015 after the maritime area demarcation with Myanmar and India, the government of Bangladesh has undertaken several consultations and workshops on the Blue Economy. The Seventh-Five Year Plan (7FYP) (2016-2020) of Bangladesh has mentioned twelve actions for maintaining a prosperous and sustainable Blue Economy which include fisheries, renewable energy, human resources, transshipment, tourism, and climate change among others (GED, 2015). In addition, in 2017, the "Blue Economy Cell' under the Energy and Mineral Resources Division (EMRD) was established with the mandate to coordinate Blue Economy initiatives across sectoral ministries. The government adopted the Delta Plan – 2100 in 2018 in which the maritime economy has been given priority to achieve sustainable economic development by 2030 (GED, 2018). The Delta plan adopts five strategies to harness the potential of the blue economy, one of which is the speedy completion of a multidimensional survey of marine resources (GED, 2018). Meanwhile, Vision - 2041, a long-term Perspective Plan for a developed Bangladesh, has identified the blue economy as one of the essential drivers for development.

The huge amount of marine water is mostly untapped which has the prospect to contribute to the Bangladesh economy on a much higher level. The Ministry of Foreign Affairs (MoFA) has identified twenty-six (26) potential Blue Economy sectors which include the fishery, maritime trade, shipping, energy, tourism, coastal protection, maritime safety, and surveillance for the development of the blue economy in Bangladesh (Figure) (MoFA, 2019). To harness the full potential of the blue economy to achieve the SDGs, the Bangladesh government needs policy support and policy development ideas and suggestions from the relevant stakeholders of the country.

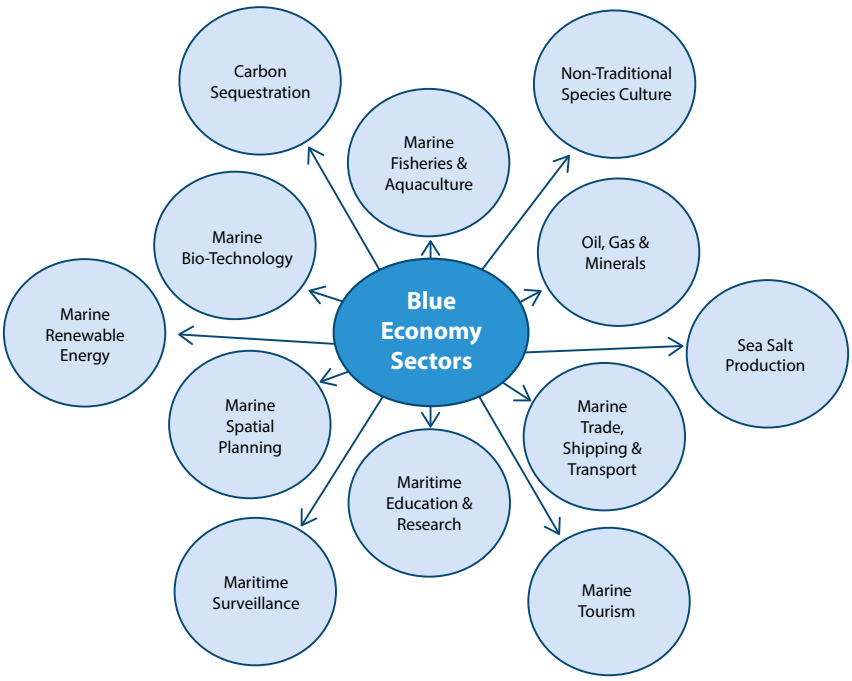


Figure 24: Major Sectors Related to the Blue Economy in Bangladesh (Adapted from Hussain et al., 2018).

4.2 Thematic areas of the blue economy in Bangladesh

Based on our review and the findings of the Roundtable Consultative Policy Dialogue, we identified nineteen specific blue economy-related topics that were grouped into eight thematic areas of the blue economy. The eight thematic areas including specific blue economy-related topics are given below:

Thematic area 1: Marine Fisheries and Aquaculture

1. Marine capture fisheries (except tuna)
2. Tuna fisheries
3. Mari culture (sea farming)
4. Seaweed culture
5. Marine pearl culture

Thematic area 2: Energy

6. Non-renewable energy (gas, coal, and oil)
7. Renewable energy (solar, wind, tide, OTEC)
8. Hydrocarbon
9. Gas (methyl) hydrate
10. Energy policy/energy mix

Thematic area 3: Marine biotechnology and therapeutics

11. Marine biotechnology and marine therapeutics

Thematic area 4: Coastal and Marine Tourism

12. Coastal and marine tourism

Thematic area 5: Ship and port management

13. Shipbuilding
14. Ship recycling
15. Ship transport
16. Port (deep sea port)

Thematic area 6: Ocean governance

17. Zoning (marine spatial planning, marine protected area)

Thematic area 7: Finance

18. Blended finance (blue bond, green bond)

Thematic area 8: Satellite oceanography

19. Satellite oceanography & ICT

We have briefly described those thematic areas below:

4.2.1 Thematic area 1: Marine Fisheries and Aquaculture

In this report, marine fisheries and aquaculture include marine capture fisheries, tuna fisheries, Mari culture, seaweed farming, and marine pearl culture.

4.2.1.1 Marine capture fisheries (except tuna)

The marine fisheries sector particularly marine capture fisheries contributed 15.05% of the country's total fish production and it plays an important role in the national economy, food security, and employment opportunities. Despite having vast marine waters, the percentage of the contribution of the marine capture fisheries is not very significant comparing the aquaculture production in the country. There are disproportionate fishing pressure in the 50 m depth zone and offshore areas of the Bay of Bengal. Small-scale fishers are mainly employed in the coastal waters which largely contributed to the total marine capture fisheries. However, at present, the contribution of offshore capture fisheries is very low in Bangladesh. Some heavily exploited commercial species are on the threatened list. Bangladesh must explore methods to maintain progress in these industries while guaranteeing sustainable stock management as demand for seafood rises nationally and globally. Marine fishing activities are critical for attaining the blue economy's full potential since it has enormous potential to contribute to the national economy. Efforts might be made to entice Bangladeshi fishing enterprises to pursue deep-sea fishing.

Figure 25: Tuna Fish Catching

4.2.1.2 Tuna fisheries

Tuna and tuna-like other highly migratory species have become high pace in the priority list of the government of Bangladesh for a couple of years, especially after the demarcation of the sea boundary with India and Myanmar that lead to opening up the access of Bangladeshi fishers to the Area Beyond National Jurisdiction (ABNJ) of high seas. But, it is not possible yet to take this opportunity by harnessing tuna and tuna-like highly migratory fishes from expanded high seas. Simultaneously, the study of tuna and tuna-like fishes in Bangladesh marine waters is one of the most poorly studied areas of the world although it possesses high potential.

Figure 26 : Tuna Fishing

4.2.1.3 Mari-culture

High-value-for-money fish and shrimp aquaculture have become a highly traded, export-oriented business in recent years. This business will provide a big amount of food and will also help poor nations like Bangladesh prosper economically. The demand for fish is growing these days, and the supply is keeping up. However, most of this contribution is based on solely freshwater aquaculture. In Bangladesh mariculture is still in its initiation stage which should be developed sustainably. Mariculture is growing and will continue to grow in importance as a supply of aquatic food in both coastal and deeper seas, as well as a source of employment and income for many coastal communities. Mariculture that is well-planned and maintained can also help to protect the ecology along the shore. Its future growth will have to take place on the Bay's coastal waters, with rising population strain on coastal resources and increased competition for resources.

Figure 27 : Mariculture Programme

As a result, a great deal of focus will be required to enhance Mariculture's environmental management through ecologically sound technology and improved management, backed up by effective policy and planning initiatives and regulations. The experience in coastal resource management shows that it is critical to enlist the help of local government units and other "on-the-ground" institutions, such as NGOs and people's organizations, to effectively implement any social or technological interventions that benefit community members. However, before these institutions can work together effectively, they must first improve their capacities, as well as the capacities of the beneficiaries, for the critical roles they play in the execution of livelihood initiatives and environmental management programs. Mari culture's future development prospects look to be favorable. When compared to alternative protein production methods, well-managed coastal mariculture provides great prospects for green growth and employment for coastal communities while emitting minimal amounts of CO_2.

4.2.1.4 Seaweed Culture

Seaweeds may provide nutritional food to ensure food security for the poor coastal people. It can be exported to other countries after meeting the national demands to get foreign revenues. Along with harvesting marine seafood, cultivating seaweed can provide an alternate source of income for the coastal people. It may be a lucrative business, especially for women. It is possible to build a massive industry with endless potential. If industrial entrepreneurs from similar disciplines join forces with the government, they may be able to open the door to a new world in the blue economy, enriching our national economy. Increasing the production of non-traditional marine resources requires the employment of contemporary technologies. Almost three crore people reside in 19 coastal districts, with the majority of them reliant on the sea for survival. Promoting seaweed growing skills among coastal residents has the potential to transform their way of life. Seaweeds have the potential to become a stand-alone export business in Bangladesh. More detailed research on the current state of naturally accessible seaweeds and their current condition of usage should be done, as well as the establishment of a long-term plan for the utilization of these resources. Through study, technology for the production of various economically relevant seed stocks, as well as their enhancements, should be produced.

Figure 28 : Seaweed Aquaculture

4.2.1.5 Marine Pearl Culture

Pearl farming is a very profitable kind of aquaculture. Due to the mild weather and a twelve-month growing time for both pearly mussels and pearls, it is clear that the future of pearl farming in Bangladesh is bright and promising. Freshwater mussels can be cultivated in a fish pond or other appropriate water body for pearl production. As a water cleaner, mussels filter the water, making mussel cultivation environmentally benign. As a result, with little input and high output, it is simple to expand in rural areas. Women are capable of doing pearl culturing operations. However, marine pearl culture in coastal areas of Bangladesh is still not started though we have a bright and promising prospect of marine pearl culture around the coastal regions. Freshwater pearl culture may be extended/replicated to coastal waters. As a result, marine pearl culture will create more job options for coastal women or poor people, who will play an essential part in Bangladesh's social and economic growth. As a result, marine pearl production will have enormously substantial economic, social, and environmental consequences. Shortly, marine pearl farming will become a major component of economic growth for Bangladesh.

Figure 29: Marine Pearl Culture

4.2.2 Thematic Area 2: Energy

4.2.2.1 Non-renewable Energy (gas, coal, and oil)

Non-renewable energy such as natural gas, coal, and oil will eventually run out. In 2009, offshore oil fields accounted for 32% of worldwide crude oil production and this is projected to rise to 34% in 2025 and higher subsequently. However, Bangladesh is yet to assess the true potential of its offshore oil and gas prospects. In Bangladesh, about 62% of its energy demand is met from non-renewable natural sources like natural gas. Still, now 26 gas fields, 24 onshore and 2 offshore have been discovered in the country. Until 2014, 19 exploratory wells were drilled in the Bay of Bengal, resulting in only two gas discoveries, i.e. the Sangu and the Kutubdia, with small reserves. The Sangu reserves of 0.8 trillion cubic feet (Tcf) have already been depleted, whereas the Kutubdia reserves of 0.04 Tcf are yet to be developed. A logical plan is necessary to carry out an extensive survey in the Bay of Bengal to identify potential oil in gas fields.

Figure 30: Non-Renewable Energy

4.2.2.2 Renewable Energy (solar, wind, hydro, geothermal, tidal, wave, OTEC)

Ocean energies are referred to as marine renewable energy because of their constant renewability and inexhaustibility. The kinetic, potential, chemical and thermal characteristics of saltwater are used in marine renewable energy sources. Examples of renewable energies include solar, wind, ocean waves, tidal currents, ocean currents, ocean temperature, and salinity gradients. These renewable resources may be converted into a usable form, usually electricity, via a variety of energy conversion methods. In the context of regional and global political economy, maximizing the use of inexhaustible indigenous sources is critical to guaranteeing energy security. As a result, marine renewable energy should be one of the key components, not only for fueling Bangladesh's blue economy but also for the country's transition to clean energy sources. A study to identify maritime renewable resources might pave the path for a new renewable energy frontier to develop.

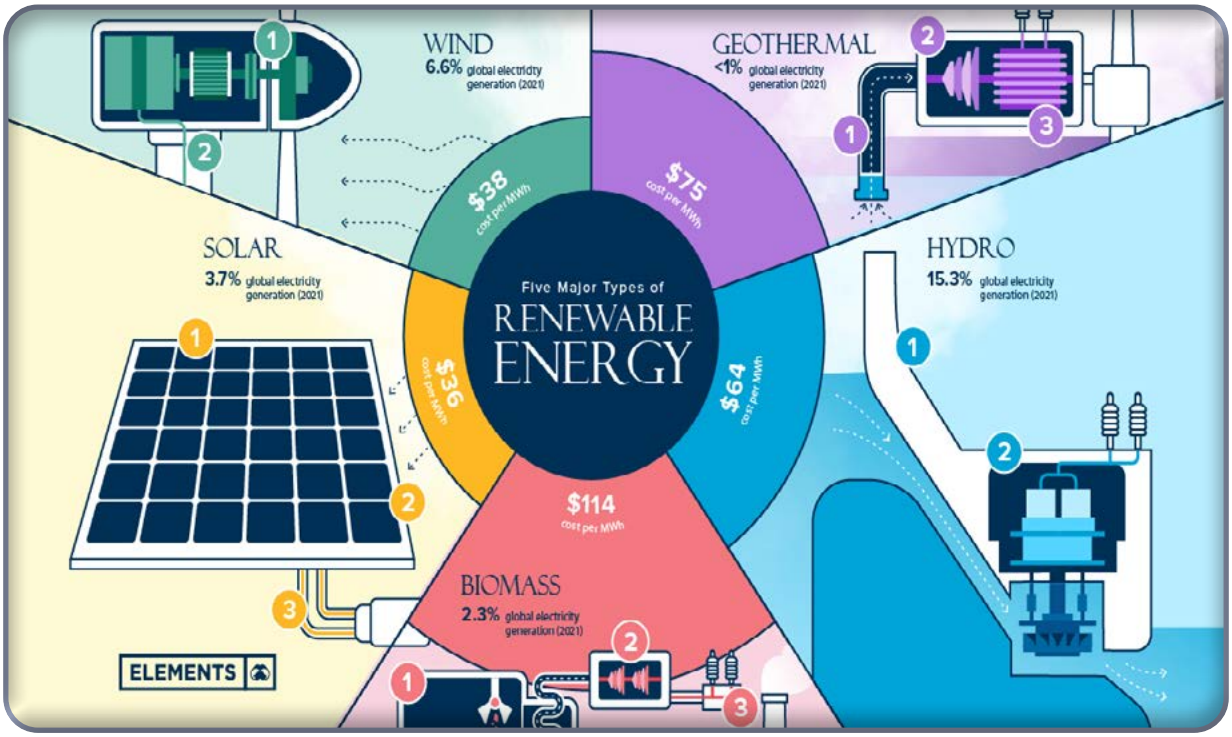


Figure 31: Renewable Energy

4.2.2.3 Hydrocarbon (gas exploration)

Oceans are the biggest reservoir of hydrocarbons like oil and gas. Currently the conventional oil reserves – i.e. those which can be recovered easily and affordably using today's technology – are estimated to be 157 billion tons. Of this amount, 26% (41 billion tons) are to be found in offshore areas. Worldwide about 210 million gallons of petroleum enter the sea each year from the extraction, transformation, and consumption of crude oil and the products refined from it, with an additional 180 million gallons coming from natural seepage. Bangladesh is the nineteenth-largest natural gas-producing county in Asia. Despite having a huge amount of maritime waters, sadly, offshore drilling in Bangladesh is practically almost non-existent and the exploration data is not sufficient to analyze the country's oil and gas reserve in the Bay of Bengal. However, from the deltaic nature, depositional history, and sediment criterion, it seems that deep offshore and adjacent areas might be rich in oil and gas. State-run Oil and Natural Gas Corp' has made a huge exploration in the Bay of Bengal with initial estimates suggesting reserves of about 21 Tcf. So there is a big reservoir of hydrocarbon in our Bay of Bengal region.

Figure 32 : Hydrocarbon (Gas Exploration)

4.2.2.4 Gas (methyl) hydrate

Natural gas hydrate (NGH) is an ice-like solid crystalline compound with a clathrate structure, which is only stable under specific conditions of low temperature and high pressure. One of the most important reasons why NGH has the potential as an alternative energy resource is that it exhibits high energy density. Because of the increasing population and fast-growing economy, the global energy demand is still projected to grow continuously, even after the strike of COVID-19 (IEA, 2020). Sustainable Development Scenario (SDS), drawn by the IEA, sets out the Net Zero Emission by 2050 (NZE2050) pathway, which requires the net emissions of CO_2 by human activities, and must approach zero by then to stabilize the global mean temperature (Davis et al., 2018). To achieve the goal of NZE2050, and to enrich the world's Blue Economy with ocean resources, it is urged to increase the contribution of cleaner energy. Natural gas hydrate is the cleanest fossil fuel and has the potential as the best burning fuel to replace coal and oil. On January 2022, Bangladesh found the presence of 17-103 Tcf of ice-like hydrate (gas hydrate) deposits containing huge amounts of methane (Sajid and Siddiqui, 2022). This has been interpreted as a 'blessing' and a 'ray of hope' for the country with the expectations that Bangladesh has all the opportunities to tap into the 'potential gold mine' and achieve the goal of a 'Blue Economy' through the gas (methyl) hydrate energy.

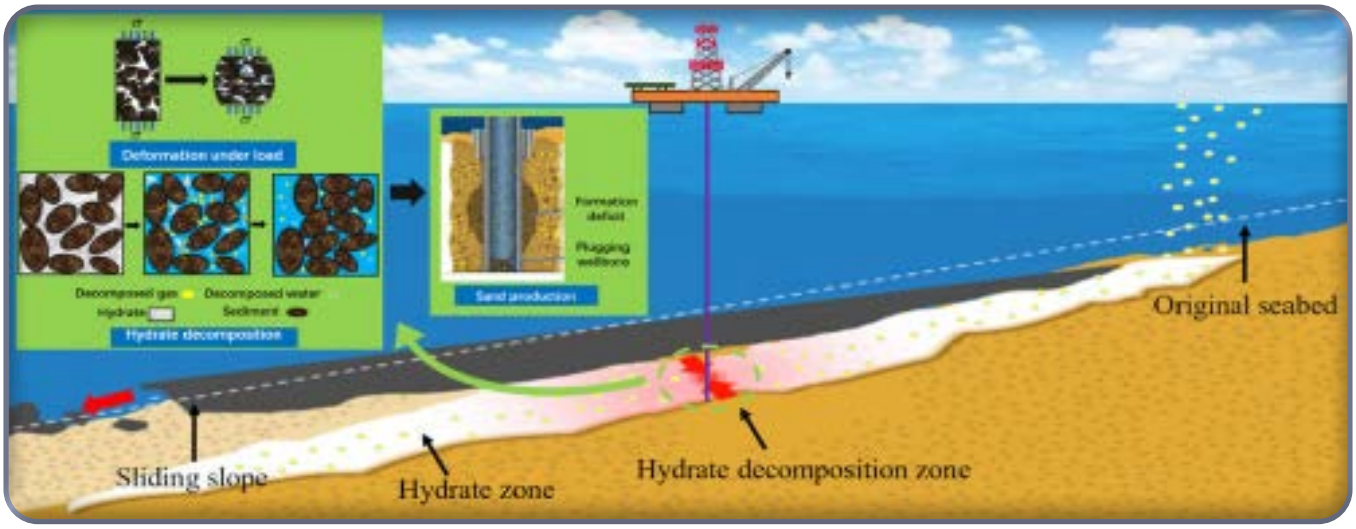


Figure 33 : Gas (Methyl) Hydrate

4.2.2.5 Energy Policy/energy Mix

Energy policies are the actions that governments take to meet the demand for increasing energy as well as the supply of it. These actions include how governments cope with energy supply disruptions and their efforts to influence energy consumption and economic growth. Again, energy policy is the scheme in which the government (or any organization) addresses issues related to energy growth and usage including energy production, distribution, and consumption (Islam and Hasanuzzaman, 2020). Energy policy comprises rules concerning energy sources, energy efficiency, energy prices, energy from abroad, energy infrastructure, and climate and environmental aspects of energy production, utilization, and transit. The main theme in energy policy concerns the trade-offs between affordable, secure, and clean energy (Tosun, 2017). In Bangladesh, the government has given continuing attention to the overall development of the energy sector in recognition of the importance of energy for socio-economic development. The first National Energy Policy (NEP) of Bangladesh was formulated in 1996 by the Ministry of Power, Energy, and Mineral Resources to ensure proper exploration, production, distribution, and rational use of energy resources to meet the growing energy demands of different zones, consuming sectors and consumers groups on a sustainable basis With the rapid change of global as well as domestic situation, the policy was updated in 2004 (MPEMR, 2004). The updated policy included additional objectives namely to ensure environmentally sound sustainable energy development programs causing minimum damage to the environment, to encourage public and private sector participation in the development and management of the energy sector, and to bring the entire country under electrification by the year 2020.

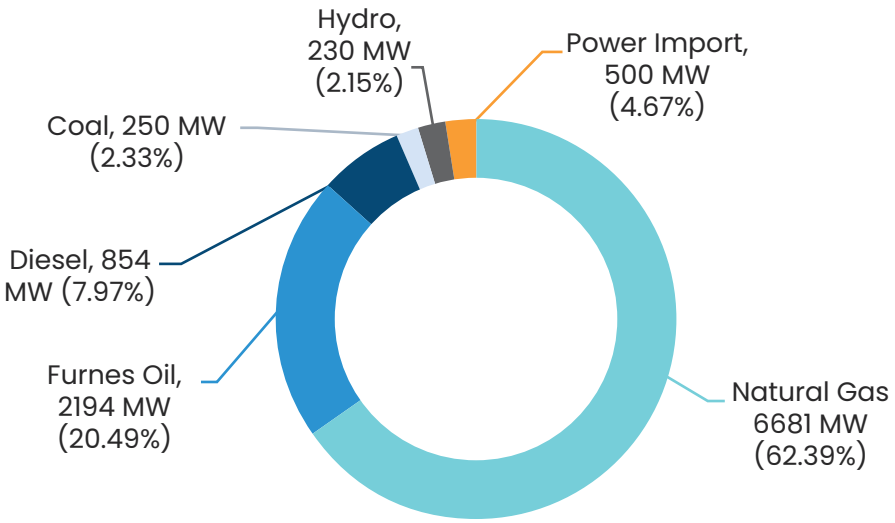


Figure 34 : Bangladesh Energy Situation

4.2.3 Thematic area 3: Marine Biotechnology and Therapeutics

In Bangladesh, the notion of marine biotechnology is relatively new. However, the scarcity of terrestrial resources prompted scientists to consider the vast potential of marine biotechnology or blue biotechnology. The great diversity of marine biota, as well as their physiological adaptations to the harsh maritime environment, has opened up new intriguing possibilities for the development of life-saving medications, drugs, anticancer derivatives, novel industrial goods and processes, and environmental monitoring systems. The need of building multidisciplinary research institutes concentrating on blue biotechnology has already been acknowledged by developed countries in Asia, Europe, and America. Bangladesh should follow suit in exploring the blue biotechnological potential of undiscovered marine biodiversity.

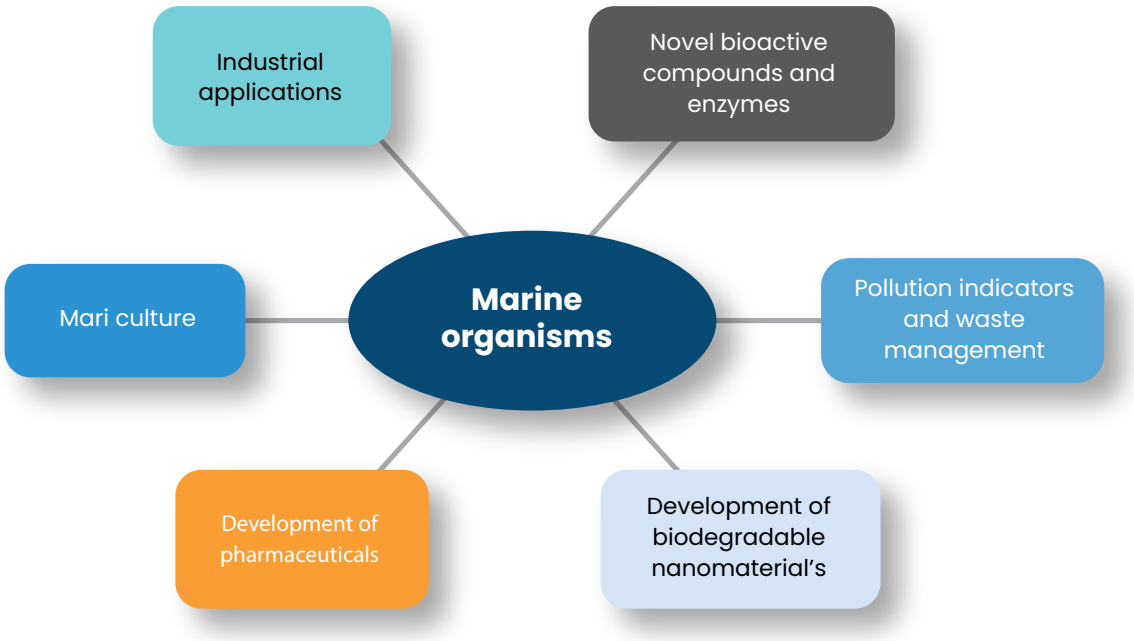


Figure 35 : Marine Resources and Animals in Modern Biotechnology

4.2.4 Thematic Area 4: Coastal and Marine Tourism

Bangladesh's tourism resources are vast, and the country's simple and kind people, as well as indigenous populations that live separated from modern civilization, have their own distinct culture and way of life, making Bangladesh a unique tourist destination. Bangladeshis are always eager to extend their friendliness to guests, who should find the country to be a pleasant experience. Tourism is significant from a variety of perspectives, including economic, social, cultural, and political. Tourism, it appears, can only help poor nations advance economically, socially, and environmentally. Bangladesh has several small islands in the southern part of the Bay of Bengal which can be important tourist places. However, tourist facilities are not developed on these islands as well as transportation systems or cruise ships are almost absent to travel these islands. In reality, the Bangladesh government must pay close attention to its strategic planning for tourist business growth as well as strategic marketing to maximize the destination's current resources and amenities.

Figure 36: Cox's Bazar Sea Beach

4.2.5 Thematic Area 5: Ship and Port Management

Figure 37 :Ship and Port Management

4.2.5.1 Shipbuilding

Shipbuilding in Bangladesh dates back to the Middle Ages, and it grew steadily throughout the British colonial period. Bangladesh already had a modest shipbuilding sector and competent labor available

around the turn of the millennium. Shipbuilding is largely a capital-intensive business, with labor playing a significant role due to the industry's reliance on trained and semi-skilled workers. Because of their cost cum price competitiveness, China, the Republic of Korea, and Japan are presently the primary global participants. Bangladeshi businesses have been encouraged to enter the shipbuilding sector by low-cost labor resources, streamlined raw material import facilities, and duty-free market access to potential customers. As worldwide demand for small and medium-sized ships rises after a period of stagnation, now is the high time for Bangladeshi businesses to prepare for an increase in global and local demand.

Figure 38: Shipbuilding

4.2.5.2 Ship Recycling

Ship recycling is defined as the whole or partial disassembly of a ship to collect components such as scrap iron, steel, and other materials for reuse and recycling. Scrap iron and steel are critical components of a country's economy. Because of the structural complexity of ships and other environmental and safety concerns, ship breaking is a difficult responsibility. Ship-breaking businesses are primarily located around Bangladesh's coasts, and it has recently emerged as a promising sector. The advantages of ship recycling are tremendous in industries such as steel and shipbuilding. Despite its many advantages, the ship breaking industry has certain drawbacks, such as pollution and risk to workers' physical safety. Following international laws for disposing of remaining ship debris can help to keep pollution to a minimum. Workers' safety and health can be maintained by adhering to a set of tight guidelines. To reduce the number of casualties, safety equipment such as goggles, helmets, hand gloves, face masks, and aprons should be given. To maintain its position as a world leader in ship breaking, Bangladesh must improve its waste management infrastructure and address worker health concerns. This industry offers very much opportunities to Bangladesh and it also should be nurtured properly.

Figure 39 : Ship Recycling

4.2.5.3 Ship Transport

Shipping is one of the most important aspects that has a significant influence on the global economy. Around 30 million Bangladeshis are directly dependent on the marine sector, which includes commercial shipping and other shipping-related services. Furthermore, sea shipping is critical for Bangladesh's socioeconomic prospects. Maritime shipping allows for the transportation of a wide range of items in big quantities at a lower cost than other modes of transportation. Marine transportation is incredibly cost-effective, time savings, and it generates a large number of employment opportunities. The shipping sector is crucial for the sustainable development of the three pillars of sustainability - social, economic, and environmental. It enables the global economy and generates revenues, all of which have a significant impact on human well-being. Coastal shipping, also known as feeder service, refers to the use of medium-sized ships to convey national and international freight at regular intervals and to and from nearby nations. Containers are distributed from the main hub ports to lesser ports or landlocked nations via the feeder services. Shipping might help the Bangladesh government to earn huge revenues that will be contributed to the national GDP and protect the social security of the dependent people.

Figure 40: Transportation

4.2.5.4 Port (deep sea port)

Ports are critical to a country's economic prosperity to cope with the globalization of the contemporary world. The development of ports is essential for long-term growth. Bangladesh is heavily reliant on foreign commerce where ports are playing a key role. Bangladesh should concentrate on utilizing current capacity as well as the development of deep-sea ports with more technologically advanced facilities and handling equipment. Bangladesh has three ports such as Chattogram, Mongla, and Payra. Many initiatives are now underway in Sonadia and Matarbari. The Bay terminal is also under construction. Focusing on ports is critical for adapting to modern industry and globalization to harness the potential of the blue economy.

4.2.6 Thematic Area 6: Ocean Governance

Being a coastal state, 18.2% of the people of Bangladesh is directly depended upon the bay for their survival. Despite being located in disaster-prone areas, the bay has been a home for fishing, transportation, and trade for the dependent people. The bay also offers a huge number of job opportunities, sources of renewable energy, bio-gas, oil, minerals, coastal aquaculture and mariculture, and so on. The Bay of Bengal is one of the most complex areas where different types of activities are taking place including fishing, tourism, mining, shipping, etc. that might create conflicts among the resource users. To sustain this flow of bounty and to add more to it, Bangladesh has been a keen participant in various international organizations and treaties. The aim is to obtain technical and practical assistance and advice from experts. In light of those international laws and rules, and depending upon the necessity arising from time to time, along with her marshaling forces, the country has also instituted a few laws of her own. However, this process could not ensure the sustainable use of ocean resources.

Figure 41 : Ocean Governance in Bangladesh: Necessities to Implement Structure, Policy Guidelines, and Actions for Ocean and Coastal Management

The country faces a few hurdles on the way to exploiting its marine resources. Lack of horizontal collaboration, monitoring, assessment, funding, ages-old laws and policies with a lack of modern technologies and research facilities are a few of those difficulties. There is a need for an Ocean Governance framework, spatial planning, and an ocean leader. However, the absence of willful participation of stakeholders and the general mass is one of the main bottlenecks. The government

of Bangladesh needs to divide the coastal and marine waters into different zones for sustainable management. Marine spatial planning (MSP) and marine protected area (MPA) for the East, Central, and West coast of Bangladesh is needed as soon as possible since the conflicts are rising day after day. Nevertheless, to overcome these challenges of different activities in the maritime areas, Bangladesh needs to adopt a suitable ocean governance framework commensurate with the existing situation.

4.2.7 Thematic Area 7: Finance

Blended finance is defined as "the strategic use of development finance for the mobilization of additional finance towards sustainable development in developing countries" (OECD, 2018). It offers countries like Bangladesh a vital opportunity to mobilize additional financial resources to address the complex development challenges set out in the 2030 Agenda for Sustainable Development. The country needs to blend the blue and green bond to achieve the SDGs.

Figure 42 : The Role of Ocean Finance in Transitioning to a Blue Economy in Asia and the Pacific

However, the concept of blended finance is new to Bangladesh and there are scant studies on it to leverage development funds effectively in coastal and marine areas.

4.2.8 Thematic Area 8: Satellite Oceanography and ICT

Bangladesh has already launched its first geostationary communication satellite named 'Bangabandhu-1'. Using indications such as tiny photosynthetic algae, subsurface temperature, salinity, weather, ocean currents, and bathymetry, satellite-based remote sensing data, it might be possible to identify suitable fishing grounds in the Bay of Bengal. Satellite sensors can analyze and quantify some of the important oceanographic parameters, such as sea surface temperature, ocean color, and oceanic

fronts, which have a significant impact on natural oscillations in fish supplies. Remotely sensed data might be delivered in near real-time to help fishermen save fuel and time on their fishing trips, as well as modelers who create fisheries predictions. Once the potential fishing grounds or schools are identified using remote sensing, an SMS may be sent to fishing boat owners and agents, and this information can be delivered to fishers at a low cost. Satellite-based remote sensing techniques can also be used to investigate maritime safety and security. Resettlement, restoration, protection, and management of ecosystems and their services in newly developed regions in the northern Bay of Bengal will require long-term planning techniques where satellite-based mapping and monitoring can be applied.

CHAPTER 5

THE BLUE ECONOMY IN THE WORLD

Figure 43 : Satellite Oceanography and ICT

5.1 Overview and the Prospect of the Blue Economy in the World

Since the 21st century, the concept of the "Blue Economy" has become increasingly popular in the world. International society believes that the blue economy covers three economic forms: the economy coping with the global water crisis (McGlade et al., 2012); the innovative development economy (Pauli, 2009), and the development of the marine economy (Behnam, 2012). The UN Sustainable Development Goals in SDG 14 sets a target that by 2030 the economic benefits will be increased to SIDS and LDCs from the sustainable use of marine resources, including sustainable management of fisheries, aquaculture, and tourism (Spalding, 2016).

5.2 The Blue Economy of Asia and the Pacific

Several studies have identified the importance of the blue economy in improving the livelihoods of Asia and Pacific countries. For example, Hasan et al. (2018) and Sarker et al. (2018) explained the job creation potential of blue economy activities in the context of Bangladesh while Pranathi and Gonchkar (2019) addressed this in the context of India. From the conceptualization and measurement of the blue economy, a few studies have emphasized the importance of the blue economy in creating jobs. For example, Pauli (2010) described the potential of the blue economy for innovation and predicted that the blue economy has the potential to create 100 million jobs by 2030.

Asia and Pacific countries assume a central place in the world economy today. The share of the Asia

and Pacific region in the total world GDP increased from 28.4% in 1995 to 33.3% in 2016 (World Bank, World Development Indicators, 2018). According to the Asian Economic Integration Report, the region's growth in trade increased by 1.7% in 2016 from 1.4% in 2015, while world trade decelerated (ADB, 2017). Despite an impressive overall growth performance in this region, many island countries belonging to the Asia and Pacific region have been declared LDCs and in most cases, the real GDP growth rate in these island countries is lower than in other countries in this region (International Monetary Fund, 2018).

In 2011, the Shandong Peninsula Blue Economic Zone Development Plan was officially approved by the Chinese State Council. It is China's first regional development strategy to focus on the marine economy (National Development and Reform Commission, 2011). The strategic positioning of the Shandong Peninsula Blue Economic Zone is to develop into a modern marine industrial cluster with relatively strong international competitiveness, a world-leading education center of marine science, a pilot zone for national marine economic reform, and opening up and a national key demonstration zone of marine ecological civilization. By 2015, the Shandong Peninsula Blue Economic Zone established a basic system of the modern marine industry, significantly strengthened comprehensive economic strength, significantly improved the independent innovation capability of marine science and technology, prominently improved the quality of the ocean and land ecological environment, constantly improved the landscape of the opening up of the marine economy, and led other areas to achieve the general requirements of building a moderately prosperous society in all aspects. By 2020, Shandong Peninsula Blue Economic Zone was supposed to develop into a blue economic zone that featured a developed marine economy, optimized industrial structure, harmonious co-existence between humans and nature, and took the lead to fundamentally achieve modernization.

Australia launched the Blue Well-being Initiative, recognizing that ocean-based industrial development and growth, or blue GDP is of great potential for Australia's economic and social development (CSIRO, 2008). EU came up with the concept of "blue growth" in 2012 (Committee of the regions, 2013). Therefore, many countries use the "Blue Economy" as a policy tool or means to drive economic growth and create jobs. Focused on revitalizing the economy, marine industrial activities include construction, transportation, mineral resources development, shipbuilding, communication cable laying, pharmaceutical enterprises, equipment deployment, sustainable energy from waves, and currents, seaside leisure tourism, and fisheries and aquaculture. In addition to traditional marine development activities, marine-oriented information and science sectors are playing an increasingly stronger role in boosting blue economy development.

5.3 EU Blue Economy

European Union (2012) proposed the "Blue Growth" strategy, specifying that Blue Growth will be the core of marine policies and stating key development areas and specific measures for the future. Blue Growth Strategy has launched initiatives in many policy areas related to Europe's oceans, seas, and coasts, facilitating the cooperation between maritime business and public authorities across borders and sectors, and stakeholders to ensure the sustainability of the marine environment. In 2014, the Blue Economy Innovation Plan was launched, specifying that the plan would be executed from three aspects: (i) develop sectors that have a high potential for sustainable jobs and growth, (ii) essential components to provide knowledge, legal certainty, and security in the blue economy and (iii) sea basin strategies to ensure tailor-made measures and to foster cooperation between countries. In 2017, the EU issued the Report on the Blue Growth Strategy Toward More Sustainable Growth and Jobs in the Blue Economy, the report examines what has been learned and what has been achieved since 2012, what is ongoing, and what is still missing. Five aspects are described in the report:

(i) Pushing for growth in five focus areas, including blue energy, aquaculture, coastal and maritime tourism, blue biotechnology, sea bed mineral resources,

(ii) The benefits of marine data, spatial planning, and maritime surveillance to facilitate growth in the blue economy,

(iii) Promoting a partnership approach,

(iv) Boosting investment, and

(v) Making a blue growth strategy fit for a future challenge.

According to the 2019 blue economy report from the European Commission, established blue economic sectors include marine living resources (i.e., fisheries, aquaculture, and fish processing and distribution), coastal tourism, maritime transport, port activities, shipbuilding and repair, marine extraction of oil, gas, and minerals (excluding seabed mining). In 2017 the established sectors directly employed over 4 million people (up by 7.2% compared to 2009) and accounted for a gross value added (GVA) of €180 billion (up by 8% compared to 2009). As regards the contribution to the overall EU economy, these figures (Figure and Figure) represented respectively 1.8 % of total EU employment and 1.3 % of EU GDP.

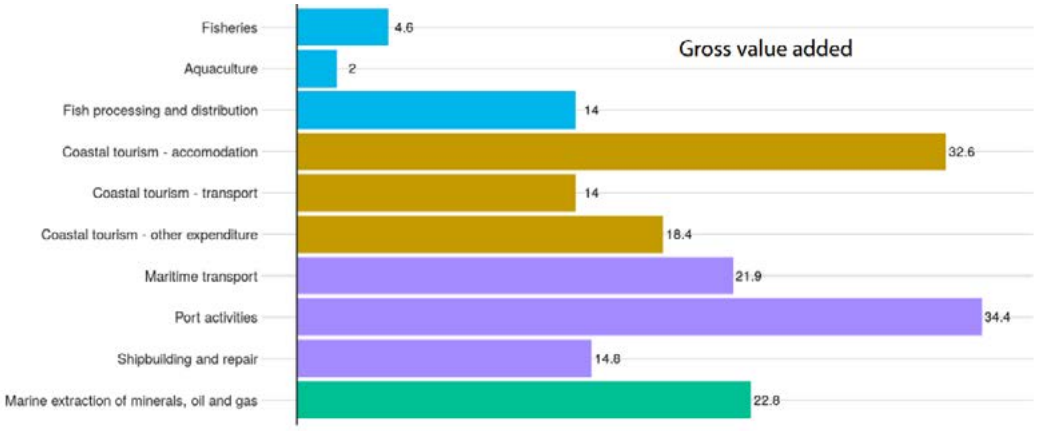


Figure 44: Gross Value Added (in Billion euros, Established Sectors Only) and the Number of People Employed (Thousands) by the EU Blue Economy Sector (2017 Data)

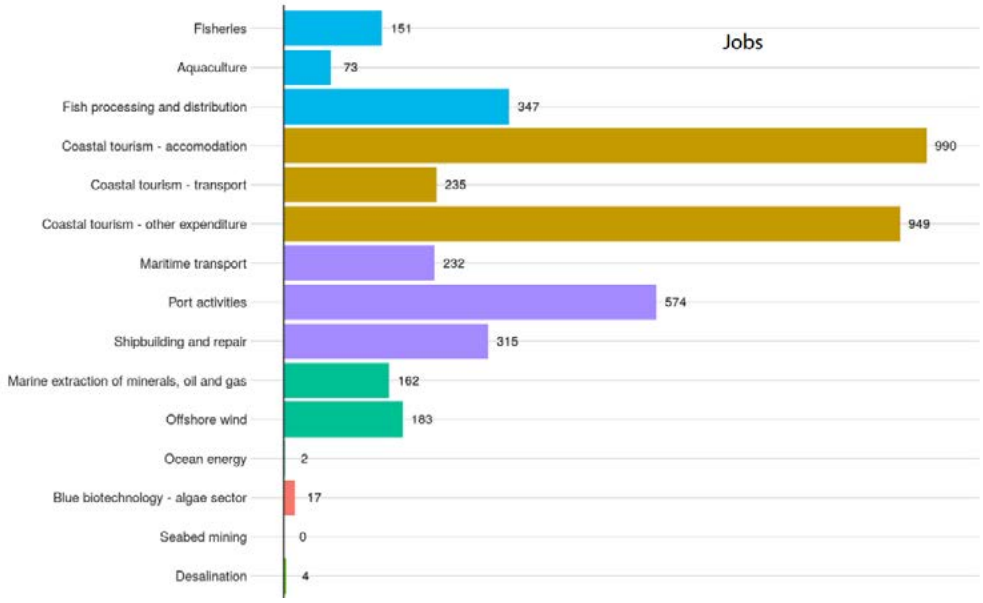


Figure 45: The Distribution of Employment by Sector (Including Emerging and Innovative Sectors) (Source: EC, 2019)

5.4 The Blue Economy of Africa

Africa's "Blue word" is made of vast lakes and rivers and an extensive ocean resource base. Thirty-eight of the fifty-four African States are coastal States. More than 90% of Africa's imports and exports are conducted by sea and some of the most strategic gateways for international trade are in Africa, underscoring the geopolitical importance of the region. Maritime zones under Africa's jurisdiction total about 13 million km^2 including territorial seas and approximately 6.5 million km^2 of the continental shelf. Currently, there are policies and strategies regarding the Blue Economy sectors, such as fisheries, transportation, energy, mining, and tourism. They are developed with limited consideration of the inherent interconnections across sectors that share a common space. For example, in the case of energy development, opportunities emanating from ocean and sea energy are largely not considered, planned for, or reflected in current policies related to sectors such as tourism and transport. Frequently, the most progressive energy policies in Africa reflect the possibilities of integrating nuclear energy for developing future energy, yet the great potential of the oceans and seas is largely not examined or considered in planning. A multi-sectoral and land-sea holistic approach would help enable the realization of a myriad of opportunities (AfDB/OECD/UNDP, 2015).

The African Union (AU) plays a crucial role in developing and implementing the Blue Economy policy and strategy in the African region. Over the past decade, the African Union Commission (AUC) has built an enlarged Africa-wide consensus regarding the critical role that the Blue Economy could play in fostering structural transformation in Africa during the next decade. This is encapsulated in the AU's 2050 Africa's Integrated Maritime Strategy (AU 2050 AIMS), which describes the Blue Economy as the "new frontier of African Renaissance." In addition, the Blue Economy is at the center of the AU's Agenda 2063, at which it was unanimously declared to be "Africa's future" and recognized as a catalyst for socio-economic transformation. In July 2015, the AU launched the African Day (25 July) and the Decade of Seas and Oceans 2015–2025 to rally action on the Blue Economy.

Different national and global initiatives all over the world are being undertaken to harness the Blue Economy. Countries like Australia, Brazil, the UK, the USA, Russia, and Norway have developed dedicated national ocean policies with measurable outcomes and budgetary provisions. Countries like Canada and Australia have enacted legislation and established hierarchal institutions at federal and state levels to ensure progress and monitoring of the Blue Economy targets (Incois, 2020).

The global health and economic crisis triggered by the Covid-19 pandemic affected severely all Blue Economy sectors for more than a year now. Coastal areas and small islands have been hit harder by travel restrictions. Addressing the combined climate, environmental, health, economic and social challenges is a daunting task, but there should be no excuse for inaction.

Long before the Covid-19 outbreak, the European Union had committed to being at the forefront of the global sustainability agenda. The EU has reaffirmed its resolve to contribute to the UN SDGs, to protect biodiversity in at least 30% of its land and seas by 2030. The EU has set the ambitious target of achieving climate neutrality by 2050 and putting sustainability at the core of its Blue Economy (EC, 2019).

The Seychelles archipelago comprises 115 tropical islands surrounded by over 1.3 million km^2 of ocean. Its prime geographical position outside the cyclonic belt, in the Indian Ocean just below the equator, has made it a popular year-round tourist destination, with visitor arrivals totaling 384,204 in 2019 (NBS, 2019).

The country's economy is dependent on tourism and fisheries (AfDB, 2022). The tourism sector contributes over 80% of the GDP, with fisheries making up the bulk of the rest. Together, these sectors have helped Seychelles—the smallest African country—achieve the highest per capita GDP figures in the continent.

In 2018, Seychelles' GDP at current market prices stood at SCR 22,063.8 million (US$ 1,243.9 million), with a 3.5% growth rate estimated in 2019, primarily driven by tourism, fisheries, and financial services. In the fourth quarter of 2019, year-on-year real GDP increased by 5.5% compared to the same quarter in 2018. Tourism and fisheries also make significant contributions to income and employment—over 25% of the country's 95,000 people are employed in tourism-related industries and 17% in the fisheries sector. The country's primary export base also revolves around fisheries, comprising consumable fish and fish products, which make up 96% of total exports (AfDB, 2022).

5.5 The Blue Economy of the USA

According to a 2014 National Ocean Economics Program study, "in 2010 the ocean economy comprised over 2.7 million jobs and contributed over $258 billion to the GDP of the United States" (Kildow et al., 2014). Meanwhile, in 2012, shore-adjacent counties were home to 48.8 million jobs and contributed $6.6 trillion to the US GDP (Senaratne, 2020). The US population tends to cluster in coastal counties, where roughly 10% of the land area is home to nearly 40% of American citizens (NOAA, 2013). But the coastal economy figures provide a backdrop from which we can break out the specific marine-related industries that comprise components of the Blue Economy.

US Secretary of Commerce addressed in 2012 Capitol Hill Ocean Week that the US Sea area has always been a strong economic engine. Some people refer to it as the "blue economy". For example, Australia believes that the blue economy includes traditional and emerging marine industries and regards the value of the marine industry as the value of the blue economy. India regards the blue economy as economic activities relying on the marine ecosystem or seabed. Blue development should increase the protection of adjacent waters, which means enlarging blue economy space by expanding our development and protection of all marine (coastal and open ocean-deep sea) ecosystems. While alleviating pressures that reach the ocean originate on land and it is through atmospheric, riverine, or connectivity that impacts reach the coastal ocean, we can further enhance our cognition toward the ocean.

Wind energy is currently at the most advanced stage of development, and the signs are extremely promising. Experts estimate that offshore wind power alone could in the future supply about 5000 terawatt-hours (TWh) of electricity a year worldwide – approximately a third of the world's current annual electricity consumption of about 15,500 TWh (1 TWh = 1 trillion watts). It is anticipated that offshore wind energy plants (WEPs) alone in Europe will supply about 340 TWh a year by 2015. About 40 offshore wind energy projects have so far been implemented worldwide, most of them in the UK, Denmark, the Netherlands, and Sweden. Two trends are clear. One, that the facilities are getting bigger all the time, and two, that we are constantly venturing into deeper waters, which will allow the construction of wind farms over far greater areas. Whereas at the beginning of this century we were building in coastal areas at depths of 2 to 6 m, wind turbine towers are now anchored to the ocean floor at depths of more than 40 m.

Floating offshore concepts are also being developed for even deeper waters. The world's first floating wind energy plant was recently constructed off the coast of Norway by a Norwegian-German consortium. Backed by the experience of hundreds of thousands of onshore WEPs, wind energy has become a mature technology. The high wind speeds and harsh environmental conditions at sea, however, mean that some technological improvements are required, a fact borne out by the problems encountered by the first large-scale wind farm in Denmark. For this reason, only twelve wind turbines from different manufacturers were initially built and tested at Germany's first offshore wind farm "Alpha Ventus". Located in the North Sea about 40 km off the island of Borkum, the farm was sponsored by the German Federal Ministry of Economics. The offshore plant is still considerably more expensive to construct than onshore due to the challenging foundation work and complicated connection to the

power grid. Nonetheless, according to experts, offshore wind energy, supported by feed-in payments and support measures, will continue to grow substantially in the coming years.

5.6 Contribution of the Blue Economy Globally

The blue economy approach emphasized that ideas, principles, and norms of the Blue Economy lend significant contributions toward poverty eradication, food and nutrition security, mitigation and adaptation of climate change, and generation of sustainable and inclusive livelihoods.

The UN Food and Agriculture Organization (FAO) estimates that fish provide more than 4.2 billion people with more than 15% of their animal protein intake (FAO, 2014). Of the world's international trade, 90% is transported by sea (ICS, 2015). Oceans also play an important role in regulating climate and the functioning of coastal marine ecosystems, such as mangrove forests, kelp forests, seagrass meadows, and saltwater marshes, as well as in storing and sequestering atmospheric carbon (Lutz et al., 2014). The global market for marine biotechnology is expected to reach US$ 5.9 billion by 2022, driven by increased investments in marine biotechnology research and growing demand for natural marine ingredients. Biotechnology is essential for developing new foods, pharmaceuticals, bioenergy, and cosmetics. To meet the world's increasing energy demand, oil and gas will continue to be the major source of world energy in the 21st century. In the 1950s, offshore hydrocarbon extraction increased tremendously. Currently, approximately 30% of world oil and gas production comes from offshore resources, and it is expected to continue to increase in the future (MODEC, 2015).

The seven established sectors of the EU Blue Economy generated a GVA of €176.1 billion in 2018 which is 15% higher compared to 2009. Gross operating surplus (profit) at €68.1 billion was 14% higher than in 2009, while total turnover was €649.7 billion, an increase of 13% (€577.2 billion in 2009). These established sectors, including the covered subsectors and their activities, directly employed almost 4.5 million people in 2018. Although this figure is only almost 1% more than in 2009, it means that the number of jobs in the EU Blue Economy is nowadays higher than before the financial crisis of 2008 and 12% greater than the previous year (2017). The increase is largely driven by coastal tourism, which saw a 20% rise in jobs compared to 2017. Marine renewable energy (production and transmission), which is still in a strong expansion phase given that it is a relatively younger sector, saw the number of persons employed increase twenty-two times more since 2009, from 383 persons to almost 9000 persons in 2018.

Marine resource turnover can lead to double counting along the value chain since the outputs from one activity can be the inputs of another activity (i.e., intermediate consumption). This may particularly affect some sub-sectors, such as living resources and ship building and recycling. For example, the value of a fish could be counted several times in the marine living resources sector, when caught in the primary production sub-sector, then when processed in the processing plants of the fish product sub-sector, and finally when sold in the distribution of fish products sub-sector. Remuneration per employee for the EU Blue Economy established sectors has increased steadily since 2009, peaking in 2015 (at €24950 per employee) and falling slightly afterward. However, with an average of just over €24020 per employee, employment remuneration in 2018 was 14.2% higher than in 2009. The decrease in average employment remuneration can be largely attributed to significant drops in the employment in non-living resources (-60% compared to 2015), a well-remunerated sector that has been contracting for some years; while the employment in coastal tourism has increased during the same period (45% compared to 2015), which is a low-remunerated sector. Gross investments intangible goods in 2018 decreased by 14.2% compared to 2009: from €29.8 billion to €25.5 billion. As detailed further down, the decline in gross investments was mainly driven by decreases in investments in the sectors of maritime transport, non-living resources, and port activities to a minor extent. Maritime transport, the largest investor in 2018 (€13.7 billion) saw gross investments drop overall by almost 22% compared to 2009.

The world counts numerous coastal and island countries with lower and lower-middle-income levels,

for whom oceans represent a significant jurisdictional area and a source of opportunity. For example, with an over 7,500 km long coastline in India spread across nine coastal states, 12 major, and 200 minor ports, India's blue economy supports 95% of the country's business through transportation and contributes an estimated 4% to its GDP.

Significant Contributions of Marine and Freshwater Ecosystems Include:

Food security, nutrition, and health: Fish contributes over 16% of the animal protein consumed by the world's population and 6.5% of all protein consumed, with 1 billion people relying on this source of protein. Fish is also a particularly critical source of nutrition. Even in small quantities, the provision of fish can be effective in addressing food and nutritional security among the poor and vulnerable populations around the globe.

Livelihoods: FAO estimates that the number of fishers, fish farmers, and those people indirectly involved in fishery-related activities is 660–820 million worldwide. In addition, women play a critical role in fishery supply chains – it is estimated that women account for 15% of people directly engaged in fisheries and up to 90% of jobs in secondary activities (particularly in fish processing, whether in the formal or informal sector). Oceans and coasts also form the foundation for extensive employment in tourism - one of the top five industries in most small island states.

Mitigation of climate change: Oceans constitute a major sink for anthropogenic emissions, absorbing 25% of the extra CO_2 added to Earth's atmosphere by burning fossil fuels. 'Blue carbon' sinks like mangrove forests, sea grass beds, and other vegetated ocean habitats are up to five times as effective as tropical forests at sequestering carbon.

Homes and shelter: Roughly 40% of the world's population lives within 100 km of the coast. Healthy coastal ecosystems provide protection from natural hazards, coastal erosion, and rising sea levels particularly in SIDS and low-lying, exposed delta regions.

Sustainable economic growth: A large number of developing coastal and island nations depend on tourism and fisheries for a significant part of their GDP and public revenues. Aquaculture is projected to continue to grow rapidly and if done sustainably, can serve as a major source of food and a cornerstone of the blue economy. Advances in seaweed production hold promise for replacing fishmeal and animal feed with plant materials produced with less pollution. Tourism, particularly nature-based tourism, also provides an important path toward the sustainable development of marine and coastal ecosystems. Coastal tourism is a key component of small island state economies. The value of nature-based tourism is expected to increase over time as the supply of pristine natural assets declines while demand, which seems impervious to economic shocks, increases with rising GDPs.

Trade: Seafood is the most highly valued internationally traded commodity in the world. In 2013-2014, around 36% of all fish production was exported and it was worth US$ 139 billion. The export value of fish is more than double that of the next most traded commodity – soybeans. And more than half of the fish trade originated from the waters of developing countries (World Bank, 2016).

5.7 Potentials of the Blue Economy Globally

Globally, over 80% of international goods are transported by sea (UNCTAD, 2018). Port cities have significant importance as they directly or indirectly support local and national economic activities, employment, and food security among other factors. It is estimated that the volume of port demands in Africa will grow by 6-8 times by 2040 (PwC, 2018). This presents a significant opportunity for local, national, and international economic growth of the blue economy.

Around 80% of global tourism are taken place in coastal locations (Obura et al., 2017). Coastal cities are typically the entry point to the coastal region by sea, rail, and air. World Wide Fund for Nature (WWF) calculates that coastal and marine tourism contributes approximately US$14.35 billion to the Western Indian Ocean (WIO) region annually (Obura et al., 2017). Coastal cities also act as hubs for the fishing industry, and support communities of the WIO that are dependent on fish for protein and livelihoods (Taylor et al., 2019). Fishing is a vital economic sector of the island states located across the WIO region comprising 8% of Comoro's GDP, 6% of Madagascar's GDP, and 9% of Seychelles' GDP (Obura et al., 2015). Billions of people worldwide, especially the world's poorest, rely on healthy oceans as a source of jobs and food, underscoring the urgent need to sustainably use, manage and protect this natural resource. According to the OECD (2016), oceans contribute US$1.5 trillion annually to the overall economy and this number could reach US$3 trillion by 2030.

The FAO estimates that around 60 million people are employed worldwide in fishing (39 million) and fish farming (20.5 million). Most are from developing countries and are small-scale, artisanal fishers and fish farmers. In 2018, global fisheries and aquaculture amounted to approximately 179 million tons, with a "first sale" value estimated at US$401 billion, generating over US$164 billion in revenues from exports, including 60% from developing countries. In 2017, fish provided at least 20% of daily mean animal proteins intakes for 3.3 billion people, with an even higher proportion in many poor countries (FAO, 2020).

Aquaculture production by the 28 EU Member States (EU-28) reached 1.28 million tons which were worth € 3.51 billion in 2011 (FAO, 2011). Based on data from the Data Collection Framework (DCF), the volume and value of sales reached 1.35 million tons and € 4.02 billion in 2011, respectively (DCF, 2008; STECF, 2013). The estimated employment of the EU-28 member states in the aquaculture sector is 80 to 85 thousand. The European Commission adopted and reformed the Common Fisheries Policy (CFP) and has published a set of strategic guidelines with common priorities and general objectives. The key objective is to promote the continuous development of the aquaculture sector, ensuring sustainability, food security, and employment. The reform is based on the open method of coordination, agreeing on common priorities and targets and working with multi-annual plans for coordination and best practices exchange (STECF, 2013).

Marine and coastal tourism is dominated by small businesses, most of which (around 90 %) employ less than 10 people. It is the largest maritime economic activity where more than 3.2 million people are involved directly or indirectly and it generates € 183 billion in revenues in GVA, more than one-third of the overall maritime economy (COM, 2014). Currently, funding opportunities for coastal tourism in the EU are available through the European Structural and Investment Funds, Horizon 2020, the Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME) framework program, the Creative Europe program, and the LIFE+ program. The proposal for the 7th European Environment Action Program is also linked to coastal and maritime tourism. In addition, the European Investment Bank provides SMEs and financial support for investments in tourism and/or in convergence regions (COM, 2014).

Ocean energy is one of the pillars of the Blue Growth Strategy. Ocean or blue energy covers all technologies aimed to exploit renewable energy from seas and oceans other than offshore wind. The importance of ocean energy is underlined in the Communication on Energy Technologies and Innovation and the Atlantic Action Plan (EC, 2013), which encourage cross-border cooperation. The Blue Energy Communication confirms that more than € 600 million have been invested by the private sector in the last 7 years, which could be further increased by favorable regulatory and legal conditions. A clear and stable policy framework facilitates private sector participation and attracts investments (COM, 2014).

The Blue Economy also serves as a framework and policy document for sustainable marine economic activities as well as new marine-based technologies (Ruiz, 2018). The WWF's principles for a sustainable

blue economy aim to briefly outline the concept of the blue economy to ensure the economic development of the ocean (WWF, 2015). The sustainable blue economy should be governed by public and private processes that are inclusive, well-informed, adaptive, accountable, transparent, holistic, and proactive. To accomplish these goals, public and private actors must set measurable goals, assess and communicate their performance, provide adequate rules and incentives, effectively govern the usage of marine space, develop standards, understand marine pollution usually originates on land, and actively cooperate to promote the changes (Grimm and Fitzsimmons, 2017).

The FAO supports SIDS through several projects around the world, including the Blue Growth Charter. Cape Verde was chosen as the pilot project of the Blue Growth Charter to promote policies and investments related to sustainable ocean development (Spalding, 2016).

Investing in a sustainable ocean economy is not just about driving superior risk-adjusted returns, but also about providing support to protect and restore more intangible blue resources. We propose seven major categories of sustainable blue economy investments, which are at varying stages and can accommodate public or private investment, debt financing, philanthropy, and other sources of funds. These seven categories are: coastal economic and social resilience, improving ocean transport, ocean renewable energy, ocean-sources food investment, ocean biotechnology, cleaning up the ocean, and anticipated next-generation ocean activities. Further, investment advisors and asset owners can support investment in the blue economy, engaging companies and pulling them toward better behavior, products, and services (Metro economics, 2021).

Mesoamerican Barrier Reef System (MBRS or MAR) is the largest reef ecosystem in America and the second-largest in the world. The study considered provisioning services, cultural services, and regulating services provided by the reef ecosystems in the MAR region, and found that tourism and recreation contributed around US$ 4,092 million in the Mesoamerican Region, where fisheries contributes around US$ 615 million. The annual benefits of shoreline protection are worth US$ 322.83-440.71 million. This report is the culmination of four online working sessions that were held in the January 2021 workshop where over 100 attendees from four MAR countries: Mexico, Belize, Guatemala, and Honduras participated (Oyer and Leeuwen, 2019).

Initiatives all across the Caribbean have begun transitioning toward inclusive, cross-sectoral, and sustainable products including industry planning and governance. The report includes two case studies from Grenada and the Bahamas and it focused on the sustainable development of the Wider Caribbean region (Attri, 2018).

The Indian Ocean Region (IOR) represents significant investment opportunities for the sustainable blue economy. The investment can be supported by showcasing the established link between corporate sustainability and financial performance. The best results for promoting sustainable investment in the Indian Ocean will come with the involvement of the government, the private sector, and multilateral organizations (Mwanza, 2018).

The Caribbean Development Bank hosted a seminar at their 2018 Annual Meeting on "Financing the Blue Economy - A Caribbean Development Opportunity." The seminar discussed both internal and international mechanisms used to fund industry, improve the system for the blue economy initiatives, and improve investment opportunities within the blue economy (Sarker et al., 2018).

Bangladesh is assessed as a case study for the potential of the Blue Economy, yet many other challenges are there, particularly in trade and commerce related to the sea and coast. The report finds that blue growth, which the article defines as increased economic activity in the ocean, must not sacrifice environmental sustainability for economic profit as seen in Bangladesh (Sarker et al., 2018).

The Organization of Eastern Caribbean States (OECS) presented the Blue Economy in the Caribbean including an overview of economic significance and major players in the region. Their vision focuses on sustainably managed healthy and rich biodiversity in the Eastern Caribbean marine environment while being conscious of promoting the socio-economic development of the dependent people of the region (Blue Economy Caribbean, 2018)

Covering over 85,000 km^2, Anguilla's extended fisheries zone (EFZ) is one of the largest in the Caribbean. The presentation provides a general outline of the implementation of an offshore fisheries license regime and examples of past benefits for island nations. Steps to creating a license include collecting and analyzing fisheries data, creating a legal framework to issue offshore licenses, and providing monitoring and surveillance (Hansen et al., 2018)

Barbados's Blue Economy Framework is made up of three pillars: transportation and logistics, housing and hospitality, and health and nutrition. Their goal is to preserve the environment, produce 100% renewable energy, ban plastics, and improve marine management policies (Parsan and Friday, 2018)

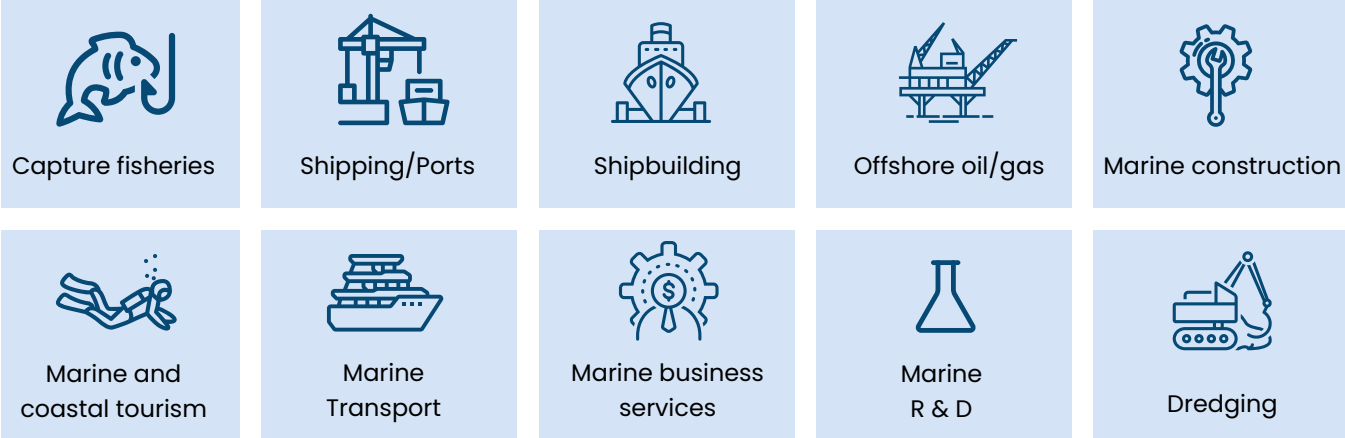
Grenada's economy was devastated by Hurricane Ivan in 2004 and subsequently felt the effects of the financial crisis leading to a 40% unemployment rate. This presented an opportunity to develop the blue growth for economic renewal. Identifying nine clusters of activities, the process was funded by the World Bank to build the first climate-smart capital city in St. George (Ram, 2018).

5.8 The Organization for Economic Co-operation and Development (OECD) Report: Potential Sectors of the Blue Economy

Oceans-related economic activities are developing against a backdrop of the soaring global population, growing consumption, and the ever-growing need for new sources of food, energy, and minerals. For example, by 2030 two thirds of the fish are expected to be farmed for food consumption, much of it at sea (World Bank, 2013). Offshore wind capacity is forecasted to rise to become the leading power generation technology by 2030 (IRENA, 2016), and seaborne trade is expected to quadruple by 2050 (ITF, 2015). On land, the oceans-related economy will experience a surge in investment in coastal infrastructure, industry, and tourism development as the global migration to cities and coasts deepens. At the same time, the risks to coastal populations from rising sea levels and storm surges as a result of climate change will drive the need for a wave of defensive infrastructure development.

List and description of different sectors of the blue economy

STABLISHED INDUSTRIES



MERGING INDUSTRIES

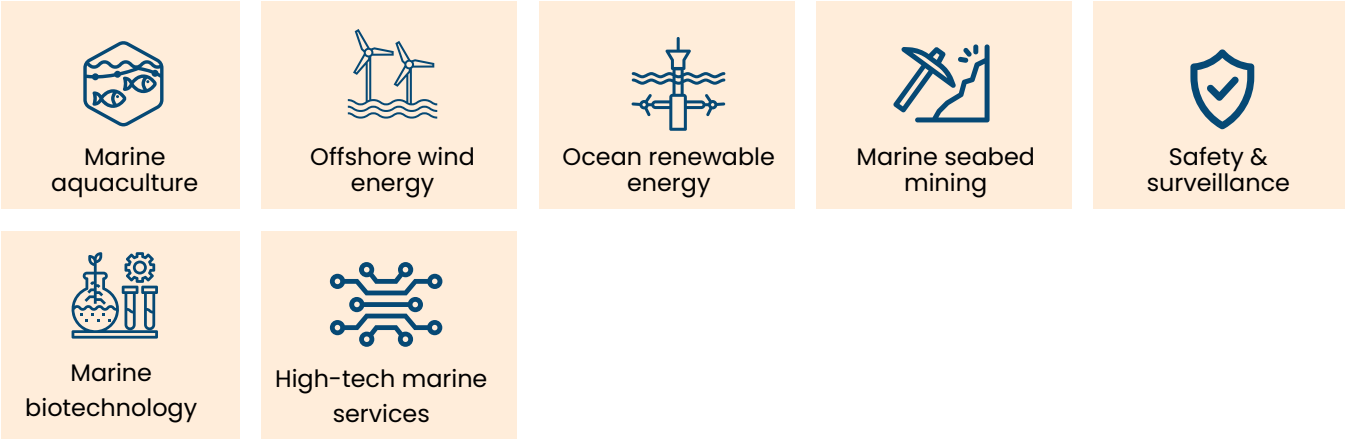


Figure 46 : Different Sectors of the Blue Economy

Fisheries

Sustainable fisheries can be an essential component of a prosperous blue economy and marine fisheries contribute more than US$270 billion annually to global GDP (World Bank, 2012). As a key source of economic and food security, marine fisheries provide livelihoods opportunities for the 300 million people involved in the sector directly or indirectly and help meet the nutritional needs of the 3 billion people who rely on fish as an important source of animal protein, essential micronutrients, and omega-3 fatty acids (FAO, 2016).

The world's population is expected to rise to 9.6 billion by 2050, creating considerable demand for food and sources of protein. Today, fish and fish products supply a significant portion of the daily intake of animal protein in many developing countries. As aquaculture supplies 58% of fish to global markets (FAO, 2016), revitalizing this sector can contribute to food security as well as social and economic inclusion for some of the poorest people in the world. Locally, aquaculture can help lessen the need for fish imports and increase employment, as well as contribute to food security and meet nutrition needs.

Figure 47 : Fishing Areas, Aquaculture

Coastal and maritime tourism

Tourism, becoming the largest global business, employs 1 out of every 11 persons globally. According to the World Travel and Tourism Council, travel and tourism's contribution to world GDP grew for the sixth consecutive year in 2015, rising to a total of 9.8% (US$7.2 trillion) (WTTC, 2016). The World Tourism Organization calculated that 2016 was the seventh consecutive year of sustained growth in

international arrivals, which grew by 46 million over the previous year to reach 1,235 million. The number of international tourists visiting SIDS destinations increased from 28 million in 2000 to 41 million in 2013. In the same period, exports from tourism grew from US$26 billion to US$53 billion (UNWTO, 2014).

Figure 48: Coastal and Maritime Tourism

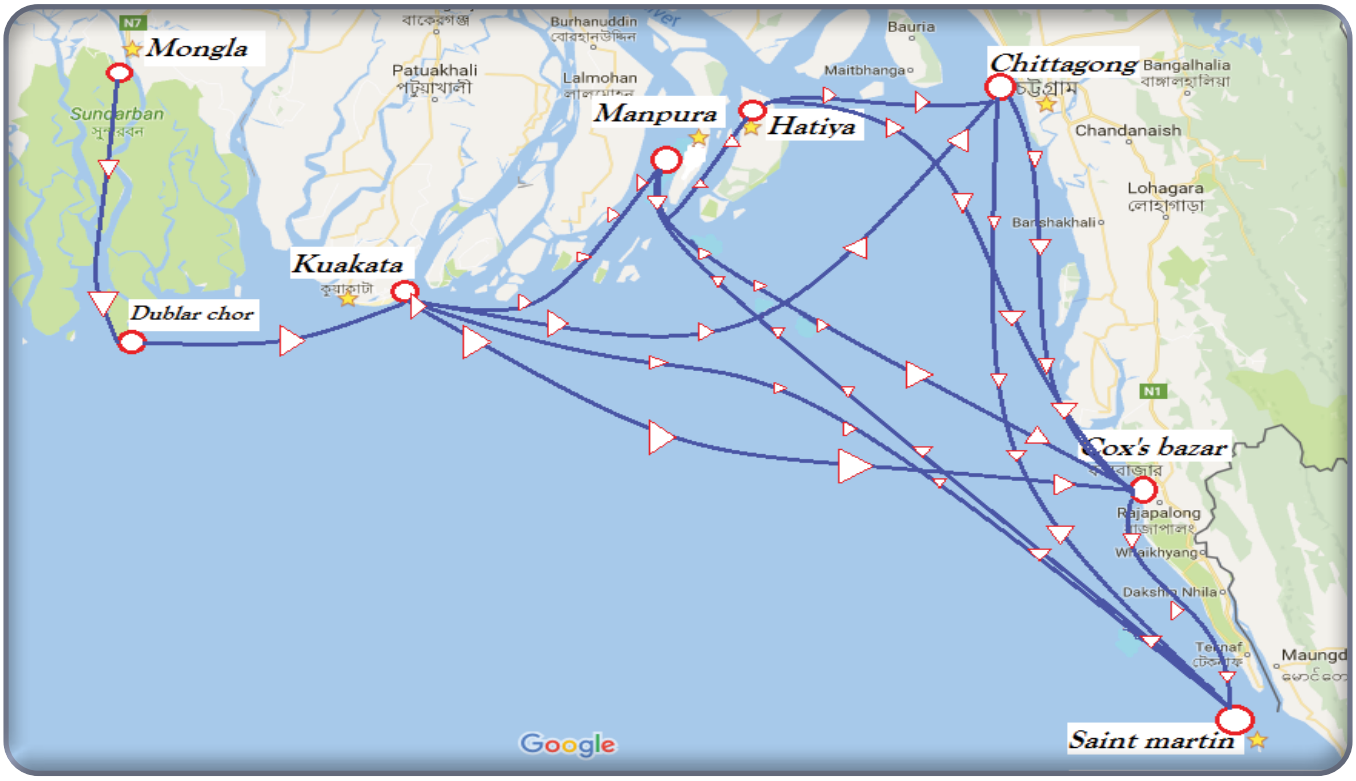


Figure 49: Geographical Representation of Coastal Tourism

Marine Biotechnology and Bioprospecting

The exceptional biological diversity of the oceans - estimated to range from 700 thousand to 1 million eukaryotic species (Appeltans et al., 2012) and millions more prokaryotic species (Curtis et al., 2002) and viral taxa (Suttle, 2013)—is an important source of novel genes and natural products, with applications in medicine, food, materials, and energy and across a wide array of bio-based industries. Marine biological prospecting includes the discovery of novel genes and biological compounds from the ocean environment that can lead to the commercial development of pharmaceuticals, enzymes, cosmetics, and other products. Because of the low quantities of raw materials that must usually be sampled, bioprospecting can generally be considered as having more limited environmental impacts (Hunt and Vincent, 2005) and thus be a potential alternative to more-intensive extractive activities.

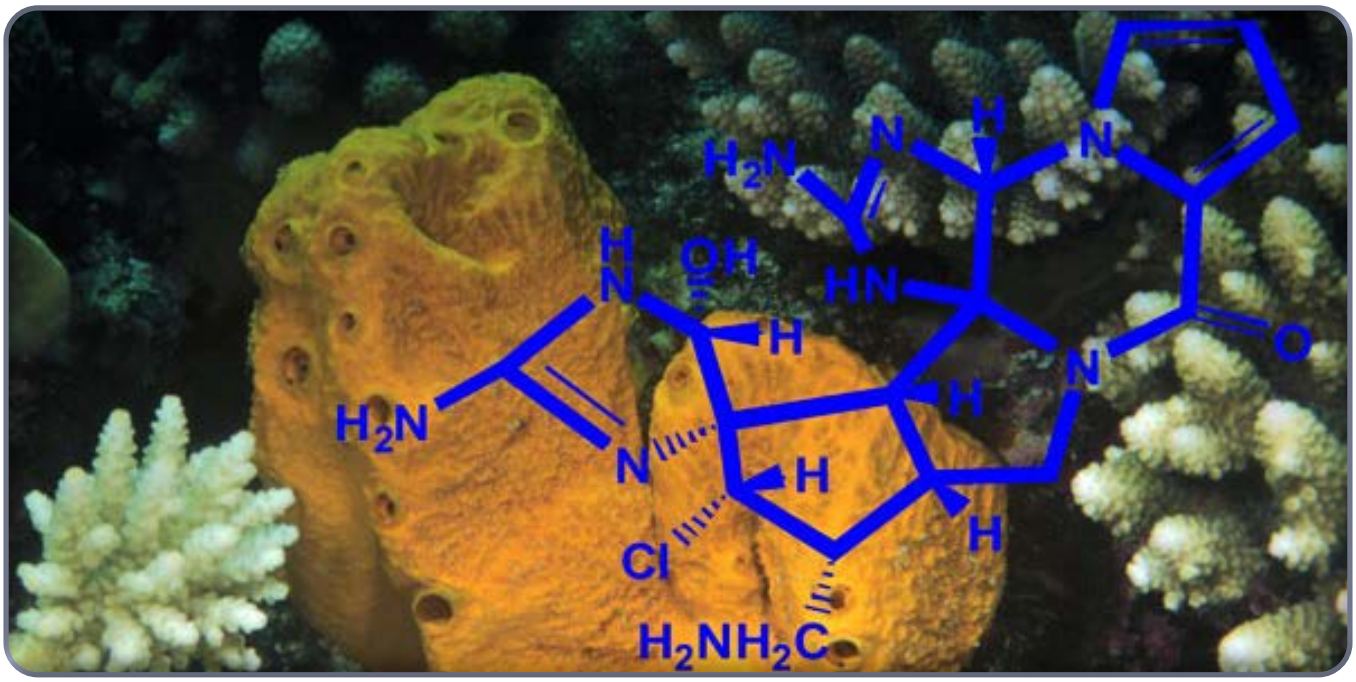


Figure 50: Marine Biotechnology

Extractive Industries: Non-living Resources

Offshore oil and gas exploration and exploitation are already underway off the coasts of many states around the world, and much has already been learned about the need to manage the risks these activities incur and some of the measures that can be taken to alleviate them. Less clear, however, is the need to balance the focus on these activities as opposed to other uses, which quite often are not compatible. It is ultimately up to the coastal states to weigh the trade-offs between these potentially lucrative activities and the extent to which they preclude other uses of marine resources, including the sustainable exploitation of marine living resources.

Desalination (freshwater generation)

Securing adequate quantities of clean and safe water to meet the needs of a growing population is one of the greatest challenges. Access to safe drinking water is particularly critical for SIDS and coastal LDCs, with profound implications for economic growth, human rights, public health, and the environment. Meeting this demand for freshwater is expected to become increasingly difficult in the context of climate change, with many regions facing more variable precipitation patterns and decreased water availability.

Renewable marine (off-shore) energy

Sustainable marine energy can play a vital role in social and economic development, as well as in climate adaptation and mitigation. While offshore wind energy is becoming more common, particularly in Europe, other forms of marine energy extraction are still experimental, and in most cases have not yet been developed on a commercial scale. These other forms of energy include wave and tidal energy and ocean thermal energy conversion. While these technologies are still untested in SIDS and coastal LDCs, their application on islands is being advanced in Hawaii, where Hawaiian Electric has experimental programs relating to wave energy and OTEC.

Maritime transport, ports, and related services, shipping, and shipbuilding

In 2015, over 80% of the volume of international trade was transported by sea, and this share is even higher for most developing countries. In terms of economic value, some observers such as Lloyd's List Intelligence have estimated the share of maritime seaborne trade was 55% of all international trade in 2013, while others estimated it was more than 70% (UNCTAD, 2016).

5.9 County-wise Blue Economic Contributions

As "Blue" signifies the sea, many countries refer to the Blue Economy as the marine economy. Countries increasingly recognize that they need more knowledge about the biophysical characteristics, carrying capacity, synergies, or trade-offs between sectors to ensure efficient and sustainable management of different activities in the marine environment. Marine and coastal spatial planning and integrated maritime surveillance are needed to give authorities, businesses, and communities a better picture of what is happening in this unique space. Digital mapping of maritime and coastal space and natural assets can form the basis for cross-sector analysis and planning to prevent conflicts and avoid externalities. Similarly, the growing science of data-limited stock assessments can provide critical information needed for improved fisheries management. In South Africa and Indonesia, mobile technology is being tested to gather previously unavailable data on fishery landings and fish stock health.

Integrated coastal zone management can enhance the protection of coastal and near-shore resources while increasing the efficiency of their uses. Coastal zones are among the most productive areas in the world, offering a wide variety of valuable habitats and ecosystem services that have always attracted humans and human activities.

Recent statistics of the ocean's economic contributions at the regional, national, and sub-national levels are given below:

- **Australia:** contribution of AU$47.2 billion to GDP in 2012, or over 3% of the total (National Marine Science Committee, 2015);
- **China:** total GVA of US$239 billion in 2010, or 4% of GDP, employing over 9 million people (Zhao et al., 2014);
- **European Union:** total GVA of €500 billion annually, employing over 5 million people (EC, 2017);
- **Ireland:** total GVA of €3.37 billion in 2016, or 1.7% of GDP (Vega and Hynes, 2017);
- **Mauritius:** around 10% of GDP on average for the period from 2012 to 2014 (Cervigni and Scandizzo, 2017);

- **United States:** contribution of US$359 billion to GDP in 2013 or more than 2% of the total, employing 3 million people (Kildow et al., 2014).
- **U.S. State of California:** contribution of US$44.8 billion to GDP in 2012, or 12% of the state's total;
- **U.S. State of Louisiana:** contribution of US$11.3 billion to GDP in 2011, or 4.8% of the state's total (Young, 2014); and
- **U.S. State of North Carolina:** contribution of US$2.1 billion to GDP in 2013, employing more than 43,000 people (Harrison et al., 2017).

Australia

Australia is one of those countries that considered the importance of the Blue Economy for addressing the major development gaps. It has the third-largest marine jurisdiction of 13.86 million km^2 which is larger than its land territory. Its Blue Economy is dominated by two sectors, namely offshore oil and gas (50%) and tourism (40%).

In the Australian context, the 'oceans as a driver of innovation' lens is the primary lens used to interpret the Blue Economy and to a lesser extent, the 'oceans as good business' lens. The 'oceans as a driver of innovation' lens in Australia is substantiated through policy documents like the 'National Marine Science Plan. This plan, coordinated by the National Marine Science Committee, is built on the AIMS index of marine industries to project future opportunities for growth and how they might be supported by the Australian science community. On the other hand, the 'oceans as good business' lens are exemplified by a focus on valuation studies that seek to quantify the worth of marine industries in Australia and project their future capacity for growth. For example, AIMS has been developing a regular valuation of existing maritime industries since 2008, known as the AIMS Index of the Marine Industry.

China

China started working on the blue economy with the 11th Five-Year Plan (2006-2010) which launched an accounting system to measure the ocean economy. The Government of China has prioritized the blue economy concept as a development strategy (Conathan and Moore, 2015). Based on these measurements, growth was shown to be impressive, averaging 13.5% annually and quickly winning recognition as a key component of the national economy (Conathan and Moore, 2015; Zhao et al., 2014). As a result, in 2011 the 12th Five-Year Plan prioritized the blue economy, focusing on economic growth targets of 9% annually in GVA to contribute 10% of GDP by 2015, and research and development expenditure growth to 2% of ocean economy output value (Conathan and Moore, 2015). With its focus on economic growth from the ocean, China's blue economy policies have also been guided by a National Marine Functional Zoning Plan originally issued by the State Council in 2002, and subsequently including industrial development zones as well as conservation zones (Voyer et al., 2018; Conathan and Moore, 2015). Indeed, in 2011 the State Council established a "blue economic zone" in Shandong Province, which was subsequently credited with generating significant economic growth for the coastal city of Qingdao (Conathan and Moore, 2015). In sum, China's blue economy policies have focused on the growth of the ocean economy, through a cross-sectoral and spatial planning process for economic development (Conathan and Moore, 2015).

India

The Government of India's Vision of New 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 this vision stressing the need for a coherent policy integrating different sectors to improve the lives of the coastal communities and accelerate development and employment. India has

a unique maritime position. Its 7517 km long coastline is home to nine coastal states and 1,382 islands. The country has 12 major ports and 187 non-major ports, handling recent years, there have been a series of initiatives for sustainable development in the maritime domain. These initiatives are catalysts to strengthen the growth of India's maritime interests and the Blue Economy. In the post-covid-19 global scenario, India is likely to witness significant growth in the marine sector through efficient and sustainable utilization of ocean resources.

South Korea

South Korea's Sihwa Lake Tidal Power Station generates power from Lake Sihwa, with a capacity of 254 MW, making it the world's largest tidal energy generation plant. The project, commissioned in 2011, is based on a seawall infrastructure originally put in place to deal with flood mitigation and agriculture. The implementation of this new energy technology on the sea was facilitated by: i. National strategy on green growth prioritizing high-potential sectors, and ii. Change in the energy policy that introduced Renewable Portfolio Standards in 2010, whereby 2% of energy by 2012 was expected from renewables, increasing to 8% by 2020 and 10% by 2022.

Indonesia

Not long after taking office in 2014 to lead the world's largest archipelagic nation, President Widodo outlined a development strategy and foreign policy for the country as a "global maritime axis" at the crossroads of the Indian and Pacific Oceans (Santikajaya, 2014). The policy was focused on growth in the ocean economy to lift Indonesia into an upper-middle-income country based on four main objectives:

- Strengthening sovereignty over the country's waters and resolving maritime border disputes;
- Sustainably managing natural resources and protecting the marine environment, notably by stepping up efforts to combat both illegal capture fishing and to expand aquaculture development, exponentially growing public revenues from the sector by 2019;
- Increasing tourism (doubling visitors by 2019) by building marinas along yacht routes, for example; and
- Building science and research capacity for a blue economy, for example, through the construction of three marine science-techno parks by 2019 (Salim, 2014).

The United States (US)

The US has thirty coastal states bordering the Atlantic, Pacific, Gulf of Mexico, and the Great Lakes. It is needless to say that the ocean economy contributes to its economy to a great extent. In 2015, the Ocean and Great Lakes economy contributed US$320 billion to the GDP and supported 3.2 million jobs. The growth of the US Ocean and Great Lakes economy continues to outpace overall US economic growth, rising by 5.7% in 2014-15 compared with 2.7% of the overall economy. Instead of Blue Economy, the National Ocean Service of the US terms the concept as the "Ocean and Great Lakes economy" and states that it is comprised of six job sectors dependent on natural resources: marine construction, marine transportation, offshore mineral extraction, ship and boat building, and tourism and recreation. In the academic world, the Middlebury Institute of International Studies, at Middlebury College, Vermont, US, has a center for the Blue Economy. The center researches how the ocean and coastal resources can support economic development and enhance healthy oceans and well-managed coastlines.

The 'oceans as good business' lens have been the US's center of attention, as the country focuses on job creation and economic activity in the sector. In 2010, then, President Barack Obama issued a

"National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes" which included some elements of environmental protection. Obama's 2010 Executive Order also directed federal agencies to implement the recommendations of the Interagency Ocean Policy Task Force (IOPTF) under the guidance of a new National Ocean Council (NOC), but since then not much progress has been made. In June 2018, President Donald Trump signed a new executive order detailing a revised ocean policy. This has completely changed the theme from preservation to resource use and extraction, further emphasizing the US's 'oceans as good business' lens.

European Union

Beginning with a 2006 Green Paper and subsequent 2007 Council approval of an integrated maritime policy (Suris-Reguerio et al., 2013), the EU developed perhaps the earliest and most well-known blue economy policy in 2012 (Voyer et al., 2018). At the time, the EU was still dealing with a difficult post-financial crisis and a fragile economic outlook, yet saw the ocean economy as a potential driver of the entire region's economy, with a potential of 5.4 million jobs and a GVA of just under €500 billion annually (European Commission, 2017). In this context, the "blue growth opportunities for marine and maritime sustainable growth" or "Blue Growth Strategy" aimed to take advantage of new technologies for ocean use, diversify from limited terrestrial resources, and expand the production of renewable energy, by focusing on five sectors of the ocean economy considered as high potential: "blue energy," aquaculture, coastal and maritime tourism, marine biotechnology, and seabed mining (European Commission, 2012).

The EU Blue Growth strategy envisaged the establishment of a competitive advantage in the global ocean economy, and in 2017 a report to the European Commission declared significant progress. "A way for tidal and wave energy to achieve their potential has been agreed upon," the report said, "regulatory barriers to aquaculture are being tackled, employment in maritime tourism is growing, products from marine biotechnology research are reaching the market, and technologies for monitoring the environmental impact of deep-sea mining have been developed" (European Commission, 2017). The strategy was focused on significant investment in research (through its 2014-2020 research program allocating more than €800 million), a European Maritime and Fisheries Fund to help encourage investment (though a lack of public and private risk funding for emerging industries was cited as a continuing challenge), and CMSP to help ensure that "we do not repeat the same mistakes on the sea as we did on land" (European Commission, 2017; Voyer et al., 2018). In 2017, the EU launched a focused initiative to promote the blue economy in the western Mediterranean, following a similar approach (European Commission, 2017).

Senegal

A coordinated mechanism was created by the president of Senegal in 2006 within the Office of the Prime Minister, with responsibility for addressing maritime security issues and the protection of the marine environment. The coordination mechanism, known as HASSMAR mandated to work with other relevant (maritime) agencies to operationalize national plans and interventions at sea. The geographical scope of operation includes maritime and fluvial waters and ports of Senegal. By locating this coordination mechanism at the highest level of the political machinery, the breakdown of coordination that is seen in many countries in the region is prevented.

Mauritius

Mauritius was at the vanguard of this effort when its government launched a "National Dialogue on the Ocean Economy" in 2013, developing a new growth strategy based on its ocean space and resources entitled "The Ocean Economy: A Roadmap for Mauritius" (Cervigni and Scandizzo, 2017). The policy set a target of doubling the ocean economic share of GDP over a 12-year time horizon (2013-2025). In 2015 the government created a new Ministry of Ocean Economy, Fisheries, Marine Resources, and Outer

Islands to consolidate various organizations, together with a National Ocean Council acting as an advisory body (Cervigni and Scandizzo, 2017). In 2017 World Bank report (Cervigni and Scandizzo, 2017) that modeled the potential for the country to achieve this target, suggested several key messages including:

- Meeting the target of doubling the contribution of the country's ocean economy to GDP was possible, but would take time (likely 15 years) and significant investment (on the order of US$580 million annually for 10 years).

- Return on investment would likely be 20%, depending upon key enabling conditions such as stable macroeconomic and exchange rate policies (to encourage investment inflows), investment in human capital (to avoid a mismatch between demand and supply of skilled and semi-skilled labor), and conservation of the ocean's natural capital.

- Investments were recommended on a cluster approach, in key sectors, starting with fisheries and aquaculture where the focus would be on reducing overfishing and environmental stresses in the lagoons and coastal fisheries, careful management of the development of underused resources such as the bank's fisheries, and an enhanced investment climate for expansion of aquaculture and the seafood hub.

- Investment in ports is expected to play a key role in the future of its ocean economy, based on the expansion of the country's role as a hub of global trade flows, including container transshipment, re-export of petroleum products, and transshipment of fish.

- Expansion of marine renewable energy is possible, with deep ocean water cooling having the most potential, as well as offshore wind (depending on financing options)—with mutually reinforcing benefits for the ICT sector.

- All of this growth would require a CMSP process to ensure that it does not come at the expanse of ocean ecosystems, as well as addressing the risks of large shocks to the ocean economy from climate change.

5.10 Present and future potential sectors worldwide

The established and emerging sectors are major contributors to the Blue Economy. The seven established sectors that are considered in the EU blue economy report - Marine living resources, Marine non-living resources, Marine renewable energy, Port activities, Shipbuilding and repair, Maritime transport, and Coastal tourism. Each sector is further divided into subsectors as summarized in Table 1.

Table 1. The established and emerging Blue Economic sectors and their subsectors (Source: EU Report, 2021)

Sector	Sub-sector
Marine living resources	Primary production
	Processing of fish products
	Distribution of fish products
Marine non-living resources	Oil and gas
	Other minerals
Marine renewable energy	Offshore wind energy

Sector	Sub-sector
Port activities	Cargo and warehousing
	Port and water projects
Shipbuilding and repair	Shipbuilding
	Equipment and machinery
Maritime transport	Passenger transport
	Freight transport
	Services for transport
Coastal tourism	Accommodation
	Transport
	Other expenditure

Future potential sectors include Marine renewable energy (i.e. floating offshore wind, wave and tidal energy, floating solar energy, and offshore hydrogen), followed by Blue bio-economy, Marine minerals, Desalination, and Maritime defense, security and surveillance, Submarine cables sector, and a newly introduced Robotics sector.

Emerging Marine Renewable Energy includes various types of renewable energy: Floating offshore wind, Wave and tidal energy, Floating Photovoltaic (FPV) energy, and offshore hydrogen generation. Moreover, offshore renewables will pave the way to achieving the objectives of the EU Hydrogen Strategy and the "Offshore Renewable Energy Strategy, which proposes to increase offshore wind capacity from its current level (12 GW) to at least 60 GW by 2030 and to 300 GW by 2050. Offshore wind deployment is to be complemented with 40 GW of ocean energy and other emerging technologies (e.g. FPV) by 2050.

The development activities of the Blue bio-economy and bio-technology vary from one MS to another. The most notable subsector is the algae sector. Although recent socio-economic data are available for only a limited number of MSs (France, Spain, and Portugal), turnover for these amounted to €10.7 million.

Another relevant sector is Desalination. In January 2021, there were 2309 operational desalination plants in the EU (mostly spread across Mediterranean MSs) producing about 9.2 million cubic meters per day. As climate change leads to hotter and dryer summers, certain countries, e.g. Spain, must ensure water supply and hence have invested in desalination plants.

Further, the importance of raw materials is part of the EU's long-term strategy. In connection with this, Marine minerals should not only contribute to ensuring the supply of raw materials; but also employ appropriate technical and environmentally-friendly practices to limit any negative impacts.

The Maritime defense, security, and surveillance sector although not an emerging activity as such, has been categorized so because extensive, comparable data are not publicly available.

Research and education are key enablers for the twin green and digital transitions. The Horizon Europe program (2021-27) has a budget of €95.5 billion (including €5.4 billion from the Next Generation of the EU Recovery Fund), of which at least 35% will be devoted to climate-related actions and supporting the transition of maritime industries to climate neutrality.

The economic importance of Submarine Cables is due to their crucial role in global communications, channeling over 99% of international data transfers and communication. There are around 378 submarine cables spanning over 1.2 million km globally, of which 205 are connected to the EU.

Finally, this chapter briefly looks into the maritime Robotics sector (including underwater and marmite airborne drones). In 2019, the global underwater robotics market was valued at €2209 million and is forecasted to reach €4390 million by 2025.

CHAPTER 6

CONTRIBUTION AND POTENTIAL OF BLUE ECONOMY, CHALLENGES AND POLICY SUPPORTS IN BANGLADESH

6.1 Contribution and Potentials of the Blue Economy in Bangladesh

Proper utilization of marine resources towards achieving sustainable economic development has got worldwide attention in recent years. Likewise, the Bangladesh government has also emphasized blue growth after settling the permanent maritime boundary with the neighboring countries. Coastal and marine resources i.e. living, non-living and renewable are identified as the main components of the blue economy of Bangladesh. Moreover, trades and commerce related to sea and coast, and protections from natural disasters also have economic returns for enhancing the blue growth. To achieve sustainable blue growth in Bangladesh, a strategic planning and management framework is required which should focus on potential sectors, research, and ocean governance. Enhancing blue growth and achieving SDGs must go together to ensure that balance does not swing too far towards blue growth at the expense of environmental sustainability. In comparison to other natural resources systems, the potential of the coastal and marine ecosystem of Bangladesh, as a driver of economic growth, has long been overlooked by policymakers. Only recent years, the Bangladesh government has provided priority to the exploitation and management of marine resources. The vast potentialities of the Bay of Bengal for national economic development are still not fully realized. However, considering the overexploited and weakly governed marine fisheries, there should be a check and balance through an appropriate policy and legal framework. Illegal fishing, piracy, climate change, and marine pollution are already at an alarming stage for the Bay of Bengal marine ecosystem.

The coastal areas and the Bay of Bengal are the heart of the blue economy in Bangladesh. Most of the ocean's economic activities including marine fishing, tourism, and research based on the Bay of Bengal consequently change the livelihoods and social status of millions of people inhabiting the coastal areas (Sarker et al., 2018; Hussain et al., 2018). Several sectors of the blue economy offer the potential for development to achieve food security and economic development objectives. The potential highlighted sectors for the development of ocean economics in Bangladesh include fisheries, marine biotechnology, marine tourism, marine commerce, shipping and navigations, salt production, oil and gas mining, bio fueling, and extraction of ocean energy (Rahman, 2017; Hussain et al., 2018; Islam and Shamsuddoha, 2018).

Bangladesh is one of the five maritime nations in South Asia. Moreover, Bangladesh being a littoral nation depends on the Bay of Bengal for its economic development to a great extent. Her inherited and historic dependency on the sea focuses on the recently emerged concept of the blue economy (Sadekin, 2021).

One of the important components of the blue economy for Bangladesh is the marine fishery. Moreover, the Bay of Bengal is considered a potential ground for the natural growth of various fishes which contribute to the supply of 52% of animal-based protein in Bangladesh. As such a deep necessity is felt to have suitable research vessels to carry out a holistic survey in the Bay of Bengal. The concept of the blue economy in Bangladesh come after the adjustment of the maritime boundary demarcation debate with Myanmar (2012) and India (2014).

The government has recently induced dialogues with the stakeholders to assimilate the unworked

potential of the marine ambiance and conduct effective realization and variation for increasing improving nutrition, food security, inventing jobs, health, poverty, and industrial profiles while observing ecosystem health as well as biodiversity, and also progressing regional security and peace. Geographically, Bangladesh has a water area of 18,290 km^2 which is 6% of its total area. Bangladesh has 12 nautical miles of local sea area, 18 nautical miles of the adjoining zone, and 200 nautical miles of the economic zone.

The Bay of Bengal blesses Bangladesh and the sea is used by us for local and foreign trading as well as flow from the very past, still, we have a lot of things to research from the maritime area and also ensure proper use of marine resources. The socio-economic improvement of coastal nations is one of the critical factors contributed by it. Through the arrangement of sea debate with India and Myanmar Bangladesh gained a large area from the Bay of Bengal.

The Blue economy is a new way to characterize ocean economic growth, the first to occur among many island nations, including small developing countries. The Blue Economy idea is now gaining recognition in some of the most influential and biggest countries in the world, such as China and the United States, to encourage the production of their abundant ocean and coastal resources.

The emphasis on the Blue Economy will eventually be paid off by enabling economic development to thrive with environmental sustainability Thus, Bangladesh with its potential can take advantage of the Blue Economy. Major maritime-based economic resources are identified such as living resources (marine non-traditional species, marine biotechnology), non-living resources (gas, oil, mineral, sea salt), marine resources, marine renewable energy, and other resources (shipping, marine trade, transport, and tourism, maritime surveillance, marine spatial planning - MSP). These resources have future potential benefits for fishermen, entrepreneurs, government, tourists, and the general population.

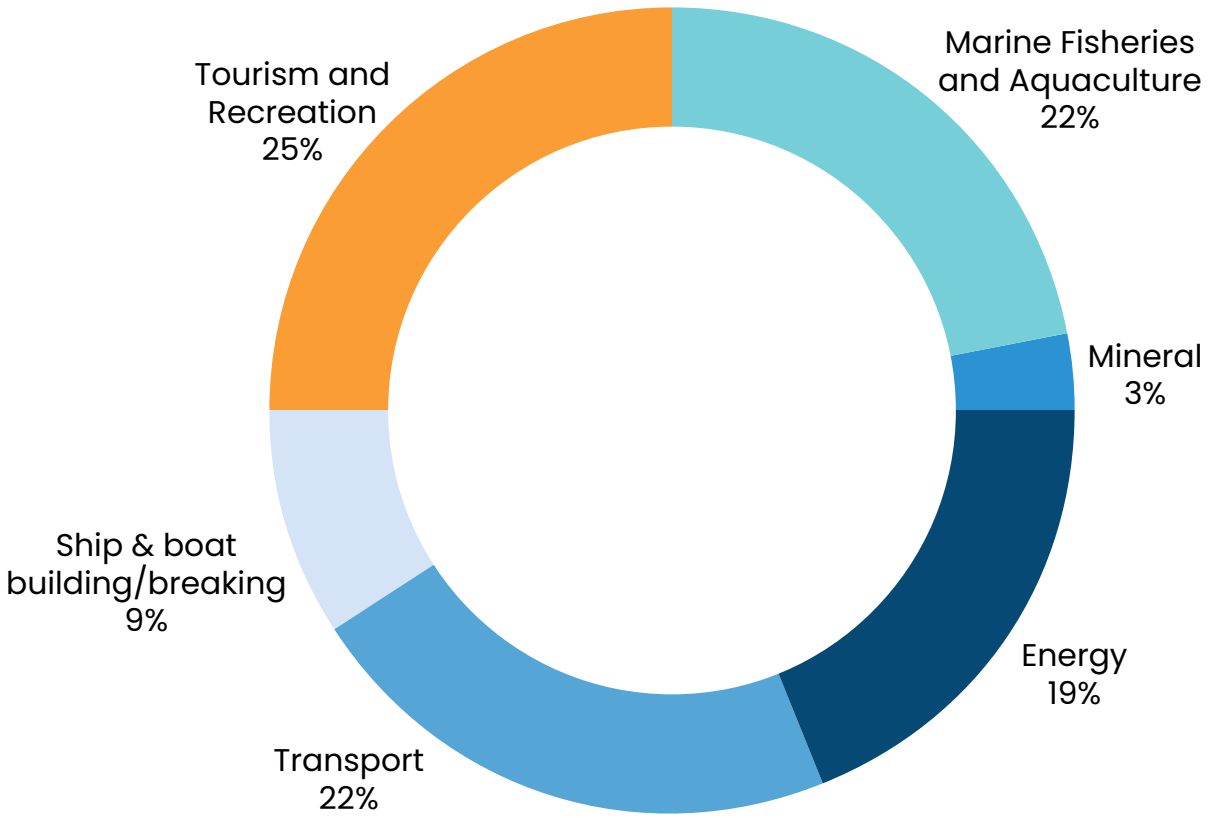


Figure 51 : Compostion of Ocean Economy in Bangladesh (% Gross Value Added)

Bangladesh has immense potential to utilize the Blue Economy concept for the betterment of its economy. To attain the expected goal different stakeholders should work together. Some recommendations can be drawn below for the useful implementation of the Blue Economy concept in our country.

i. Based on our in-depth analysis regarding policymaking on Sustainable Blue Economy (SBE), Bangladesh should adopt some key initiatives in this context. The policymakers should put into action the following strategies which are necessary for our overall socio-economic development.

ii. During the primary period 3/5 years scheme for the Blue Economy program, was completed by the Ministry of ICT for technological support, the Ministry of Fisheries and Livestock, the Ministry of Water Resources, the Ministry of Shipping, the Ministry of Planning, and the Ministry of Finance.

iii. Technological and other collaboration in Bangladesh can guide by one of the major Blue Economy conquest statements reported by UNEP (2015). We can exchange and collaborate and adept technical knowledge.

iv. We have to take some effective measures to reduce the pollution of other environmental degradation and seawater for Sustainable Blue Economy.

v. Initial adequate infrastructural improvements are needed to enhance maritime and coastal tourism since the tourism industry has become an emerging source of national income.

vi. Government, businesses, and community partnerships (public-private partnerships) should be developed through business connectivity and integrated infrastructure (Sadekin, 2021).

6.1.1 Marine capture fisheries (except tuna)

The fisheries sector, particularly marine fisheries, is considered an established sector of the blue economy around the world. Around 475 marine fish species along with 36 shellfish species, and other animals are available in the coastal and marine waters of the Bay of Bengal. In 2020-2021 FY, the marine fisheries sector contributed 6,81,239 metric tons of fish which is 14.74% of the country's total fish production and it plays an important role in the national economy, food security, and employment opportunities (DoF, 2022). It is estimated that Bangladesh catches only 0.70 million tons of fish from the Bay every year out of the total 8.0 million tons of fish (Bangladesh Bank, 2020).

From the coastal and marine waters of Bangladesh, hilsa (*Tenualosa ilisha*), the flagship fish species, is extracted largely as it has high market demands in national and international markets (Figure). Hilsa contributes to 12.22% of total fish production, around 1% of GDP, and employs 3 million fishers directly or indirectly in the country. Some other fish and shellfish species that have high market demands are also extracted commercially. As a result, increasing fishing pressure on those particular fisheries resources results in over-exploitation which makes them vulnerable. In contrast, other commercially less important and/or nonconventional marine fisheries resources like octopuses, squids, cuttlefish, etc. remained under exploitation.

There is a serious thought process and implementable plan for exploiting our deep sea resources to enhance the present production from the marine capture fisheries sector. Thus, increased efforts are needed to maximize the harvest of those particular species sustainably. If the government can extract the full potential of the marine fisheries resources, then it might increase the blue economic growth of the country significantly.

Figure 52: Fishers are Processing Hilsa (Tenualosa ilisha) for Selling in the market

We have four major marine fishing grounds viz. south patches, south of south patches, middle ground, and swatch of no ground in the Bay of Bengal so far (Figure 45). These fishing grounds are exploited extensively over the years. After the maritime boundary demarcation from India and Myanmar, we have sovereign rights over 1,18,813 km^2 of waters of the Bay of Bengal which is mostly untapped. Within these maritime waters, a new fishing ground might be available which needs to be explored. Thus, the government needs to reassess the existing fishing grounds and explore to find new fishing grounds to harness the potential of the blue economy of Bangladesh.

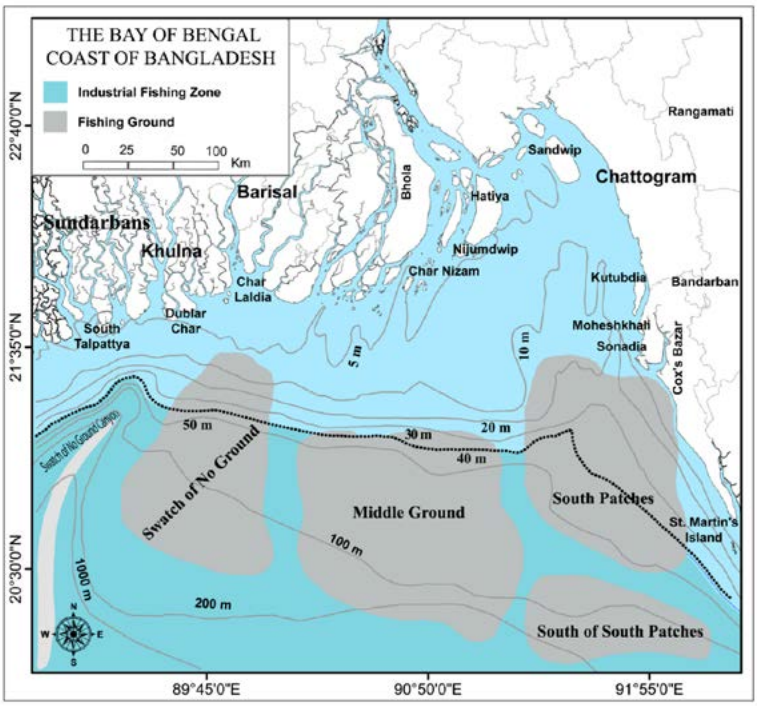


Figure 53: Map Showing the Bay of Bengal Coast of Bangladesh. The Area Beyond the Black Dotted Line (40 m Depth Contour) is the Industrial Fishing Zone. Shaded Regions Indicate the Four Major Fishing Grounds, i.e., South Patches,

South of South Patches, Middle Ground, and Swatch of No Ground (source: Alam et al., 2022).

One study reported that almost all fish resources are harvested within our 50 m depth zone areas in the Bay of Bengal from the shoreline. Since each space has a particular carrying capacity, so time has arrived to go beyond the 50 m depth zone to harvest fish. However, the stock size of all marine fish and shellfish species is not estimated properly though an initiative was taken to estimate the stock size based on the fisheries statistics from the annual Handbook of Statistics (1983 - 2017) together with survey data from both the R/V Anushandhani (1983 – 1999) and the R/V Meen Sandhani (2017 - 2018) (Fanning et al., 2019). The main reason is the statistical handbook information was never intended for stock assessment purposes and is too aggregated to allow individual species analyses. However, some particular fish and shellfish species' stock status was estimated based on the 2019 stock assessment working group report (Figure).

From these analyses, only three species (*Pampus Chinensis, Dussumieriea sp.*, and *Pennahia area*) are not presently being overfished, that is the estimated F ratio is below 1.0. All three of these can be considered incidental catch species with the primary target species being *Pampus argenteus*, *Sardinella sp.*, and *Otoliths cuvieri* respectively. All three primary target species are overfished to some degree and depleted to some degree, quite severely in the case of *Otolithes cuvieri*. Indian salmon (*Leptomelanosoma indicum*) is one of the most valuable finfish species in Bangladesh and is severely overfished and depleted. Species in this condition are at significant risk of commercial extinction and may be extirpated without specific management protection. In addition, we do not have any vulnerability assessment of marine fish species because of lacking enough scientific data. Therefore, the government needs to estimate their exact stock size for sustainable harvesting and take proper management strategies to conserve them considering each species' limit and target reference points.

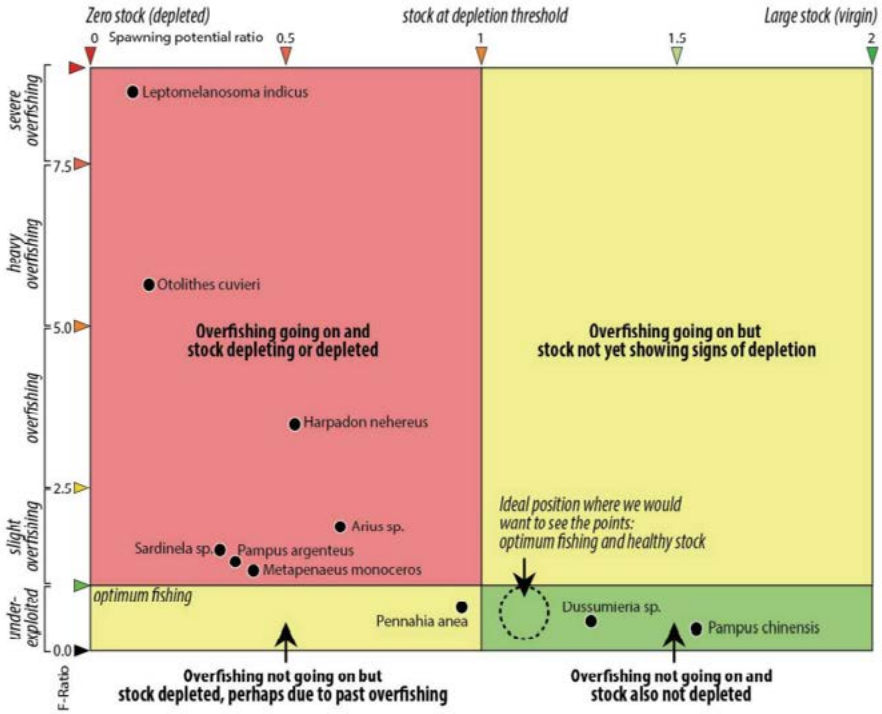
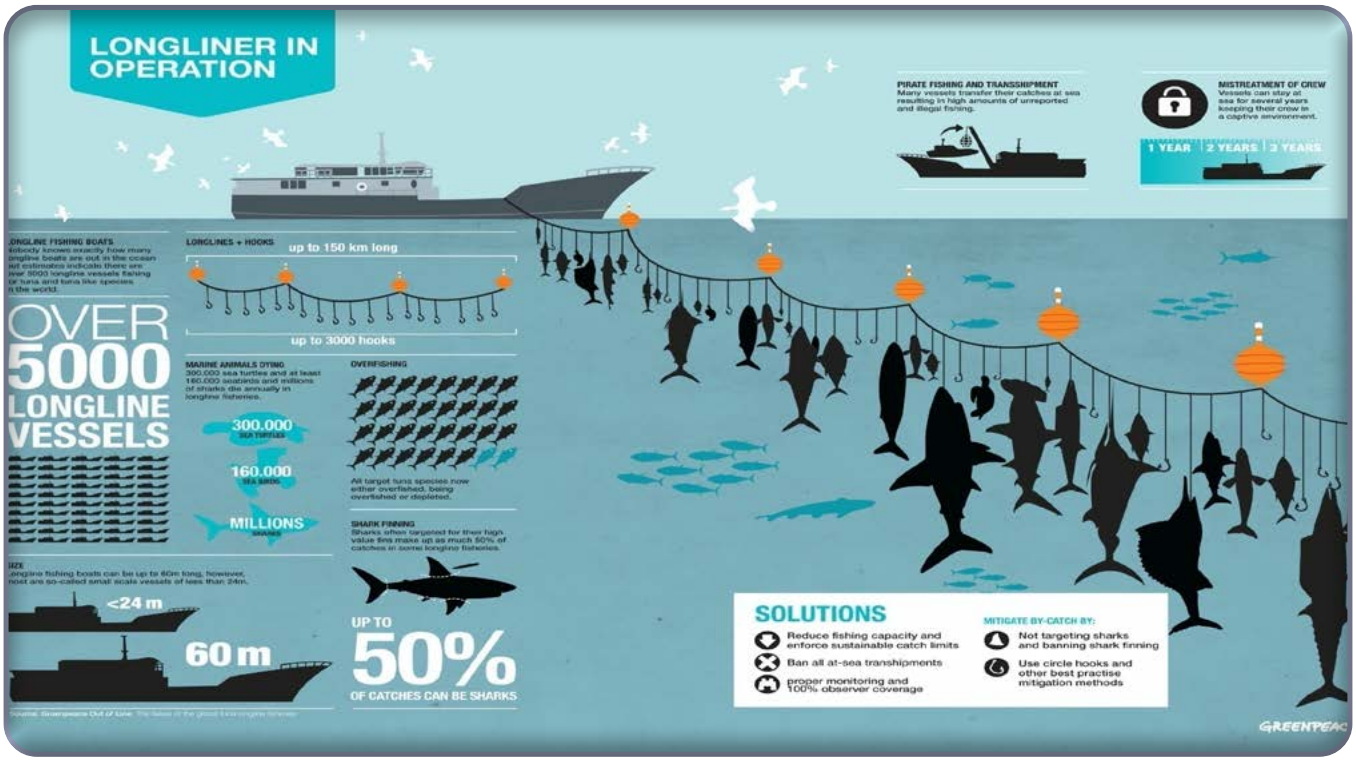


Figure 54 : The Stock Status of Some Particular Fish and Shellfish Species is Based on the 2019 Sock Assessment Working Group Report (source: Fanning et al., 2019).

To facilitate spawning and the conservation of marine fisheries resources within the economic zone of Bangladesh, the government has imposed 65 days of marine fishing bans (from 20 May to 23 July) since 2015. During this period, catching any kind or species of fish and crustaceans by all types

of fishing vessels in the coastal and marine waters is banned each year. The government provides subsidies (e.g., 40 kg rice/month/family) for the affected fishers during the 65 days of bans, however, it is not sufficient to maintain their livelihoods. In addition, most of the affected fishers do not get the subsidy due to insufficient allocation. As a result, illegal fishing happens in some parts of the country. So the government might take proper strategies or readjust the compensation scheme to support the affected fishers during the ban period to refrain them from illegal fishing.

6.1.2 Tuna fisheries



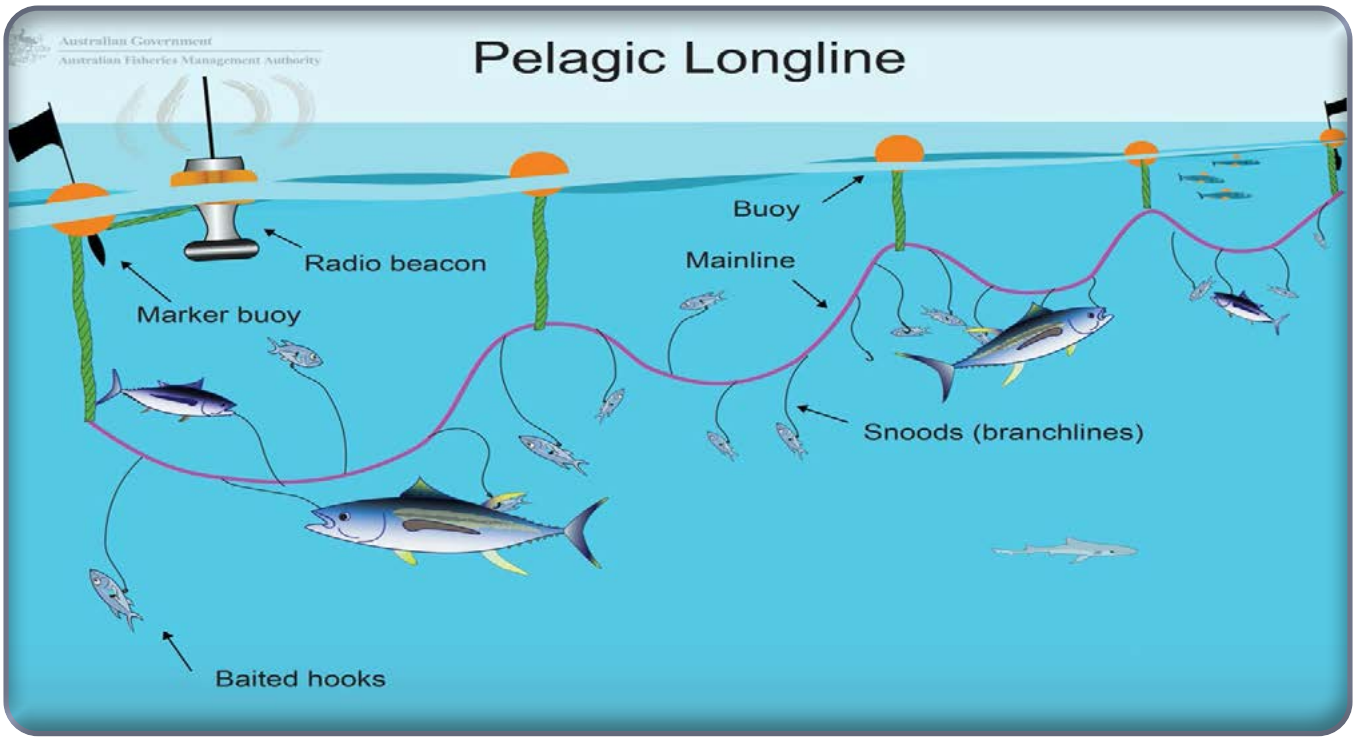


Figure 55 : Tuna Fishing

Every year, nearly 7 million tons of tuna and tuna-like species are fished worldwide (FAO, 2020). Coulter et al. (2020) reported that 67% of the world's tuna catches are made in the Pacific Ocean, 12% in the Indian Ocean, and 12% in the Atlantic Ocean. In the Indian Ocean, several tuna species like Frigate tuna (*Auxis thazard*), Bullet tuna (*Auxis rochei*), Eastern little tuna/kawakawa (*Euthynnus affinis*), Big eye tuna (*Thunnus obesus*), Long tail tuna (*Thunnus tonggol*) and Skipjack tuna (*Katsuwonus pelamis*) are usually fished by the neighboring countries of Bangladesh such as India, Sri Lanka, Myanmar, and the Maldives, etc. However, Bangladesh cannot commercially fish it yet because of the initiation stage of such a fishing industry.

The government of Bangladesh has taken several actions to harness the potential of tuna fisheries. In 2015, Bangladesh became a member of the Indian Ocean Tuna Commission (IOTC), an inter-governmental organization responsible for the management, conservation, and appropriate utilization of tuna and tuna-like fish outside the boundary of its 200 nautical miles. As a member of the IOTC, the country has to provide information on tuna stocks in its water boundary. However, the government does not have any data regarding the stock size of tuna in the maritime waters of Bangladesh and ABNJ in the Bay of Bengal. Thus, the government invites the private sector to move forward from 2016 to catch tuna and pelagic fishes beyond the 200 m depth of the Bay and in international waters. The ministry of fisheries and livestock allotted 9 long liners and 7 purse seiners fishing license agreements for tuna fisheries. The Department of Fisheries has made at least half a dozen attempts to send private sector fishermen to the deep sea where only tuna and other pelagic fish are available. But the attempts were fruitless.

Several constraints like the need for huge investment, lack of data about tuna stocks, available species and ideas about tuna fishing grounds, lack of tuna fishing skills, uncertainty to catch the expected amount of tuna, lack of business prospects, off-season job insecurity, etc. fail to woo the local fishing communities or private sector from tuna fishing. As a result, the government has taken a project 'Exploring tuna and similar pelagic fishes from the deep sea in the Bay of Bengal' in July 2020 to catch costly and migratory tuna fish from Bangladesh marine waters and ABNJ of high seas as the country

eyes to make a debut in deep-water fishing in the Bay of Bengal (DoF, 2021). The project is ongoing and it will be completed in December 2023.

The position of Bangladesh will rise higher if tuna can be sustainably extracted from the deep sea. Economic growth and employment opportunities will also be increased substantially. For this, proper attention is needed in every aspect of exploitation, handling, processing, export, and marketing as well as in biological and institutional management strategies to harness the blue economic growth.

6.1.3 Mariculture

Around the world, total marine fisheries and aquaculture production was 115.2 million tons in 2018 whereas marine culture production was 30.8 million tons (26.74% of the total marine fisheries and aquaculture production) (US$106.5 billion) excluding aquatic mammals, crocodiles, alligators and caimans, seaweeds and other aquatic plants (FAO, 2020). Despite technological developments in marine finfish aquaculture, marine and coastal aquaculture currently produce many more mollusks than finfish and crustaceans. In 2018, shelled mollusks (17.3 million tons) represented 56.2% of the production of marine and coastal aquaculture. Finfish (7.3 million tons) and crustaceans (5.7 million tons) taken together were responsible for 42.5%. However, in Bangladesh, the marine fisheries sector contributes 0.68 million tons of finfish and shellfish (mostly shrimp) in 2020-2021 FY which is 14.74% of the country's total fish production and it is mostly capture-based fisheries (DoF, 2022). Since almost most of the fish resources within our 50 m depth zone areas in the Bay of Bengal from the shoreline are harvested, mariculture can be initiated in those areas.

Figure 56 : Fishfarming by Mariculture

Bangladesh is one of the champions (5th in ranking) among the top 10 countries of the world for freshwater aquaculture. The tremendous success was achieved due to the innovation and development of artificial breeding techniques and various aquaculture technologies and extensive dissemination of those at the farm level. The leading freshwater aquaculture species are carp, tilapias, catfishes (*Pangasius* sp. and Asian catfish), and climbing perch in Bangladesh.

Though the country owns vast coastal and marine water resources, in respect of marine aquaculture farming, Bangladesh is still lagging behind other countries of South East Asia; viz. China, Myanmar, Philippines, and Vietnam. There are opportunities to initiate and introduce both brackish and marine fish species aquaculture. Lessons can be learned from the success of freshwater aquaculture breeding and farming in the country including adopting various marine aquaculture farming technologies from other countries.

The government of Bangladesh is continuously exploring to identify cultivable marine finfish, shellfish, aquatic algae, and coral species and their culture methods in the coastal and marine waters to harness the potential of the blue economy. There are opportunities to initiate and introduce both brackish and marine fish species aquaculture (Table 2). In 2018, the government implemented a pilot project entitled 'Introduction of Oyster Culture in Bangladesh' funded by the Indian Ocean Rim Association (IORA) which completed its first phase. The project faced some challenges during the initial culture period in the coastal water of Cox's Bazar (e.g., changes in water quality variables, pollution level, etc.) which required follow-up research to conclude the possibility of large-scale culture.

Table 2: Opportunities for mariculture systems development in coastal areas of Bangladesh (source: Hussain et al., 2018).

Mariculture options	Technology Adoption	Locations
Quality seed production & intensification of tiger shrimp farming	Domestication of shrimp brood stocks, SPF seed production & Semi-intensive farming	Khulna, Satkhira, Bagerhat, Sonapara, Ukhia and Chakria at Cox's Bazar
Seabass *Lates calcarifer* breeding and farming	Development of hatchery breeding techniques; Inshore and offshore cage farming	In near shore and offshore areas i.e. Moheshkhali, Kutubdia channel, Sonadia island, Saint Martin island, Dubla island & other coastal suitable regions
Grey mullet (*Mugil cephalus* breeding and farming)	Development of hatchery breeding techniques; Land-based semi-intensive farming	Cox's Bazar, Chattogram, Khulna, Bhola, Barishal & other coastal suitable regions
Saline-tolerant tilapia (GIFT/ Molobicus strain) farming	Development of hatcheries for monosex seed production; Land-based and offshore cage farming	Cox's Bazar, Chattogram, Khulna, Bhola, Barishal & near shore, and offshore areas i.e. Moheshkhali, Kutubdia channel, Sonadia island, Saint Martin island, Dubla island.
Soft shell crab, culture	Development of hatchery breeding techniques; Land-based farming in the suitable brackish water areas	Cox's Bazar, Moheshkahali, Kutubdia, Chattogram, Khulna Bhola, Barishal & other coastal suitable regions.
Pomfret breeding and farming	Identification of species suitable for breeding and captive culture; Development of breeding & culture techniques	Cox's Bazar and other suitable coastal regions
Mussel, Oyster, and other shellfish culture	Identify suitable mussels, oysters, and other shellfish species for culture Development and implementation of shellfish techniques	Cox's Bazar, St. Martins, and other suitable coastal areas
Explore and culture of sea cucumbers, sea urchins, etc.	Identification of sea cucumber and sea urchin species; Development and implementation of suitable techniques of sea cucumber and sea urchin culture & utilization	Cox's Bazar, St. Martins, and other suitable coastal areas
Development and implementation of Integrated Multi Trophic Aquaculture (IMTA)	Integrated Fish (finfish + shrimp) + Shellfish + Seaweed culture	Cox's Bazar, Chattogram, Khulna Bhola, Barisal & other coastal suitable regions

Regarding the intensification of tiger shrimp farming, the use of traditional and extensive farming practices can be avoided by initiating semi-intensive culture systems in most shrimp farms with the introduction of domestication of tiger shrimp brood stocks, production of healthy shrimp seed i.e. Specific Pathogen Free (SPF) seeds; exportation of quality feeds and adopting good aquaculture practices. Tiger shrimp are predominantly cultivated in the coastal districts of Satkhira, Khulna, Bagerhat, and Cox's Bazar, where culture areas expanded rapidly between 1970 and 1990, to about 183,221 ha (Belton

et al., 2011). By adopting semi-intensive farming, shrimp production can be achieved at 4000 – 6000 kg/ha/crop against the present low and minimum production (60 – 230 kg/ha, cited by Hossain et al., 2014).

Breeding and farming of seabass, and ***Lates calcarifer***, unlike in the Philippines, Thailand and Vietnam could be also initiated as important high-value aquaculture species. If artificial breeding and seed production techniques are evolved successfully then land-based farming onshore and case culture at offshore suitable locations can easily be expanded. As seabass is a carnivore species a special feeding method could be introduced including the formulation of high-protein feeds. Similarly, for other brackish and marine water fish species viz. mullets, pomfrets, etc. artificial breeding and farming technologies can also be evolved and implemented. To enrich finfish mariculture, saline tolerant tilapia species either the existing GIFT strain or ***Molobicus*** strain, which has already been developed by a France company in the Philippines, could successfully be utilized at suitable coastal farms as an alternative crop of shrimp aquaculture.

One of the most promising mariculture shellfish species is the mud crab, ***Scylla Serrata***, available in the brackish ecosystem in Bangladesh. Crab fattening and exporting to other countries are being done on a limited scale. Soft shell crab farming (presently being practiced on a limited scale in Sathkhira, Cox's Bazar, and Moheshkhali areas) is an innovative and new technology, which could extensively be practiced in the feasible other coastal areas like Cox's Bazar, Moheshkhali, Kutubdia, Chattogram, Khulna Bhola, Barishal regions. To sustain and intensify this practice, artificial breeding and seed production in the hatcheries will extremely be essential and for this purpose shrimp hatchery faculties in the coastal region can be utilized.

In the Asia Pacific region, the countries such as China, Indonesia, Malaysia, Taiwan, Thailand, Singapore, and Vietnam are making headway in finfish mariculture using hatchery-produced seeds and formulated feeds. Lessons can be learned from these countries and the concept of blue economy development can be incorporated into our national policy. Bangladesh might initiate marine aquaculture farming urgently where promising candidates of finfish, shellfish, and non-traditional species like abalone, crab, sponges, sea cucumber, sea urchins, etc. can be farmed.

6.1.4 Seaweed culture

Marine macro-algae or seaweeds are ecologically and biologically important sources of bioactive compounds such as carotenoids, dietary fibers, proteins, essential fatty acids, vitamins, and minerals (Gullón et al., 2020; Rengasamy et al., 2020). SeaSweeds are considered a high-quality food all over the world because of having high levels of fiber, minerals, ⊠-3 fatty acids, and moderate concentrations of lipids and proteins for human nutrition. However, the available amounts of the bioactive compounds and nutritional values of seaweeds may vary from species to species depending on the season, environmental factors, and geographical locations (Dawczynski et al., 2007).

Seaweed farming is highly developed in many coastal Asian countries such as Japan, China, Korea, Taiwan, Philippines, Malaysia, Indonesia, and Thailand. Global production of seaweed (farmed and wild) from Asia is 34.83 million tons which is valued at US$11.8 billion and contributes 97% of the total global production (FAO, 2021). According to GMI (2021), the global market value of seaweed could exceed US$95 billion by 2027.

Approximately 250 species of seaweed are found in Bangladesh (Hossain et al., 2020). Among them, 14 species are commercially viable but only four variants are being farmed, and that too on a small scale. The farmed species include ***Gracilaria tenuistipitata***, ***Ulva intestinalis***, ***Ulva Lactuca*** and ***Hypnea musciformis,*** etc. Bangladesh annually produces just around 600 tons of seaweeds (Billah and Naher, 2021) primarily along the southeast coast at present which is not notable on a global scale. With over 710

km of coastline and 25,000 km^2 of the coastal area, Bangladesh has enormous potential for seaweed cultivation as the country's beaches, estuaries and mangroves make it an ideal habitat for the plant.

The seaweed industry in Bangladesh is in an initial stage and if the full potential of seaweed is realized, the sector could grow exponentially and create numerous jobs for people, particularly women living in coastal areas such as Cox's Bazar, Chattogram, Noakhali, Patuakhali, and Satkhira (Figure). The annual seaweed utilization in our food, feed and manure, cosmetics, and pharmaceuticals industries are 47,775 kg, 11,700 kg, 13,650 kg, and 24,375 kg respectively (Billah and Naher, 2021). These could potentially contribute Tk 55.87 million to the blue economy of Bangladesh in near future.

Figure 57: Seaweed Harvesting in the Coastal Regions of Chattogram, Bangladesh

The scientists of Bangladesh Oceanographic Research Institutes are currently working on three kinds of seaweed in their laboratory to develop a commercial extraction process for agar-agar, carrageenan, and sodium alginate. Currently, Bangladeshi pharmaceutical companies import this agar-agar from other countries, which costs a huge amount of money. If we could develop the industries here, the money would remain at home. In addition, these three products have a huge demand in the pharmaceutical industry around the world. For instance, the outer shell of any capsule medicine - that plastic-like transparent shell - is made with processed agar-agar.

In Bangladesh, one local seaweed product developer has developed more than 110 products from seaweed so far, including desserts, ***balachao*** (local pickles), noodles, salad, drinks and smoothies, sunscreen, and other cosmetics. The cosmetics items vary from potato and seaweed cleansers, sunscreen, and seaweed facials with coffee, tea, milk, etc. The food items include seaweed rice wraps, seaweed salads, seaweed papads, seaweed and fish curry, seaweed custard, seaweed milk pudding, seaweed ice cream, etc.

The popularity of value-added seaweed products and their acceptance is yet to reach adequate levels among mass consumers. If proper action is taken, seaweed can be a huge industry with limitless possibilities in the future. Seaweed cultivation can be a sector of a durable economy along with ensuring food security. Along with the government, if industrial entrepreneurs of related fields come forward, seaweed farming can open a new horizon to harness the potential of blue economic growth which will enrich our national economy.

6.1.5 Marine pearl culture

Pearls are hard, a glittering substance produced by mollusks or other bivalves when a foreign body such as a grain of sand enters them and as a reflex, the mollusks begin to coat the irritant with layer upon layer of a pearly substance known as 'nacre'. Pearls are the world's most valuable stones and have been called the "queen of the jewels" throughout history. Most pearls are cultivated rather than naturally produced. Pearl culture is a type of aquaculture with significant economic, social and environmental impacts.

Pearls can be cultured in both freshwater and marine waters. At present, China is the largest freshwater pearl producer and is accountable for more than 95% of the world's freshwater pearl output. However, in terms of marine pearl production, Japan is the leading pearl-producing country (23 t) compared to China (18.6 t) (Zhu et al., 2019). In marine water, the oyster is the most dominant pearl-producing mollusk. Recently, India, Thailand, the Philippines, and Vietnam have started commercial pearl culture operations.

In 1999, the Bangladesh Fisheries Research Institute began freshwater pearl culture research (BFRI) and successfully produced pearls in pearl-producing native mussels such as *Lamellidens marginalis*, *L. corrianus*, *L. phenchooganjensis,* and *L. jenkinsianus* (Hossain et al., 2004). Under the Ministry of Fisheries and Livestock, BFRI is currently implementing 'the Pearl Culture Development and Expansion Project' (Figure). However, marine pearl culture in coastal areas of Bangladesh is still not started though we have a bright and promising prospect of marine pearl culture around the coastal regions.

Figure 58: Young Pearl Farmer beside His Pearl Culture Pond, Located at Bharatpur Village of Atgharia Upazila in Pabna district (source: Hridoye Mati O Manush).

A study conducted in 2015 reported that pearl-rearing marine bivalves are available in the coastal regions of Bangladesh. A total of 7 pearl bearing bivalve species (*Meretrix meretrix, Crassostrea sp., Perna Viridis, Placuna placenta, Pinctada margaritifera, M. lyrate*) were identified on the coast with a salinity of 18-34 ppt, pH 8.1-8.3, water depth 0.2-2.0 m and average temperature between 24-25 °C in their habitat. From the reared oyster, the highest 54 nos. small pearls in April and the lowest 7 pearls in December from a single *P. placenta* were obtained (Rahman et al., 2015). The study proved that pearls

can be obtained from marine oysters in captivity in Bangladesh, and this offers large-scale cultural potentialities on our coast. In the case of mussels, freshwater mussels are widely used to grow pearls commercially but marine mussels should also be able to create pearls research on marine mussels growing pearls is scarce and is up for intense research.

It is expected that pearl culture including both freshwater and marine will become an important component of aquaculture and mariculture in Bangladesh in near future. Freshwater pearl culture may be extended/replicated to the coastal region. In addition, help may be rendered from China/Japan/Thailand, etc. for the marine pearl culture. To grow this extremely successful business, open-minded, resourceful, and prudent entrepreneurs are required. To accomplish this, we must bring the benefits and revenues of pearl production to light and encourage people to pursue this as a livelihood option. Our country's blue economy is still on the verge of becoming successful and widespread. Thus, a highly valuable and profitable sector such as pearl farming can contribute significantly to the total economic value of the country's blue economy.

6.1.6 Non-renewable energy (gas, coal, and oil)

Figure 59 : Non-Renewable Energy

Non-renewable energy is a source of energy that will eventually run out or cannot be remade or re-grown at a scale comparable to its consumption. Most sources of non-renewable energy are petroleum, hydrocarbon gas liquids, natural gas, and nuclear energy. In Bangladesh, about 62% of its energy demand is met from non-renewable natural sources like natural gas. Still, now 26 gas fields, 24 onshore and 2 offshore have been discovered in the country. In recent times, 20 gas fields are in production, one offshore gas field has depleted after 14 years of production while another offshore field has not been viable for production due to small reserves. The estimated proven plus probable recoverable reserve was 40.09 Tcf. As of June 2020, a total of 17.79 Tcf of gas has already been produced leaving only 12.26 Tcf recoverable reserve in the proven plus probable category (Hydrocarbon Unit, 2021).

According to Hydrocarbon Unit (2021), the current average production of natural gas is about 2978 MMcfd in Bangladesh. A total of 994 billion cubic feet (bcf) of natural gas was produced in 2019-20 which was used by power 46%, fertilizer 5%, captive power 15%, industry 16%, domestic 13%, CNG 4%, and others very small amounts. The present demand for gas in the country is about 3508 MMscfd

whereas the supply is 2978 MMscfd (gas + imported LNG) indicating a shortage of about 530 MMscfd. It is estimated that demand for natural gas will rise to about 4622 MMscfd by 2030.

6.1.7 Renewable energy (solar, wind, hydro, geothermal, tidal, wave, OTEC)

Harvesting clean energy from the environment to satisfy the ever-growing energy demand is of great importance for the survival and sustainable development of human civilization. Hence, enormous efforts are being exerted worldwide to generate renewable and environmentally benign energy from wind, solar, geothermal, biomass, ocean thermal, wave, and tidal sources (Zhou et al., 2013; Jia et al., 2014).

Figure 60: Renewable Energy

Recently, the government of Bangladesh has declared that around 100% of the entire population has access to electricity and per capita, electricity generation reached 560 kWh in 2022 (The Daily Star, 2022). Most of the electricity is produced from fossil fuels like natural gas and other furnace oil, diesel, coal, and a minute amount from renewable energy sources (Hossain, 2022). However, the natural gas reserve is running out due to its extensive uses in power generation and industrial uses. The rapid decline in our reserve hydrocarbon shift of power generation mode toward coal-based power plants (Payra Thermal Power Plant - 1,320 MW) and nuclear power plant (construction going on in Rooppur Nuclear Power Plant) has increased over the last decade. The government has the vision to reduce dependence on natural gas for electricity production to contribute to greenhouse gas emission reduction and made plans for the energy to depend on renewable energy sources by the year 2030. Renewable energy will play a vital role in meeting the electricity demand, especially in the off-grid areas of the country.

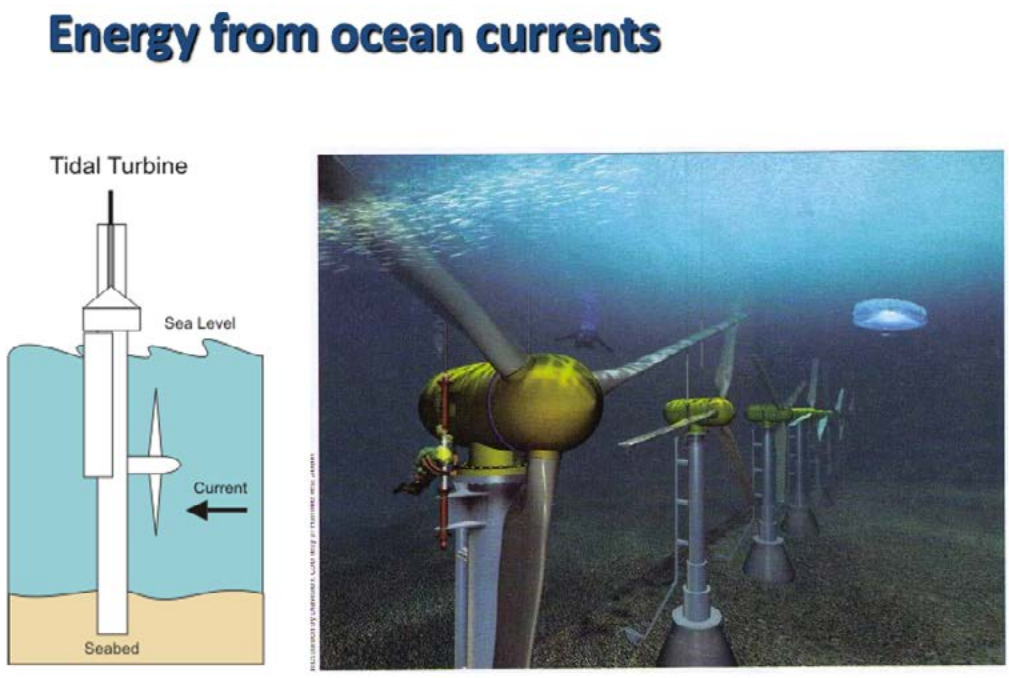


Figure 61: Energy from ocean currents

The prospect of renewable energy in Bangladesh is very promising, especially in the case of solar energy. However, shortly, renewable energy will remain annexed to the current energy genesis by non-renewable conventional means. Still, renewable energy will play an important role in reaching consumers outside the national grid or in places where the grid connection is delayed. Major sources of renewable energy in Bangladesh are as follows: 1. solar power, 2. wind power, 3. hydropower, 4. geothermal energy

Solar power

Due to Bangladesh's geographical position, it is an ideal location for solar energy utilization. Also, as it is a subtropical country, 70% of the year sunlight is plentiful. This makes the use of solar panels very effective in Bangladesh. Daily solar radiation is 4-6.5 kWh/m² and maximum radiation is generally received in the months of March-April and minimum in December-January. Hence, solar energy can be a viable solution to the power crisis in Bangladesh.

Figure 62 : Solar Power

Recently, the government issued a National Solar Energy Roadmap (SREDA) draft. According to SREDA (2022), the installed renewable energy capacity is 780.92 MW (solar energy – 546.93 MW and hydropower – 230 MW). The total figure was up from 579 MW in 2018 (Energy Tracker Asia, 2021). The jump isn't significant, but it marks a trend for what's coming next. While the Bangladesh government targets 10% renewables in the total energy mix by the end of 2021, the figure at the moment is only 3% (Uddin et al., 2019). The government has set an ambitious goal of generating more than 4,100 MW of electricity from renewable energy sources by 2030 as the county looks to cut greenhouse gas emissions significantly. It recommends a new solar target to address the sluggish clean energy progress. The aim is to have up to 40 GWs by 2041, with 40% coming from rooftop solar. If the government prioritizes the accelerated action plan, by 2041, Bangladesh can have solar energy accountable for 50% of the installed capacity.

Solar energy offers some key qualities like having no waste and emission, resulting in no adverse effects on the environment, and is ideally suited for distributed resource applications. The government has recently taken many steps to address this fact. Concurrently, some non-government organization (NGOs) is working to provide solar panels to consumers and the price of these panels, at present, is very affordable. Until now, the expansion of renewable energies, such as wind and solar power, has mainly taken place onshore. The energy in the oceans has remained largely untapped. But things are changing at present. The production of environmentally friendly energy from the oceans is now being promoted worldwide. Expectations are high. It is hoped that wind, waves, and ocean currents will meet a substantial share of the world's electricity needs.

Wind Energy

Figure 63 : Wind Energy

Wind power is the conversion of wind energy by wind turbines into a useful form, such as electrical or mechanical energy. The power is directly proportional to the velocity of the wind. The lengthy period of wind flux, particularly in the islands and southern maritime facial of Bangladesh, announces that the average wind speed remains between 3 and 4.5 m/s from March to September and 1.7 to 2.3 m/s for the rest of the year. So, in islands and coastal areas, the appeal of windmills for pumping and electrification is very high. Bangladesh Power Development Board (BPDB) has completed a 1000 kW capacity wind battery hybrid power project in the Kutubdia islands. Under this project, a total of 50 units of 20 kW

capacity stand-alone type wind turbines are being installed. The total power generated by all the wind turbines is stored in a battery bank. Wind Battery Hybrid Power Plant (WBHPP) was officially started on March 30th, 2008. The other project of BPDB completed a 0.90 MW capacity grid connected to wind energy at the Muhuri Dam area in Feni district in 2004 (Ullah et al., 2012). The BPDB has allotted that wind energy can contribute up to 10% of the energy generated. One major benefit of wind turbines is that they do not need any fuel for electricity generation. The feasibility of wind conditions for the generation of electricity at different places in Bangladesh are varied and the maximum annual average wind speed is 2.42 m/s in Cox's Bazar and a minimum of 2.08 m/s in Hatia Island (Khairul and Husnain, 2011). Even though solar power dominates the renewable energy mix of Bangladesh, wind, for now, remains at a very low (2.9 MW) (SREDA, 2022).

Hydropower

Figure 64 : Hydropower

Kinetic energy from streaming or perishable water is exploited in hydropower plants. Hydropower plants are classified into two categories: large (> 10 MW) and small (< 10 MW). On average, 1.4 trillion cubic meters of water flow in Bangladesh per year, and the annual average rainfall is 2,300 mm, which varies from 1,200 mm in the northwest to 5,800 mm in the northeast. Recently, a 230 MW hydropower generation plant was set up in Karnaphuli, Rangamati. It is the only hydro station in Bangladesh and is operated by BPBD. Micro and mini hydropower plants have limited potential in Bangladesh except for those in Chattogram and the Chattogram hill tracts region.

Geothermal energy

Geothermal energy is a very powerful and efficient way to extract renewable energy from the earth through natural processes. This can be performed on a small scale to provide heat for a residential unit or on a very large scale for energy production through a geothermal power plant. It is cost-effective, reliable, and environmentally friendly but it has previously been geographically limited to areas near tectonic plate boundaries. With this technology, the steam and hot water produced inside the earth's surface can be used to generate electricity. Bangladesh has various locations for harnessing geothermal resources. Geothermal energy is generated about 4000 miles beneath the surface, in the earth's core. The process takes place due to the slow decay of radioactive particles generating the high temperatures needed to produce steam. About 10,716 MW of geothermal energy is generated in

total in 24 countries worldwide. The northern districts of Bangladesh show the prospect of exploring geothermal resources. As the demand for electricity in urban as well as in rural areas is increasing, our production of electricity is not. The rural electricity demand can be covered by the production of electricity through geothermal energy. A private company Anglo MGH Energy has initiated a project to set up the country's first 200 MW electricity generation plant from geothermal sources close to Saland in the Thakurgaon district.

Figure 65 : Geothermal Energy

Tidal power

Tidal power is a form of hydropower that converts the energy of tides into electrical power. As tides are more predictable than wind and sunlight, tidal energy can easily be generated from the changing sea levels. Dams or barrages with water turbines can be placed diagonally in a river's mouth or inlets to generate electricity from the motion of tides. The coast of Bangladesh has a tidal rise and fall from 2 to 5 m. Among these coastal areas, Sandwip, which experiences 5-meter tidal waves, has the best prospect of generating tidal energy. Moreover, according to existing literature, Bangladesh can generate tidal power from these coastal tidal resources by applying low-head tidal movements and medium-head tidal movements. Low-head tidal movements use tides of height from 2 m to 5 m in areas like Khulna, Barisal, Bagerhat, Satkhira, and Cox's Bazar regions. In contrast, medium-height tidal movements use more than 5 m high tides which are available in Sandwip (Ullah et al., 2012). So, geothermal can be a great source of energy for electricity generation in Bangladesh.

Figure 66 : Tidal Power

Ocean wave energy

Ocean wave energy is generated directly from waves in oceans. It is another viable type of renewable energy which helps to decrease the harmful emissions of greenhouse gases associated with the generation of power. It has the potential of being a significant source of electricity in Bangladesh. Though the main purpose of ocean wave energy plants is to generate electricity, they can also be used for pumping water, water desalination, etc. The oscillating water column method is technically feasible and is becoming economically attractive for this purpose in many countries. This type of wave energy harnessing device is being commissioned by several countries such as the UK (500 kW), Ireland (3.5 MW), Norway (100 kW), India (150 kW), etc. Bangladesh has the potential for harnessing ocean wave energy from the Bay of Bengal.

Figure 67 : Ocean Wave Energy

OTEC (ocean thermal energy conversion)

Ocean thermal energy conversion produces energy from temperature differences in ocean waters. OTEC is a process or technology for producing energy by harnessing the temperature differences (thermal gradients) between ocean surface waters and deep ocean waters.

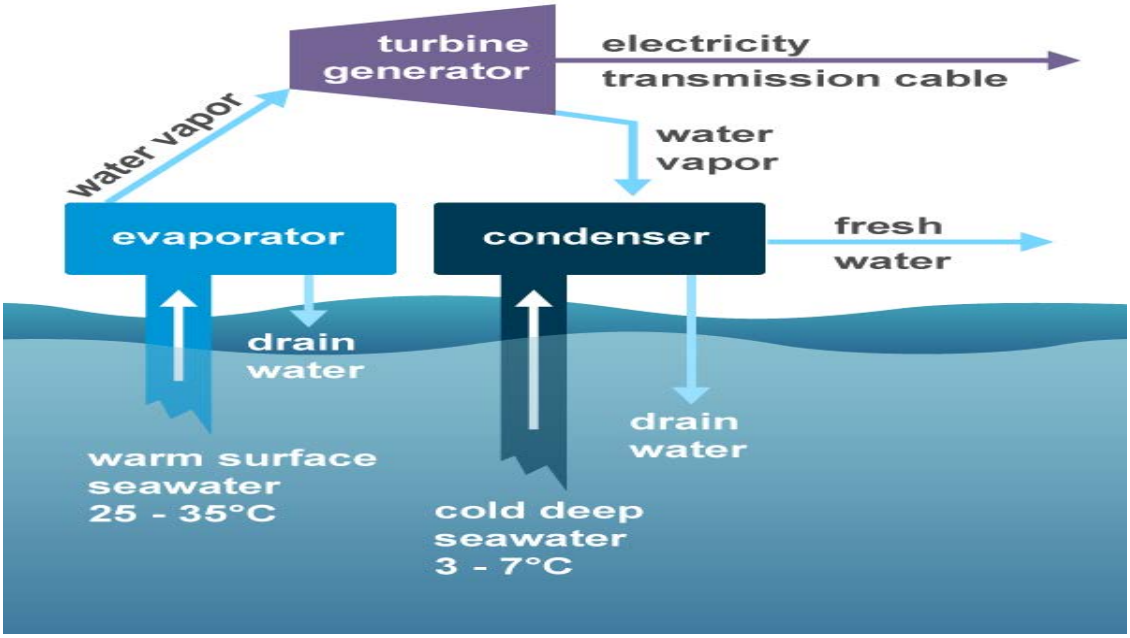


Figure 68 : OTEC (Ocean Thermal Energy Conversion)

Energy from the sun heats the surface water of the ocean. In tropical regions, surface water can be much warmer than deep water. This temperature difference can be used to produce electricity and desalinate ocean water. OTEC systems use a temperature difference (of at least 77° Fahrenheit) to power

a turbine to produce electricity. Warm surface water is pumped through an evaporator containing a working fluid. The vaporized fluid drives a turbine/generator. The vaporized fluid is turned back to a liquid in a condenser cooled with cold ocean water pumped from deeper into the ocean. OTEC systems using seawater as the working fluid can use condensed water to produce desalinated water.

Energy derived from temperature differences

OTEC utilizes the temperature difference between warm surface water and cold deep water to generate power. To drive the steam cycle in an OTEC power station, the temperature difference must be at least 20°C. The technology is therefore more suited to warmer marine regions. The warm water is used to evaporate a liquid that boils at low temperatures, producing steam which drives a turbine. Cold seawater (4 to 6 degrees) is then pumped up from a depth of several 100 m and used to cool and condense the steam back to liquid form. Until now the cost of OTEC technology has been considered prohibitive, requiring pipelines of several 100 m in length and powerful pumping systems. The US government supported OTEC development and initial testing in the mid-1970s but withdrew its funding in the early 1980s. Interest in the technology has recently been rekindled, however. An American-Taiwanese consortium is now planning to construct a 10 MW facility in Hawaii. Furthermore, public institutions and businesses in France have launched the IPANEMA initiative, which aims to promote both ocean-based renewable energies and OTEC technology. It is estimated that OTEC has the potential to harness several 1000 TWh of electric power each year. Unlike wind and wave energy, this form of electricity production is not subject to fluctuating weather conditions.

In the Bay of Bengal, there are three large basins: the Krishna Godavari basin of India, the Rakhine basin of Myanmar, and the Bengal basin of Bangladesh. Geologists consider the Bengal basin to be one of the most resourceful basins in the Bay of Bengal after the Krishna Godavari basin of India. On Bangladesh's marine border, it discovered 25 shallow and deep-sea blocks (Figure). Only three blocks for gas and oil exploration have been given thus far. Yet her institutional and technological ability is not advanced enough to properly explore and manage these resources.

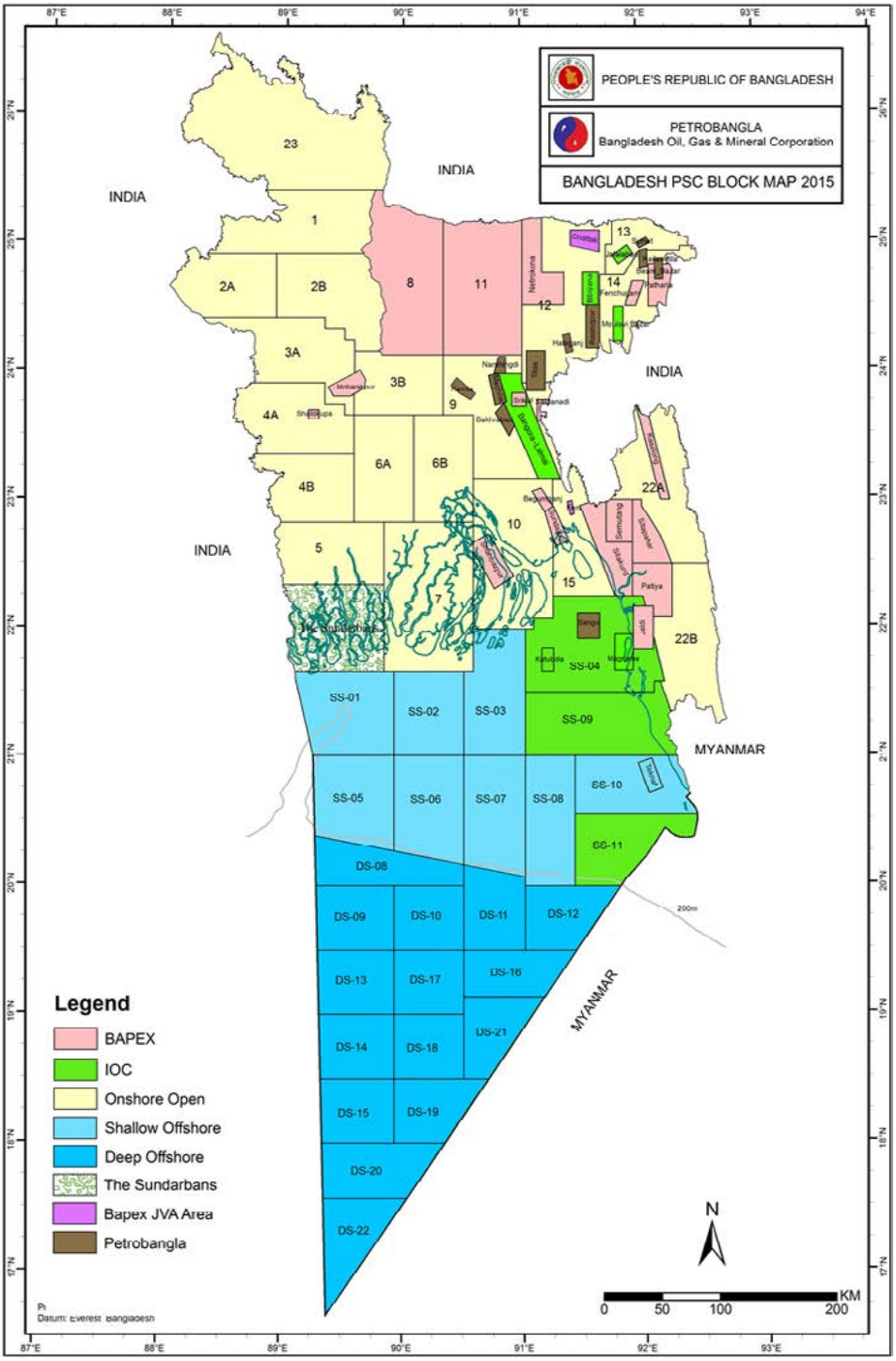


Figure 69 : Onshore and Offshore Gas Blacks of Bangladesh

Bangladesh Petroleum Exploration and Production Company Ltd. (BAPEX) is set to initiate the first-ever oil and gas exploration in offshore Magnama very soon under a joint venture with Australian Santos which will carry out offshore drilling. BAPEX and Santos are currently mobilizing rigs and all necessary equipment to commence hydrocarbon exploration at the offshore site. The Santos-BAPEX joint venture also aims to initiate the drilling of the Magnama-2 well. The Magnama structure is located within block 16 areas where the now-shut Sangu well is located. Interpretation of the survey indicated the natural gas presence in the Magnama structures that consisted of several stacked structural stratigraphic

reservoirs with at least four zones marginally intersected in the Magnama-1 discovery well. According to media sources, Bangladesh and India would jointly drill a new block in the Bay of Bengal under PSCs to expand gas output. The SS-4 block, located in the Bay of Bengal, will be drilled by Oil and Natural Gas Corporation (ONGC), Videsh Ltd, Oil India Ltd, and Bapex.

Making the extraction of gas and oil from offshore sites will enable Bangladesh to tackle its ever-increasing need for gas for power easier and it will help sustain the onshore gas fields longer. But, extracting gas from offshore sites is not like onshore gas fields. So many variables work against the whole process and those are actively tackled by the rig which requires extensive knowledge and experience and money to implement Bangladesh, as of now, lacks experts in this sector to facilitate funding or any kind of work whatsoever. So, this project aims at determining possible sites for non-renewable energy and how to extract them profitably. We need to lessen our dependence on foreign countries over such an important sector to keep the profits to ourselves instead of sharing them with other countries for lack of expertise.

Natural gas and solid biomass and waste account for the majority of Bangladesh's total primary energy consumption with the remainder being oil, coal, and hydro. In 2012, Bangladesh's primary energy consumption was an estimated 55% natural gas, 27% traditional biomass and waste, 15% oil, 3% coal, and less than 1% hydropower and solar, according to the International Energy Agency.

Bangladesh, the eighth largest natural gas producer in the Asia Pacific region in 2014, produced 833 Bcf/y, all of which were domestically consumed. Natural gas production in Bangladesh has steadily increased by an annual average of 6% from 2004 to 2014. However, Bangladesh still faces acute natural gas supply shortages, especially in the electricity sector. These shortages, in turn, have led to rolling blackouts of electricity.

Onshore fields currently supply all of the country's natural gas supply, although production of these mature fields is expected to plateau in the next few years. Bangladesh is seeking greater investment in its offshore area. The country plans to launch its next licensing round for several shallow glasses of water and deep-water fields in 2016, about four years after its last tender.

Bangladesh also hopes to increase natural gas supply through LNG imports to limit strains on its power grid and reduce blackouts. In 2014, state-owned Petrobangla signed a preliminary agreement with a US consortium, consisting of Astra Oil and Excelerate Energy, to build the country's first offshore floating LNG import terminal with a regasification capacity of 240 bcf/y. Bangladesh is prioritizing natural gas imports to relieve some of the gas shortage issues in the short term and intends to expedite the development of its first LNG terminal. Bangladesh is seeking to extend a memorandum of understanding signed with Qatar to supply natural gas to the terminal with the expectation that the terminal will come online by 2017. Also, the state-owned Power Cell is evaluating plans to build an onshore LNG import terminal at Moheshkhali Island in the Bay of Bengal.

Natural gas

Figure 70 : Natural Gas

Natural gas played a vital role as the main energy source in the rapid development of Bangladesh, production, and consumption has been increased drastically during the last decades. In Bangladesh, significant quantities of the natural gas reserve have been identified by geological and geophysical explorations. In 1993, the initial estimated recoverable gas reserve was around 12.43 Tcf. The amount became around 26.84 Tcf by 2011 and finally grew to 27.12 Tcf at the end of 2017. From this amount, around 15.22 Tcf of gas has already been produced. Right now, the country has around 10 Tcf of gas left for extraction in 22 different gas fields. While the annual consumption is close to 1 Tcf.

Bangladesh's local gas production is already marking significant drops, leading to a shortfall in the fossil energy source and increased gas imports in the form of liquefied natural gas (LNG). Data provided by the government-owned national energy resources company, Petrobangla, show that daily gas consumption in the country currently stands at 3,126 million cubic feet per day (mmcfd). Of this, 2,284 million cubic feet of gas is generated from domestic sources, while the rest is imported from the Middle East. In 2020, the local fields produced 2,570.4 million cubic feet of gas per day. Within two years, the local gas production has come down by 286.4 mmcfd and, consequently, reliance on LNG imports is increasing to bridge the gap between the demand and supply from domestic sources. But the volatile LNG pricing trend on the global market hints at a major danger for Bangladesh in availing of the pricey product in the future. Experts and stakeholders said depleting reserves in the operational gas fields along with sluggish exploration work to discover new gas basins have set off alarm bells, foreshadowing a major disruption in economic activities. If a rigorous gas exploration program is not taken up straight away, the gas-based industrial infrastructures, including readymade garment factories, power plants, and fertilizer factories, will suffer a big setback with a sudden supply fall. Because of increased consumption, triggered by massive economic growth over the past decade, amid no new major gas discoveries. So, it is, therefore, an urgent need to increase the number of gas reserves. An alternative and effective way is to the development of off-shore gas fields to increase the gas reserve.

Coal

Coal is a readily combustible sedimentary rock composed essentially of lithified plant materials, with

a small amount of inorganic matter present in the form of mineral impurities. Wet, spongy, and porous organic debris called peat is compressed, lithified, and altered to coal by burial compaction and thermal alteration. As the coalification of peat proceeds with increasing burial, progressively higher-ranking coal is generated. Accordingly, coal has been classified into the following ranks: 1. lignite or brown coal, 2. sub-bituminous coal, 3. bituminous coal, and 4 anthracite coal.

Figure 71 : Coal Mining

The quality of coal is determined by the amount of moisture, fixed carbon, volatile matter, ash, and total sulfur present. Coal was the principal commercial energy source in the world till the end of the nineteenth century. With the advent of petroleum resources, the share of coal in the world's energy mix had reduced. Yet, it remains a leading fuel throughout the world.

To date, five major Gondwana coalfields have been discovered in Bangladesh. In order of discovery year, these are Jamalganj (1962), Barapukuria (1985), Khalashpir (1989), Dighipara (1995), and Phulbari (1998). It is more than a hundred and seventy years since geologists forecasted the good possibility of discovering a large coal deposit beneath the alluvial plain of North Bengal. The hopes of the geologists were vindicated when in course of searching for oil in 1959 SVOC drilled a hole in Kuchma X-1 in the Bogra district, where Gondwana coal was encountered at a depth of 2381 m from the surface. Consequently, in 1961 under the UN-Pak Mineral Survey Project the Geological Survey of Pakistan (GSP) carried out detailed geological, geophysical, and drilling operations in the districts of Bogra and Rajshahi and found coal resources of about 1,050 million tons in Jamalganj. Barapukuria coalfield was discovered in 1985 by' GSB in the Dinajpur district. Coal layers are encountered at a shallow depth of about 18-500 meters. In 1989 GSB discovered another coalfield at Khalashpir in the Rangpur district where coal layers are encountered at depths of about 257-450 m below the surface. In 1995 another major coalfield was discovered by GSB at Dighipara where coal was encountered at a depth of about 250 m below the surface. A USA- Australian coal mining company BHP discovered a major coalfield named Phulbari in 1997. Here coal was encountered at depth of 130-260 m below the surface. The total coal reserve in the five discovered fields in the country is about 2000 million tons. In 2019, total energy production and consumption from coal were 0.021 and 0.171 quadrillion Btu (USEIA, 2022).

Besides the Permian Gondwana coal in the northern part of Bangladesh, GSP discovered two beds of

ligno-bituminous Tertiary coal in the Takerghat-Baglibazar area at a depth of 45 m to 97 m below the surface in the years 1960-62. The beds are 0.90 m to 1.70 m thick and reserves were estimated at 3.00 million tons.

At present coal is being produced commercially only from the Barapukuria underground coal mine in the Dinajpur district which has gone through a period of 8 years of construction and one year of production. The current production rate is about 1500 tons per day. The plan to establish an open-pit mine in nearby Phulbari was aborted last year in the wake of mass protests by the local people. Coal in the Jamalganj-Paharpur area is too deep to mine. The extraction of coal bed methane from this field is under consideration.

The facts that make coal mining difficult in Bangladesh are the greater depths of coal seams and more importantly the occurrence of a 100 - 200 m thick loose water-bearing sandy layer covering the coal deposits. In 2002, National Gas Utilization Committee forecasted that the share of coal in the energy mix of Bangladesh will not change very significantly in the short to medium-term future and its contribution will possibly remain in the range of 4-6% of the total commercial energy input of the country. Most energy experts believe that there is no option for Bangladesh other than mining its coal for power generation because the future power demand cannot be met from gas-based power plants as the gas reserve is too limited to run for long. At present, the only coal-based power plant (250MW) in the country is in operation near the Barapukuria coalmine, which feeds the plant. If the Barapukuria mine runs efficiently for its expected lifespan and if feasibility studies conducted in other fields conclude positively only then we can expect that the contribution of coal to the total energy mix in the country will increase in the future.

Coal can be extracted in two ways: open-pit and close-pit. There are trade-offs between open and close pit methods. Open pit extraction is associated with massive environmental pollution, habitat destruction, and displacement of residents. On the contrary, close-pit or underground coal extraction creates less environmental impact comparing open-pit extraction. However, coal production might be 50-60% less in close-pit methods than in open-pit methods.

Scientists have determined that extracting and burning the world's remaining coal reserves would tip the scales toward irreversible climate change. Coal is the world's single biggest contributor to global warming. Whereas most of the developed world has abandoned coal, governments in poorer countries like India and Bangladesh are trying to squeeze out what they can out of the natural resources, despite damning effects of air contamination that have already made their cities among the most polluted and unlivable in the world: Delhi's air is already three times more toxic than Beijing's; Dhaka city's air was measured to have the highest density of lead in the world. In 2050, it is assumed that international communities might impose restrictions on coal extraction all over the world. After this period, the government of Bangladesh might not be able to extract coal i.e. our coal reserve might remain unutilized. So the government of Bangladesh, despite the environmental critics, hopes to increase its coal production by 2030.

Oil

Bangladesh holds 28 million barrels of proven oil reserves and it ranks 82nd position in the world (Worldometer, 2022). Total Oil Reserves in Bangladesh are less than even a single year of oil consumption (41.25 million barrels as of 2016), making Bangladesh highly dependent on oil imports to sustain its consumption levels. Bangladesh consumes 113,000 barrels of oil per day (B/d). In terms of oil consumption, she ranks 77th in the world, accounting for about 0.1% of the world's total consumption of 97.10 million barrels per day. The country consumes 0.03 gallons of oil per capita every day (based on the 2016 population of 158 million), or 11 gallons per capita per year [1 barrel = 42 US Gallons], and produces 4,105 barrels per day of oil (as of 2016) ranking 99th in the world. Bangladesh produces every

year an amount equivalent to 5.4% of its total proven reserves (as of 2016) and imports 21% of its oil consumption (23,554 barrels per day).

Bangladesh is a net importer of crude oil and other liquids. In 2014, the country produced 4,800 barrels per day (bbl/d) of petroleum and other liquids and consumed more than 124,000 bbl/d. Because oil consumption has been increasing since 2010 to make up for the shortage of natural gas, especially in the power sector, Bangladesh continues to increase its crude oil and oil product imports. Bangladesh processes crude oil at its 28,000-bbl/d-refinery owned by Eastern Refinery Limited (ERL), a subsidiary of Bangladesh Petroleum Corporation. Bangladesh Petroleum Corporation initially planned to triple the refinery's capacity by 2016, although little progress has been made thus far.

6.1.8 Hydrocarbon (gas exploration, buying ship, leasing ship)

Sadly, offshore drilling in Bangladesh is practically almost non-existent and the exploration data is not sufficient to analyze the country's oil and gas reserve. However, from the deltaic nature, depositional history, and sediment criterion, it seems that deep offshore and adjacent areas might be rich in oil and gas. State-run Oil and Natural Gas Corp has made a huge exploration in the Bay of Bengal with initial estimates suggesting reserves of about 21 Tcf. So there is a big reservoir of hydrocarbon in our Bay of Bengal region.

Figure 72 : LNG

Bangladesh currently has 26 blocks in the Bay. Of them, 15 are deep-sea blocks and 11 are in shallow waters. Bangladesh is trying to conduct exploration using its resources in some shallow water blocks. The deep-water blocks may be placed for international bidding. Only three blocks for gas and oil exploration have been given so far. Two Production Sharing Contracts (PSCs) were signed with ONGC Videsh Ltd (OVL) and Oil India Ltd (OIL) for drilling at blocks SS-4 and SS-9 during the Bangladesh Offshore Bidding Round of 2012. A PSC for deep-sea block DS-12 was signed with South Korean oil and gas company POSCO DAEWOO Corporation under the "Quick Enhancement of Electricity and Energy Supply (Special Provisions) Act, 2010 but didn't become successful due to disagreement about gas costs. Fortunately, Bangladesh currently has 27 gas fields, with the latest one being in the southwestern coastal district of Bhola in October 2017, the biggest one so far, having hundreds of billions of cubic feet of reserves (The Business Standard, 2021). The recoverable gas resource was estimated to be approximately 12.43 Tcf in 1993. By 2011, it had risen to roughly 26.84 Tcf, and by the end of 2017, it had reached 27.12 Tcf. Around 15.22 Tcf of gas has been generated so far from this quantity. As a result, the remaining 12 Tcf of gas may be saved for later. Furthermore, the country's residual gas resource is expected to be sufficient to meet the country's expanding natural gas demand for the next 10–12 years (Shetol et al., 2019).

There is a need for the exploration of new gas reserves to support the future needs of the country. The expansion of existing gas fields to enhance the gas reserve referred to as "reserve growth," is an alternate and successful method. Reassessing reservoir parameters using modern techniques will greatly enhance the number of gas reserves (Shetol et al., 2019). Bangladesh is spending huge foreign currency on importing crude oil and hence drawing back in terms of sustainable development. The time has come to focus on petroleum exploration in the vast offshore areas. To utilize the huge reservoir of hydrocarbon for strengthening the economy and to gain the ability to explore those areas exactly where gas and oil can be found a research vessel is needed. Till now, Bangladesh has only two research vessels namely RV Meen Shandhani and CVASU Research Vessel (CVASU, 2022). These vessels need to be fully operational and have to utilize their full exploration capacity with efficient manpower and crew decoration.

6.1.9 Gas (methyl) hydrate

On January 5, 2022, Bangladesh found the presence of 17-103 Tcf of ice-like hydrate (gas hydrate) deposits containing huge amounts of methane (Sajid and Siddiqui, 2022). This has been interpreted

as a 'blessing' and a 'ray of hope for the country with the expectations that Bangladesh has all the opportunities to tap into the 'potential gold mine' and achieve the goal of a 'Blue Economy' through natural gas energy. Based on the available seismic survey data, the presence of gas hydrate was identified at water depths from about 1,300-2,850 m below the seabed at a depth ranging from 220 to 440 m in the Bay of Bengal.

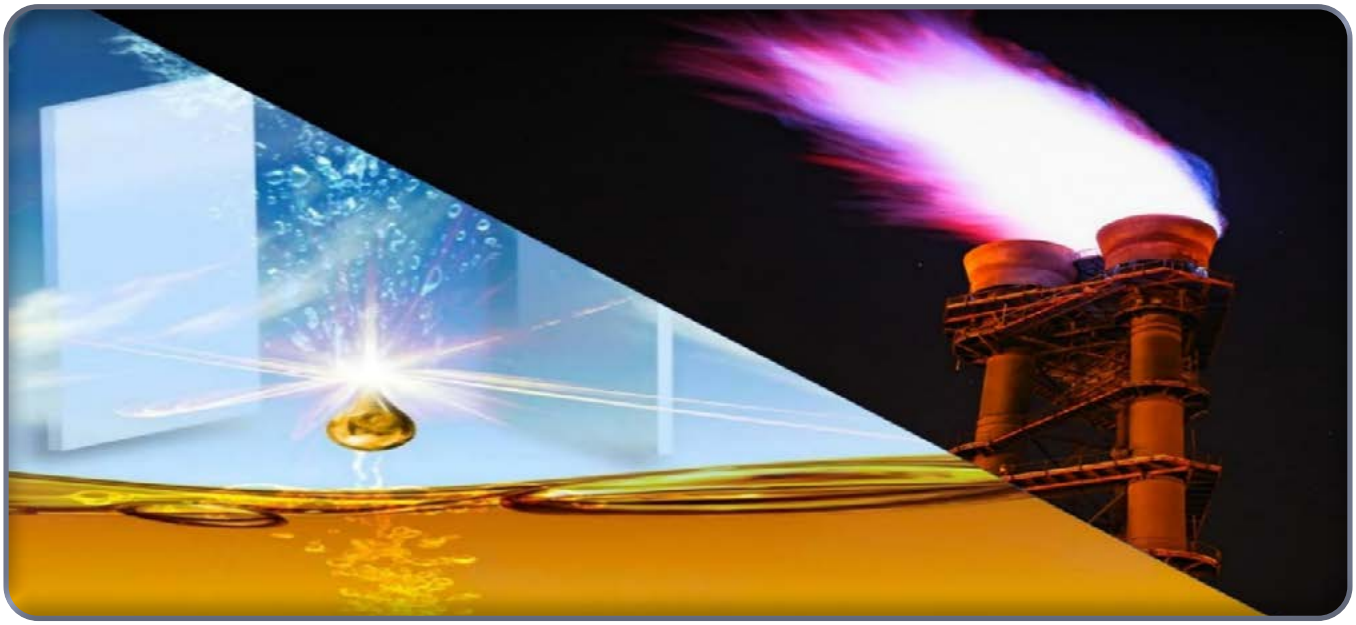


Figure 73 : Conversion of Methane into Natural Gas

Although there is still a large gap to achieve commercial gas production from NGH reservoirs, research and development (R&D) activities and programs have been progressing around the world. Countries including the United States, Canada, Japan, South Korea, China, and India have taken the lead in NGH research. China conducted its first operation to extract natural gas from gas hydrates in the South China Sea in 2017. Recently in February 2020, China extracted 861,400 cubic meters of natural gas from gas hydrates found in the South China Sea. The production process also set two world records: one for the largest total volume extracted and another for the most produced – 287,000 m^3 – in a single day (Ministry of Natural Resources of China). Before that, in 2017 China extracted natural gas hydrate from mines in the Shenhu area of the South China Sea, drilling 203-277 m below the depth of 1,266 m (Rahman, 2022).

While Bangladesh at COP26 committed to gradually cutting down its fossil fuel usage and going for green energy, the country still needs fossil fuels like natural gas in the next two decades to ensure a smooth transition and energy security. Now, the discovery of gas hydrates has come as a blessing. Bangladesh has a lot to do with this potential gas resource but insufficient funding, high technology, materials for digging and welling, etc. are the major challenges to exploring and exploiting these gas resources.

Bangladesh has estimated potential natural gas hydrate deposits of 0.11 to 0.73 Tcf in its exclusive economic zone (EEZ) areas alone, which is equivalent to 17-103 Tcf of natural gas reserves, according to the Foreign Minister and his colleagues. A complete seismic survey of all areas of EEZ and the continental shelf of Bangladesh will help determine the actual reserves, they said. Foreign Minister Dr. AK Abdul Momen, State Minister for Foreign Affairs Md Shahriar Alam, and Secretary, Maritime Affairs Unit (MAU) at the Ministry of Foreign Affairs Rear Admiral (retd) Md Khurshed Alam jointly shared the outcome of a desktop study at a media briefing at the Ministry of Foreign Affairs. Dr. Momen said Prime Minister Sheikh

Hasina had been very positive about this study from the very beginning and given all kinds of support. "Undoubtedly, the results of this study are very encouraging for Bangladesh. This huge reserve of gas hydrates is a landmark event in the context of Bangladesh, especially in the next century, in resolving the energy crisis and as a source of environment-friendly fuels," he said. The foreign minister hoped that Bangladesh would soon enter a new era in the field of energy through the extraction of gas hydrates. After the formation of the Desktop Study Group, the work was completed through the relentless efforts of Petrobangla, Bapex, and local experts, including the National Oceanography Centre in Southampton, UK, over the past three years, group leader Khurshed Alam said. This study group worked even in the stagnation caused by covid-19, he said, adding that the study had been completed and the presence of gas-hydrates had been found. "A preliminary idea about its location, nature, and reserves has been found." According to this study and based on preliminary observations, Alam said there was evidence of the presence of natural gas hydrates in significant areas of EEZ in Bangladesh. The presence and potential of this huge amount of gas hydrate are expected to play an important role in meeting the overall demand of Bangladesh's energy sector in the next century, he said. The results of the study will be forwarded to the Energy and Mineral Resources Division for conducting a full seismic survey to determine the quantity and presence of actual reserves and to determine the environmental impact and mitigation strategies. In addition, the study will be published in a world-renowned research journal.

6.1.10 Energy policy/energy mix

In Bangladesh, the government has given continuing attention to the overall development of the energy sector in recognition of the importance of energy for socio-economic development. The first National Energy Policy (NEP) of Bangladesh was formulated in 1996 by the Ministry of Power, Energy, and Mineral Resources to ensure proper exploration, production, distribution, and rational use of energy resources to meet the growing energy demands of different zones, consuming sectors and consumers groups on a sustainable basis With the rapid change of global as well as domestic situation, the policy was updated in 2004 (MPEMR, 2004). The updated policy included additional objectives namely to ensure environmentally sound sustainable energy development programs causing minimum damage to the environment, to encourage public and private sector participation in the development and management of the energy sector, and to bring the entire country under electrification by the year 2020.

It is mentionable that the Power System Master Plan (PMSP 2010) is the Study for Master Plan on Coal Power Development in the People's Republic of Bangladesh. The Plan is based on the Vision 2030 Long Term Power Development Strategy for Bangladesh. Its objective is delivering a stable and high quality electricity to the People of Bangladesh via the creation of a power network that will help realize comfortable and affluent lifestyles for all. Government of Bangladesh has a target to become a developed country by 2041. The development of energy and power infrastructure therefore is very important for the long-term economic development of the country. Power System Master Plan (PSMP) 2016 was prepared in aiming at formulating a comprehensive energy and power development plan up to the year 2041, covering energy balance, power balance and tariff strategies.

We all know that the vision of the country is to become a middle-income nation by 2026 and a high-income nation by 2041. Governed by this vision, the net electricity demand is forecasted to be 61 GW by 2041. The power-generating sector of Bangladesh largely depends on natural gas since the reserve of natural gas is higher compared to all other fossil fuel-based energy resources. About 65% of final energy consumption comes from different biomass fuels and about 30% of consumption comes from different renewable sources. Despite all these efforts, we are still far away from being self-sufficient in the energy sector. However, natural gas is predicted to deplete by the year 2028, which threatens the future energy security of Bangladesh. Therefore, Bangladesh needs immediate attention to the modification of its existing energy mix to meet future energy demands for sustainable economic growth.

Due to a shortage of capital, it has not been possible to undertake systematic development of Power Generation, Transmission, and Distribution projects and rational use of electricity in the country. For these, we need to invest more in exploring new hydrocarbon sources in our unexplored maritime region, particularly in offshore areas. However, increasing fossil fuel consumption is responsible for greenhouse gas emissions which exacerbated environmental concerns. So, we need to emphasize renewable energy sources such as solar energy, wind energy, energy derived from the ocean, salinity gradient energy, etc. as well. For this, the government needs to update the energy policy and efficiently introduce an energy mix. Being a developing country, it is necessary to provide energy for sustainable economic growth so that the economic development activities of different sectors are not constrained due to a shortage of energy.

Bangladesh's economic growth and development performance over the past decades has been impressive. The country has achieved 7% plus growth despite minimum mineral and natural resources. A huge supply of electricity is required to support the growing export-oriented industry in the country. The government has envisioned coverage of electricity for the entire population of Bangladesh by 2021. The government has taken extensive plans to increase electricity to 40,000 MW by 2030 and 60,000 MW by 2041. However, well-qualified professionals and all infrastructure systems are prerequisite factors to support the energy policy of the country. Natural gas is the main source of Bangladesh for power generation. The reserve of gas is not enough to support the increasing energy demand. Considering the growing demand, inadequate gas supply has driven Bangladesh's policymakers to differentiate energy sources for power production.

6.1.11 Marine Biotechnology and Therapeutics

Marine biotechnology (or blue-biotechnology) is a young subset of biotechnology and simply refers to the science and technology that uses marine bio-resources such as fish, algae, bacteria, and invertebrates, or their parts, to bring desirable products and other benefits to humans. It is one of the fastest emerging high-technology sectors in the blue economy with a market of about US$3.7 billion in 2022 (Global Industry Analysts Inc., 2022). It has wide-ranging applications in industrial sectors including pharmaceuticals, cosmetics, nutritional supplements, molecular probes, enzymes, and agrochemicals. There are enormous prospects and potentials for blue biotechnologies using various marine medicinal, nutritional and ornamental resources.

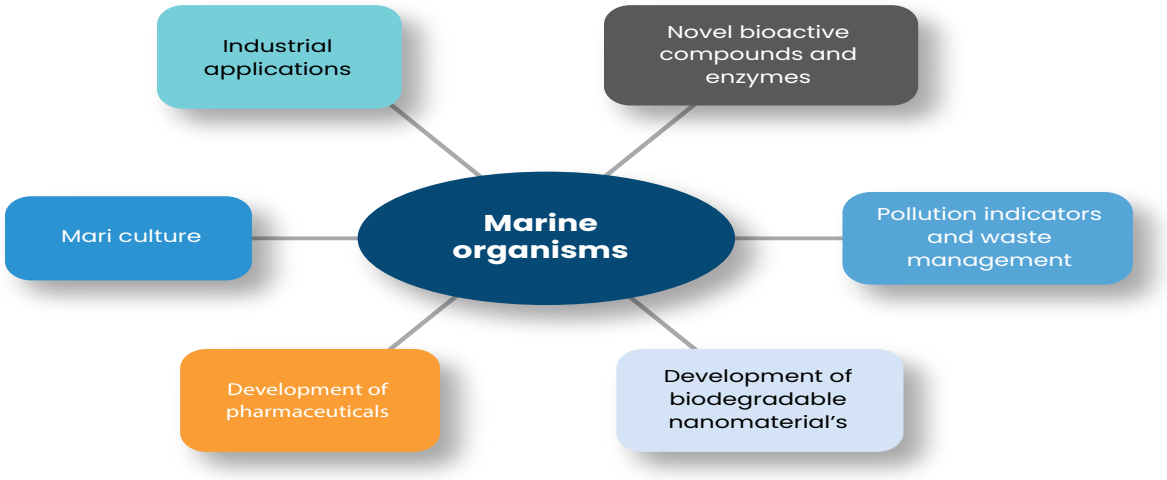


Figure 74 : Marine Resources and Animals in Modern Biotechnology

Marine biotech has the potential to address a suite of global challenges such as sustainable food supplies, human health, energy security, and environmental remediation. Marine genetic resources like bacteria are a rich source of potential drugs. In 2020 there were over 36 marine-derived drugs in clinical development, including 15 for the treatment of cancer (Midwestern University, 2022). One area where marine biotech may make a critical contribution is the development of new antibiotics. The potential scope is enormous; more than 30,000 novel chemicals have been identified by marine bioprospecting and 300 patents registered on marine natural products over the last five decades (Alves et al., 2018). The unexplored and understudied nature of much of the underwater world means that the capacity of marine organisms other than fish and shellfish to provide inputs to the blue economy is only just beginning to be appreciated, partly through new gene sequencing technologies for living organisms. In the next stage, around 20-25 years from now and subject to technological breakthroughs, the blue biotechnology sector could become a provider of mass-market products, together with a range of high-added value specialized products, and the activity is expected to generate 10-12% annual growth in the coming years.

Exploration of the sea biodiversity is now helping us understand, for example, how organisms that can withstand extremes of temperature and pressure and grow without light could be used to develop new industrial enzymes or pharmaceuticals. It can provide bio-sourced products such as coating with anti-fouling or anticorrosive properties for maritime transport and shipbuilding. Blue biotechnology can also contribute to the development of specific biopolymers and biomembranes that improve the overall efficiency of the desalination process. Biostimulation can also be used to protect natural habitats by fostering bioremediation after important pollution (as for the Exxon Valdez oil spill when bacteria were stimulated to degrade hydrocarbons). Another example is bioremediation in the case of oil spills. A conclusion from this example is that the maritime sector as a whole has a strong interest in promoting new bio- technologies, cross-cutting services, and suppliers that can benefit more than one sector – and bring about advantages that cannot always be foreseen.

However, at the moment no such technology is available in Bangladesh. Although, many institutes (BARI, BLRI, BJRI, BRRI, BTRI, NIB), research centers (BCSIR, ICDDRB), universities, and private organizations of the country are involved in conventional (land-based) biotechnology works with mentionable progress and success (i.e., whole genome sequencing of jute, high-yielding varieties of rice, pest/ salt/ drought-resistant crops, bio-fertilizers, vaccines, etc.), surprisingly there is no national marine biotechnology R&D institute and programs. The promising pharmaceutical and coastal aquaculture sectors as well as the livelihoods of poor people of the country would benefit if marine organisms can be used as a source of new materials/ products, especially for applications in health (antibiotics, anti-cancer, bioactive compounds, nutritional supplements, etc.) and food (marine fish, shrimp, mollusks, seaweed farming).

To date, coastal aquaculture of the country is centered on only shrimp species like (***Peneaus monodon***) farming, but it is also a disease-prone industry and economically less attractive. To enhance aquaculture productivity, domestication of new species such as grey mullet (***Mugil cephalus***), seabass (***Lates calcarifer***), white shrimp (***P. indicus***), mud crab (***Scylla serrata***) and their larviculture technology, and selective breeding schemes to develop disease-resistant shrimp stocks can be the suitable alternatives involving biotechnological approaches. Nevertheless, numerous untapped novel microorganisms and under-exploited fisheries.

Blue biotechnology can help both fisheries and aquaculture industries by producing fish varieties that can become quicker, more beneficial, and greater with tastier flesh, by developing gene transfer technology to be used to develop the growth of fish or by using monoclonal antibodies and DNA probes to new diagnostic strategies for pathogens. Transformation of marine bio-resources (main, co-product, and by-products) into food, medicine, animal feed, and related bio-based items i.e. cosmetics, nutritional supplements, enzymes, and agrichemicals could help Bangladesh meet future challenges of the 21st century.

6.1.12 Marine and coastal tourism

Coastal and maritime tourism is the oldest and largest segment of the tourism industry as well as one of the largest wedges of the maritime economy. Coastal and marine tourism are interconnected as both rely on the marine environment. Coastal tourism takes place in a coastal environment, which refers to both beach-based and non-beach-focused land-based recreational and tourism activities depending on the vicinity of the sea and includes the suppliers and various manufacturing industries with connections to these activities. In contrast, marine or maritime tourism takes place at sea and consists of mainly water-based and various nautical sports. Coastal and marine zones are well known for providing specific habitats for diverse and unique biodiversity along with picturesque scenic beauty that attracts many tourists (Islam and Sarker, 2021).

Figure 75 : Sea Beach in Bangladesh

Bangladesh is a littoral country beside the Bay of Bengal and has the world's longest-unbroken sea beach of 710 km of coastline, 200 nm EEZ and 12 nm terrestrial zones. Despite having a huge maritime area, relatively limited tourism facilities are developed in a couple of spots including Cox's Bazar (the world's longest unbroken sandy beach), Teknaf, and St. Martin's Island in the eastern and Kuakata (the only beach in Bangladesh from where one can enjoy both the sunrise and sunset scene) and Sundarbans-based tourism in the western part of the country. Although little success has been achieved in coastal tourism, particularly in beach and Sundarbans-based tourism, marine tourism has remained mostly unexplored.

Coastal and marine tourism can ensure social, environmental, and economic benefits through the sustainable use of marine resources. The travel and Tourism sector accounts for 10.4% of the global GDP and 10.6% of global employment in 2019 (WTTC, 2021). The contributions of this sector in Bangladesh in terms of GDP and employment are 4.3% and 3.8%, respectively (WTTC, 2021) which is mostly land- and partially coastal-based tourism. The current blue economy of Bangladesh focuses mainly on tourism and recreation (25%), followed by marine capture fisheries and aquaculture (22%), transportation (22%), offshore gas and oil extraction (19%), ship and boat building/breaking (9%), and minerals (3%). However, there is a huge potential to develop coastal and marine tourism in a developing country like Bangladesh (Nobi and Majumder, 2019).

A large number of countries such as Maldives, Sri Lanka, the State of Kerala in India, Queensland State in Australia, etc. had devised strategic tourism policies and plans and succeeded in this very important sector of the economy. Very few legislative arrangements have focused specifically on coastal and marine tourism in Bangladesh. The current government of Bangladesh has tried to emphasize this specific sub-sector of tourism as a crucial part of the blue economy. As a result, it has attempted to formulate various legal institutional arrangements to promote coastal and marine tourism, especially after the victory in maritime delimitation. Ministry of Civil Aviation and Tourism (Bangladesh Tourism Board and Bangladesh Parjatan Corporation); Ministry of Foreign Affairs; Ministry of Shipping; Ministry of Home Affairs; Ministry of Environment, Forests, and Climate Change; Ministry of Cultural Affairs; Ministry of Finance; Ministry of Local Government, Rural Development, and Co-operatives; Ministry of Law, Justice, and Parliamentary Affairs; Ministry of Chattogram Hill Tracts Affairs; Ministry of Land; and so on, are involved in endeavors to promote coastal and marine tourism in Bangladesh. Moreover, some autonomous, private, and non-governmental organizations are cooperating with these ministries in their efforts to advance this sub-sector of tourism.

6.1.13 Shipbuilding

Historically Bangladesh is a maritime nation. After the maritime boundary settlement with Myanmar and India, the country focuses on the prospects of the Blue Economy and aspires to be a developed economy by 2041 (CRI, 2014). Bangladesh is being included on the 'white list' of the International Maritime Organization (STCW, 2018).

Figure 76 : Shipbuilding In Bangladesh

Shipbuilding is one of the sectors of the blue economy which is considered an important economic and industrial sector in Bangladesh. Bangladesh has 700 rivers that come down from the surrounding countries and it has 24,000 km long inland waterways. At present about 10,000 inland and coastal ships have been playing all over the country, which carry more than 90% of total oil products, 70% of cargo, and 35% of passengers. More than two million people are involved in the shipbuilding industry directly or indirectly. All inland and coastal ships are constructed and repaired locally in Bangladeshi shipyards. Recently Bangladesh successfully exported its first ocean-going ship to a high-end market like Denmark

competing with giant competitors like China, India, and Vietnam in 2008. Few local shipyards are capable of making ships up to 10,000 DWT (deadweight ton) as per international standards.

Bangladesh is a shipbuilding country where 130 shipbuilders are registered and operational. All are privatized except those three shipyards run by the Bangladesh Navy that are- Dry Dock Chattogram, Khulna Shipyard, and DEW Narayangonj. Notable privatized shipbuilders are Western Marine Shipyard Limited (WMShL), Ananda Shipyard and Slipways Limited (ASSL), Karnaphuli Shipyard Limited, Dhaka Dockyard, and Engineering Works Limited, Narayanganj Engineering and Shipbuilding Limited, Chattogram Shipyard Limited, Bashundhara Steel and Engineering Limited, High-Speed Shipbuilding and Engineering Works Limited, FMC Dock Yard Ltd, Meghna Group and Radiant Shipyard Limited. Among them, ASSL and WMShL are exporting ships and contributing to the economy of Bangladesh. Around 70% of the shipyards are located in and around Dhaka, 20% are in Chattogram and 10% are in Khulna and Barisal. Local shipyards can design and fabricate ships up to 3,500 DWT to fulfill the demand of the local market. Recently few local shipyards have attained the capability to manufacture ships of 10,000 DWT.

As per World Trade Organization (WTO), the global shipbuilding market size is US$1,600 billion. If only 1% market share can be captured by Bangladesh, it will be worth US$16 billion. If we can grab 1% of the global order for only the small ships market, the amount will be worth US$4 billion. Two leading local shipyards, Ananda and Western Marine have bagged orders to make 41 small vessels worth about US$0.6 billion mainly from European buyers. Bangladesh is suitable for small and medium combined cargo vessels, multipurpose vessels and oil tankers up to 15,000 DWT and some extend to 25,000 DWT. However, the small and medium shipbuilding market is flourishing and the future of Bangladeshi shipbuilding is brightening day by day.

Under this context, Bangladesh mainly builds various types of small vessels. Ships built here include multipurpose vessels, fast patrol boats, container vessels, cargo vessels, tankers, dredging barges, ferries, passenger vessels, and so on. Because of the current trend of the world, at present, Bangladesh should build cargo ships combining small and medium class vessels, 15,000 DWT multi-purpose ships, and oil tankers, and if possible, the country should be able to focus on building 35,000 DWT ships. From 2008 to 2017, Bangladesh exported 41 ships to 15 different countries. The revenue earned by these exports is US$170 million. This industry was declared the “thrust sector” due to its potential in the export business. Presently, Bangladesh is contributing 0.84% of the global shipbuilding market (BIDA, 2019).

According to the latest report of UNCTAD, Bangladesh’s ranking in the industry has shot up by 13 slots to 14th in the world, and the country has even overtaken India, Singapore, Spain, Romania, Malaysia, Norway, and Indonesia. This ranking has been arrived at by collating relevant information on building world-class certified ships (Shemon, 2017)elevated engineering skills, reasonable infrastructure, long term government policy support along with attractive investment climate. National and international issues and factors which apparently do not encourage shipbuilding in Bangladesh need to be addressed. Impacts of those issues will be evaluated and measures towards finding a solution will be incorporated. In this paper at first, an overall picture of this industry has been depicted by identifying the actual shipbuilding practice in both public and private sector. Relevant data have been explored through extensive review of literature, field visits, interacting with shipyard and ship owners. The potentiality, capability and problems of the shipbuilding sector of Bangladesh have been identified.”,”author”:[{“dropping-particle”:””,”family”:”WS Shemon”,”given”:””,”non-dropping-particle”:””,”parse-names”:false,”suffix”:””}],”container-title”:”Bsmrmu.Edu.Bd”,”id”:”ITEM-1”,”issued”:{“date-parts”:[[“2017”]]},”page”:”49-69”,”title”:”Problems & Prospects of Bangladesh Shipping Industry: A Comparative Overview”,”type”:”article-journal”},”uris”:[“http://www.mendeley.com/documents/?uuid=ef4a09b9-2652-4e71-91a0-8bd26bfe0dad”]}],”mendeley”:{“formattedCitation”:”(WS Shemon, 2017.

6.1.14 Ship recycling

Bangladesh is a leading ship recycling country in the world. Effectively starting in the 1980s, the Bangladesh ship recycling industry has emerged in the course of the past few decades as one of the leading destinations for dismantling and recycling end-of-life seagoing vessels of the world. In 2015, the industry scrapped and recycled 222 ships weighing a total of about 2.4 million light displacement tons (LDTs). Such scale of domestic operation has placed Bangladesh at the top of the recycling countries in 2015 in terms of LDTs of scrapped ships. On average, the industry scrapped and recycled over 175 ships totaling about 1.8 million LDTs a year over the past decade to 2015. During this period, the Bangladesh ship recycling industry has accounted for over 25% of all ship scrapping done by the five leading ship-breaking nations. All ship recycling yards in Bangladesh operate on the 18 km long Shitakundu-Bhatiyari coastal strip in the north of Chattogram. In 2015, there were 148 registered ship-breaking yards of which 68 yards were in operation (Ahammad and Sujauddin, 2017).

Figure 77: Shiprecycling in Bangladesh

In Bangladesh, the scrapping of old unusable ships is a must for the sea-borne trade to continue for the foreseeable period, and also for the continual emancipation of the entire international community. Shipping is the bridge for wider world civilization. Older inefficient ships are detrimental to the sea and the environment and conflict with the concept of the blue economy. However, the present style and method of scrapping, especially as they are, for example, in Bangladesh, polluting the sea and the environment, and exploiting poor laborers, by most of the ship recycling yards, are severely criticized by all concerned with the sea and the environment. On the other hand, for example, in these countries, especially in Bangladesh scrapping is proving jobs and steel. Ship breaking is the prime source of steel and iron materials for the growing industries and infrastructure of the country, which is the 2nd largest breaker, having no iron ore mines and base processing steel mills. This industry not only met the growing needs of furniture, household fittings of all classes, boilers, life-saving boats, generators, and so on but also generated employment opportunities. There are about 125 ship-breaking yards with an annual turnover of about US$2.4 billion. Ship recycling must be turned into a modern industry with all eco-friendly infrastructures and compliance with international conventions (Das and Shahin, 2019).

The internationally competitive ship recycling industry of Bangladesh is making valuable contributions

to the national economy. Each year minimum of 18,33,461 MT to a maximum of 19,89,252 MT of reusable materials are produced from the ships recycling industry of Bangladesh (Hossain, 2017). The industry generated output worth, on average, about Taka 53.3 billion (approximately US$770 million at 2009-10 constant prices) a year over the past five years to 2015. In terms of customs duties, income, and other taxes, the industry has paid around Taka 5 billion (US$68 million) a year, providing an important source of government annual revenues (Ahammad and Sujauddin, 2017). In 2017, more than 7,000 ships were scrapped which was the highest number in the last six years, and Bangladesh is ranked 1st considering the number of ships. It provides about 70-75% scrap steel as raw materials for steel and re-rolling mills. Ship recycling also recovers numerous machines, components, and hardware such as pipes, chains, boats, anchors, and propellers, the value of which was estimated at Taka 7.6 billion (about US$111 million) at the 'yard gate' for the year 2015 (Ahammad and Sujauddin, 2017). More than 1,50,000 people are directly and indirectly involved in these industries. So ship recycling is very important for our economic development.

Shipbreaking is unavoidable for the international community and essential for a few countries. Therefore, a method must be adopted which will transform scrapping into a green industry. Implementation of The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships is the answer. The highest benefit from shipping is derived from developed nations. They have therefore a major role, rather a vital role, to play. To turn to scrap 100% green without exploiting the workers it is indeed necessary to take necessary steps, such as creating funds for scrapping from the income of the ship over her operational life. When scrapping is green, scrapping is one of the best-fitted industries for the blue economy However, there are increasing concerns regarding the environmental pollution from ship recycling activities in Bangladesh. Ship recycling must be turned into a modern industry with eco-friendly infrastructure and compliance with international conventions (Zakaria et al., 2012) shipbuilding industry and other industries and it has also been generating huge employments for the country. But, existing problems of this industry in terms of safety, health and environmental issues bring negative image for the country sometimes. This paper is aimed to identify the underlying problems of ship recycling industry and then analyze the nature of the problems to make it helpful overcoming the obstacles. A brief overview about strength, weakness, opportunity and threat of the industries in global perspective has been also discussed.DOI: http://dx.doi.org/10.3329/jname.v9i2.10515 Journal of Naval Architecture and Marine Engineering 9(2012.

Some of the regulatory developments have been able to increase responsiveness to the overwhelming outcomes from harmful waste export and increase a few important principles associated with the threats to the sustainability of the fragile global system. Some mentionable international and national legislations are-

International Conventions

- International Maritime Organization (IMO) Guidelines
- International Labor Organization (ILO) Guidelines
- MARPOL (Marine Pollution) Convention 1973/78
- EU Waste Shipment Regulation
- International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (Hong Kong Convention)
- Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, 1989

- Law of the Sea Convention, 1982
- Stockholm Convention
- Rotterdam Convention
- International Convention on the Control of Harmful Antifouling Systems on Ships, 2001

National Legal Regulatory Bodies

- Department of Environment (DoE)
- Department of Inspection for Factories and Establishment and Explosive
- Environment Conservation Act, 1995
- Environmental Law, 1995
- Marine Fisheries Ordinance, 1983
- Rules on Ship Breaking and Hazardous Waste Management
- Ship Breaking and Recycling Rules, 2011
- Ship Building and Ship Recycling Board (SBSRB)
- Bangladesh Ship Recycling Bill, 2018
- Marine Pollution Act
- Air pollution Act, Bangladesh
- Environment Protection laws, 1997
- Labor Law, 2006

6.1.15 Ship transport

The ship transport or shipping industry is rapidly growing both domestically and internationally. The government of Bangladesh is very much dependent on this sector for the facilitation of national and international trade which boosts the country's GDP exponentially. Bangladesh has the potential to grow as one of the strongest maritime industries giving tough competition to all the maritime industries in this sub-continent. Shipping falls under the purview of the Ministry of Shipping and it is governed by the Inland Shipping Ordinance 1976 and the Bangladesh Merchant Shipping Ordinance Act 1983.

Figure 78 : Ship Transport

More than 90% of Bangladesh's external freight trade is seaborne and ongoing globalization has made this flow ever more important. The long coastline and age-old tradition of sea navigation in Bangladesh have led to a relatively strong development of maritime services that support the sea trade and sea transport function (ranging from shipping agents, freight forwarders, and insurance to classification and inspection, and maritime education in the Marine Academies/Dockyards/Shipyards/Nautical Institutes, etc.). Presently Bangladesh's value of export and import stands at about US$78 billion (2017-18) and is carried by almost 3,000 foreign ships visiting our ports. Against our import and export value, during the last ten years, importers, exporters, and buyers have paid US$95 billion as freight and related charges only to foreign shipping companies, airlines, and freight operators to carry goods in and out of Bangladesh.

There are only 42 registered (2018) Bangladeshi merchant ships which are not sufficient to carry even a fraction of our cargo. The country will not achieve a national income of as much as 16.6% overnight; it will increase gradually. It has a huge potential to tap once its ongoing projects are completed. Patenga Container Terminal will have a cargo handling capacity of 4,50,000 TEUs yearly. Moreover, at Patenga, vessels of up to 10 m draft will be able to berth. Currently at port jetties, vessels of up to 9.5 m draft an anchor. At the same time, the country's first-ever deep seaport at Matarbari in Cox's Bazar will be a breakthrough for the country where vessels of up to 14 m draft can berth directly. Around 1.1 million TEUs worth of containers is expected to be handled at Matarbari Port, which is expected to be completed by 2025. It is also expected that by 2041 container handling capacity of the Matarbari port will increase to 1.4-4.2 million TEUs. Another mega project 'Bay Terminal' - in Chattogram will be completed by 2026 in two phases. Some 30-35 vessels of around 12 m draft will be able to berth at a time at the Bay Terminal, which is expected to handle 5 million more containers. The terminal will not depend on tides and so vessels can berth 24 hours 7 days a week. According to the Chattogram Port Authority, by the next five to six years, the cargo handling capacity of the port is expected to rise to over 7 million TEUs. Considering the average import growth rate of 15.79% (last 10 years) and export growth rate of 15.43% (last 10 years), the projected freight value for the next ten years would be around US$435 billion.

6.1.16 Port (deep sea port)

Deep seaports are gateways of mega-ships and large carriers to and fro most coastal states and can also be said to be an avenue for international trade between such states and the international markets. The economy of Bangladesh is heavily dependent on international trade where maritime ports play a key role in transporting 94% of our foreign trade. The country has one of the world's fastest-growing economies. It is on Goldman Sachs's list of the "Next 11" emerging economic powerhouses

of the 21st century. Although a small country, Bangladesh is of clutch geopolitical importance, being located in the armpit of India and right on the Indian Ocean. Being the world's largest Bay, all south Asian regional trade is done through the Bay of Bengal by ships. Bangladesh is a keystone nation in the region, balancing together the contending influences of India, China, the USA, and Japan. About 11 % of the GDP of the Netherlands is generated by the activities of the port of Rotterdam alone (Alderton, 1999). Spanish ports provide an added value ranging from 6.78 % to 7.70 % of total GNP and generate an amount ranging from 8.20 to 8.95 % of Spanish employment in 1993 (Coto-Millan and Martinez-Budia, 1999).

Figure 79 : Chattogram and Mongla Sea Port

Bangladesh has two major ports in Chattogram and Mongla and one minor port in Patuakhali known as Payra port. They have a draft of a maximum of 9.5 m (Chattogram and Mongla) and 8 m (Payra) and a maximum berth of 190 m, 225 m, and 200 m, respectively. The draft varies greatly due to changes in water level with the tide. Chattogram and Mongla, are too shallow for large container ships and require costly load transfers to smaller vessels to get the cargo in and out - an added step that can cost an additional $15,000 per day and severely decreases the ports' global competitiveness.

However, Bangladeshi ports are not compared and not yet considered to the global standards in terms of both technical and non-technical matters. One of the major problems of the existing ports is the draft problem thereby most large ship can't enter the jetty and the plowshares that can enter the jetty has to wait for the high tide (Tareq et al., 2021). At present, ships of higher tonnage cannot dock at these ports and are forced to offload their cargo at transshipment hubs in Sri Lanka and Singapore, then smaller vessels bring consignments to Bangladesh. This results in delays and an increase in trading costs. Ultimately, affecting our economy greatly. To address this situation, the government of Bangladesh has initiated the construction of a deep-sea port in Matarbari, Maheshkhali supported by the Japan International Cooperation Agency (JICA). The deep-sea port will have a draft of a maximum of 14 m and a berth of a maximum of 300 m with an LNG terminal, a series of four 600 MW coal-fed power plants, as well as rail lines, roadways, and electrical systems as part of a monumental infrastructural package deal. The master plan is that the port would be used to receive coal, which could power an entirely new industrial zone in the far southeast of the country. This will open new employment opportunities which in turn will play a major role in our economy.

The construction of a deep sea port is a demand of time because of the following reasons -

- Increased employment services and improve per capita earnings;
- Increased revenue from berthing charges and handling charges for the transshipment of cargoes;
- Lower operating costs by handling larger vessels;

- Savings from vessel waiting and service time;
- Development of local bunker markets, ship and marine insurance agency, ship repair and dockyard services, pilotage, and legal services, including positions as a regional arbitration center and development of other professional maritime services; and
- Overcoming saturation of Chattogram ports by having an alternative port.

6.1.17 Ocean governance

Ocean governance is the integrated conduct of the policy, actions, and affairs regarding the world's oceans for sustainable use of coastal and marine resources reducing the risk of irreversible damage to our marine ecosystems. According to Patil et al. (2018), in 2015 the ocean economy contributed US$6.2 billion in GVA to the Bangladesh economy which is approximately 3% of the total economy.

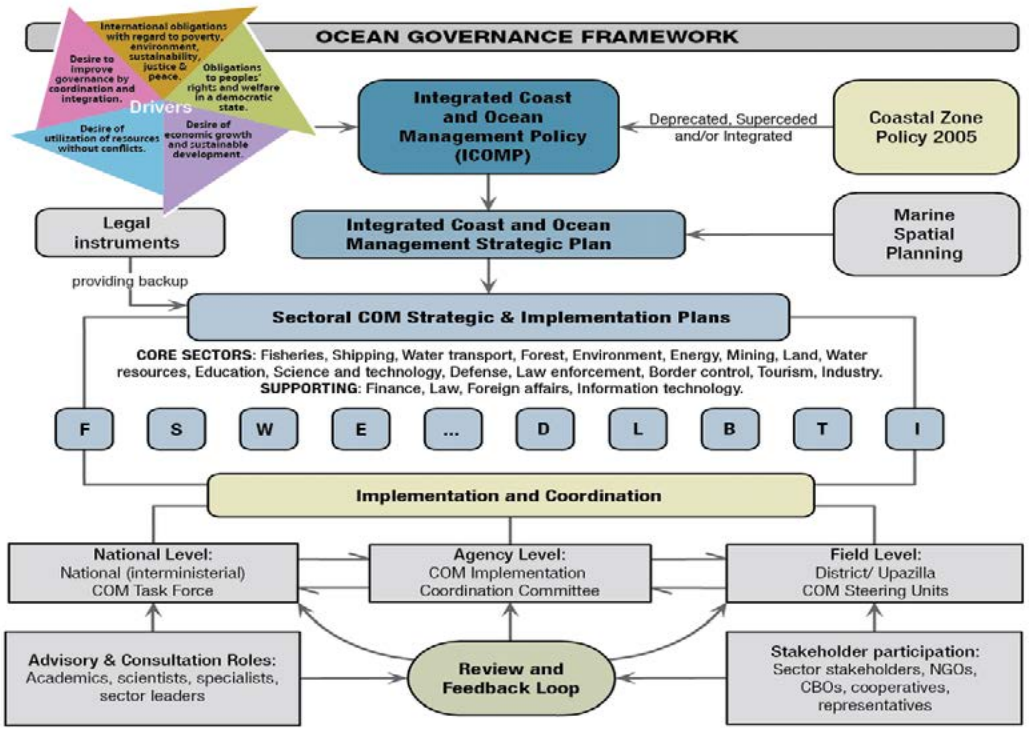


Figure 80 : A Proposed Framework of Ocean Governance for Bangladesh

Marine and coastal fisheries is an established sector in Bangladesh that significantly contributes to food security and the national economy. However, some rising concerns are over-exploitations, conflicts between industrial fishing trawlers and artisanal fishers, pollution (Hussain and Hoq, 2010), etc. have created adverse impacts on this sector. On the other hand, the marine oil, gas, and mineral production sector is an emerging sector as the nearshore and offshore areas of Bangladesh's coast offers potential reserve of oil and gas resources that are yet to be exploited (Hussain et al., 2018). As the energy demand is increasing continuously, the number of exploratory surveys to find specific areas to extract oil and gas will be increased from the ocean. At the same time, biodiversity conservation, recreation, maritime transport, etc. will also be increased. All of these activities in marine water areas might create significant pressures and impacts on the overall ecosystem including marine and coastal fisheries.

The blue economy provides food, energy, transportation, mineral, water, leisure, and health facilities from the ocean, and the marine resources of Bangladesh can be tapped to enhance the economy. The principal maritime stakeholders of Bangladesh are as follows- marine fisheries and aquaculture, marine biotechnology, offshore energy and deep-sea mining, marine tourism and leisure, shipping, port and maritime logistics, shipbuilding, marine manufacturing and ship recycling, marine renewable energy, etc. There are increasing economic activities as well as increasing competition among the stakeholders for exploiting the ocean. The coastal and marine environment of Bangladesh is perturbed by rapid urbanization, deforestation, and unplanned extraction of marine and coastal resources. Severe natural disasters and extreme climate change events include cyclones, storm surges, warming trends, coastal erosion, tidal surges, ocean acidification, floods, sea-level rise, salinity intrusion, and manufactured hazards (Alam et al., 2021).

For sustainable blue economic growth and development in marine waters, MSP and MPA have become popular ocean management tools. The exploration of marine resources and marine environment management are reciprocal. Where there is exploration, there is a possibility of pollution of the marine environment. Proper zoning of maritime areas through MSP and MPA is immediately necessary for the consumption of marine resources without jeopardizing the marine environment. It will facilitate the process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives for sustainable blue economy growth and development.

Zoning will bring multiple marine resource users including fisheries, energy, industry, government, conservation, and recreation under a map-based policy and a uniform legal framework. Bangladesh's 7th five-year plan (FYP-2016) clearly states its wishes to adopt MSP in its maritime area including EEZ, territorial water, and continental shelf, and in the 8th five-year plan Bangladesh also emphasizes blue economy development MPAs are dedicated spaces in the ocean for protecting and maintaining biological diversity as well as associated cultural resources. Taking this into account, the government of Bangladesh has already declared three MPAs. In 2014, Swatch of No Ground was declared the country's first MPA, covering an area of 1,738 km^2. In 2019, the government declared another 3,188 km^2 around the Nijhum Dwip Island as the second MPA/marine reserve, which increased the country's MPA coverage to 2.8% of its EEZ. Lastly, the government declared 1,743 km^2 of the area adjacent to St Martin's Island as the 3rd MPA for conserving biodiversity. However, the government's target to declare 10% of her EEZ as MPA by 2020 is still not completed. In this case, ocean governance is needed for sustainable coastal and marine resource management.

6.1.18 Finance

As a lower-middle-income country, Bangladesh will increasingly experience the reduction of available concessional financing for development. In this scenario, blended finance has the potential to attract investment in areas and sectors that are critical for the attainment of the SDGs in Bangladesh. This innovative approach helps enlarge the total amount of resources available to developing countries, complementing their investments and ODA inflows to fill their SDG financing gap, and support the implementation of the Paris Agreement.

Green bonds offer investors and issuers a product dedicated to raising finance for 'green' (or sustainable) projects. The term 'green bonds' refers to bonds that exclusively finance low-carbon and climate-resilient projects. The financed projects must deliver defined environmental benefits. Full standards of what constitutes the label 'green bond' are still emerging, though in general, they provide financing to a wide range of climate-smart sectors including energy efficiency, pollution prevention, sustainable agriculture, fishery and forestry, the protection of aquatic and terrestrial ecosystems, clean transportation, clean water, and sustainable water management. They also finance the cultivation of environmentally friendly technologies and the mitigation of climate change. The World Bank is a major

issuer of green bonds and it has issued 164 such bonds since 2008, worth a combined US$14.4 billion (Segal, 2021). In 2020, the total issuance of green bonds was worth almost US$270 billion, according to the Climate Bond Initiative (2021). Bangladesh has approved its first green bond, to finance environmentally-friendly projects including renewables.

The World Bank defines blue bonds "as a debt instrument issued by governments, development banks or others to raise capital from impact investors to finance marine and ocean-based projects that have positive environmental, economic and climate benefits." A blue bond is a relatively new form of a sustainability bond, which is a debt instrument that is issued to support investments in healthy oceans and blue economies. The bonds are part of ADB's Action Plan for Healthy Oceans and Sustainable Blue Economies launched in 2019, which aims to catalyze sustainable investments in Asia and the Pacific by committing to invest in healthy oceans, ensure the achievement of SDG 14, and contribute to the security and prosperity of the region and provide technical assistance of at least US$5 billion by 2024 (ADB, 2021).

In Bangladesh, blended finance including green- and blue-bond mechanisms can help the government to achieve the SDGs. However, the concept of blended finance is new to Bangladesh and there are limited studies on blended finance to leverage development funds effectively in coastal and marine areas. So more studies are needed to understand the potential of blended finance in Bangladesh.

6.1.19 Satellite oceanography and ICT

Satellite oceanography encompasses oceanographic research and technological development resulting from manned and unmanned systems in Earth's orbit. These systems observe and measure oceanographic parameters such as sea surface winds, sea surface temperature, waves, ocean currents, frontal regions, etc. The scope of oceanographic research embraces the sciences of physics (including acoustics), geology, biology, and chemistry. The technological developments include new sensing methods and sensor systems to acquire oceanographic data with specified degrees of resolution, accuracy, coverage, and timeliness.

Earth & orbiting satellites as platforms for ocean & viewing sensors offer unique advantages, the opportunity to achieve wide synoptic coverage at fine spatial detail and repeated regular sampling to produce time series several years long. The sampling characteristics of different satellite oceanography methods depend on the sensor platform combination. Earth & orbiting satellites are constrained by forces due to gravitation and inertia. There are just two basic types of orbits useful for ocean remote sensing: 1. Geostationary and 2. Near-polar.

Sensor types for observing the ocean

All sensors employed on ocean-observing satellites use electromagnetic (EM) radiation to view the sea (Figure).

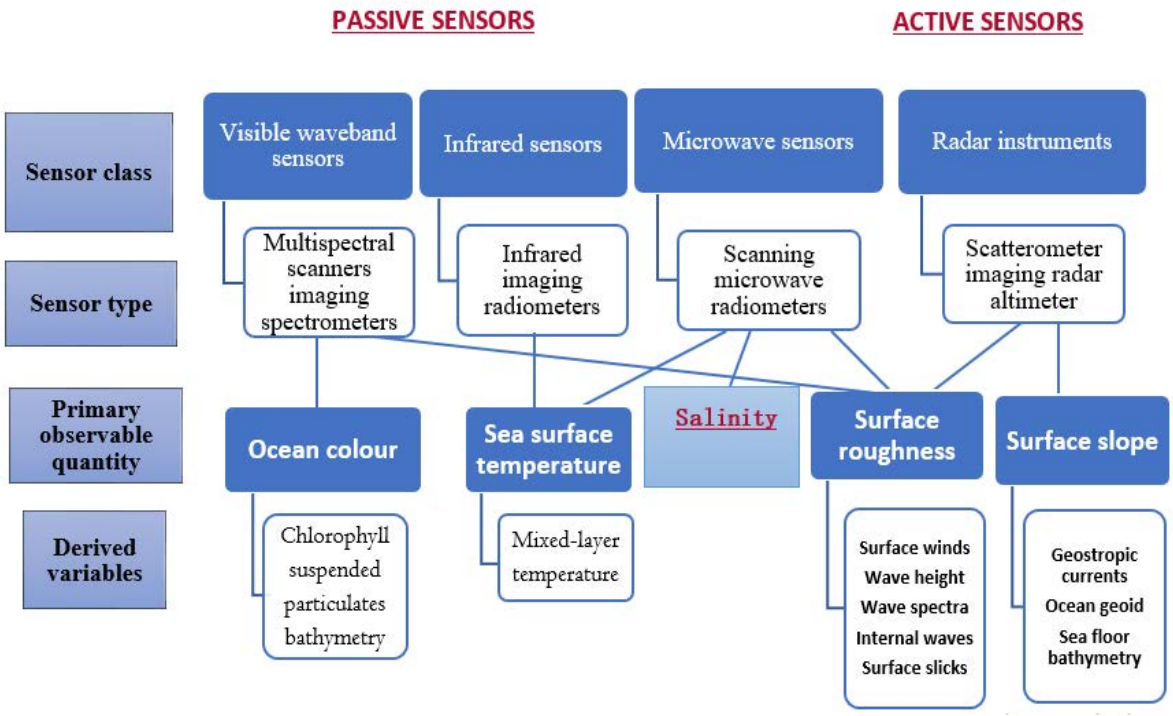


Figure 81: Application of Satellites for Ocean Management

Bangladesh made an electronic request to the International Telecommunication Union (ITU) to launch its artificial satellite. In March 2012, the US-based Space Partnership International was hired as the project's lead consultant to design the artificial satellite system. BTRC has signed an agreement with French company Thales Alenia Space worth Tk. 1 thousand 951 crores 75 lac 34 thousand to buy the satellite system. BTRC also signed an agreement to buy an orbital slot from the Russian satellite company Intersputnik in 2015. An organization called 'Bangladesh Communication Satellite Company Limited' was formed in 2017 for the overall management of artificial satellites. The Bangabandhu-1 artificial satellite is placed in the geostationary slot at 119.1° east longitude. It was named in the name of Bangabandhu Sheikh Mujibur Rahman.

Bangabandhu Satellite-1 is the first terrestrial communication and broadcasting satellite of Bangladesh. It was launched from the Kennedy Space Center on May 11, 2018. Through this, Bangladesh was added as the 57th country to launch its satellite. The project was implemented by the BTRC under the Department of Posts and Telecommunications and was the first parody launch of a Falcon-9 Block-5. In the year of 2008, the BTRC formed a committee on the construction of artificial satellites. Then in 2009, the issue of launching state-owned artificial satellites was added to the National Information Technology Policy. Bangabandhu satellite 2: The government has initiated plans to launch the country's second satellite about three years after the first reached orbit. Bangabandhu-2 is expected to launch in 2023, according to government sources. Unlike Bangabandhu-1, which was a communications satellite, Bangabandhu-2 will be a Low Earth Orbit (LEO) observation satellite. As a result, it will be tailored toward environmental monitoring, meteorology, cartography, and defense purposes.

Officials at the Ministry of Posts and Telecommunications said it is planned for the new satellite to be used to monitor the vast maritime territories of Bangladesh and surrounding countries, as well as the country's land borders with India and Myanmar. LEO satellites typically orbit at a height of 500-800 km. Posts and Telecommunications Minister Mustafa Jabbar told that the country is currently paying for data from other observatory satellites, but this cannot go on for long due to concerns over data security. The government of Bangladesh needs absolute and direct access to the data and security

for our country's maritime boundaries, maritime resources under the deep sea, and border territories. Other data can be collected for defense as well. The country cannot rely on other countries for this data, and that's why this satellite is very important for Bangladesh.

6.2 Challenges of and policy supports for the blue economic development in Bangladesh

From earlier discussions, it is evident that the blue economy priorities vary from country to country, nevertheless, there are some common practices that Bangladesh can follow to explore its blue economy potential. Besides, Bangladesh may take note of the innovative ideas initiated by other countries and apply them in a viable context. These are discussed subsequently. Bangladesh needs a national plan to develop the Blue Economy. Countries considered at the forefront of Blue economy implementation, i.e., Ireland, Seychelles, South Africa, and the EU have devised their own Blue Economy plan. For example, the "2012 Harnessing Our Ocean Wealth (HOOW)" policy document of the Republic of Ireland, "the Blue Economy Strategy Roadmap Implementation (BESRI)" of the Republic of Seychelles, "the Operation Phakisa" policy document of the Republic of South Africa and "Blue Growth Strategy" of the EU were initiated to the establishment of Blue Economy regimes in the respective countries. Notably, the purpose of the Blue Economy plan should be to establish a framework that can guide the planning and development of maritime activities rationally and sustainably for the social and economic development of Bangladesh. Thus, for developing the Blue Economy plan in Bangladesh, stakeholders in all potential Blue Economy sectors and coastal communities need to be consulted. However, experts point out that Bangladesh first needs to focus on human resource development and capacity building before developing a well-articulated national maritime policy which will take time.

It is necessary to formulate and strengthen legal frameworks to better integrate Blue Economy considerations. For Example, to give effect to her Blue Economy policy, South Africa established the Ocean Act and the Integrated Ocean Governance regime which was necessary to give Operation Phakisa the force of law as a Blue Economy component of South Africa's national development plan 2030 (Walker, 2018). Similarly, the US Magnuson-Stevens Fisheries Conservation and Management Act (MSA) of 1976 was amended in 2007 to enable her to achieve long-term sustainability in fisheries. For Bangladesh, the starting point could be the ongoing efforts to design the Integrated Coastal and Ocean Management Policy, as well as the various Blue Economy sectoral policies under review or design. Developing a Blue Economy institutional framework that covers the gamut of administrative and operational maritime entities is required to actualize Blue Economy. However, at present, maritime affairs in Bangladesh are managed without any central coordination. There are many agencies involved, e.g., the Navy, the Coast Guard, the Ministry of Fisheries and Livestock, the Department of Energy and Mineral Resources, the Ministry of Shipping, and so on. Therefore, institutions operating independently are yet to have proper coordination and accountability of the Blue Economy activities. For greater coordination, a central coordinating body is necessary given the increased level of activities in maritime areas.

The challenges and policy support for the blue economic development in different subsectors in Bangladesh are discussed below:

6.2.1 Marine capture fisheries (except tuna)

Challenges

i. The government of Bangladesh has no dedicated research vessel for exploring the marine fisheries resources in the Bay of Bengal. Some of the participants of the consultative policy dialogue also agreed with it and they emphasized having dedicated research vessels;

ii. Estimation of most of the marine fish and shellfish stock in the Bay of Bengal is data and time-dependent. To do a continuous and rigorous stock assessment needs a huge amount of funds;

iii. Though the government declared that industrial trawlers cannot fish in 40 m to as shallow as 10 m depth, industrial fishing trawlers (e.g., bottom trawl) are intensifying fishing operations in inshore water and making conflicts with artisanal fishers;

iv. There are environmental concerns regarding bottom trawling in the Bay of Bengal as it destructed bottom habitats including breeding and feeding grounds of many fish and shellfish species; and

v. It is not possible to set target reference points to extract data deficient marine fish and shellfish species as there has no exact data.

Recommendations

i. The government needs dedicated research vessels to conduct extensive fisheries research in the Bay of Bengal;

ii. Need to modify or revise national fisheries policy 1998 in the context of the blue economic growth and development through the lens of sustainability;

iii. Estimation of the stock size of the marine fish and shellfish species (need budgets);

iv. Increase fishing activities in the offshore (more than 50 m depth) zone of the Bay of Bengal to boost marine capture-based production;

v. Reassessment of existing fishing grounds or identification of new fishing grounds in the maritime waters of Bangladesh (need budgets);

vi. Fishing ban readjustment considering the period of marine fishing bans in India/Myanmar;

vii. Readjustment of compensation schemes for the fishers during the 65 days of marine fishing bans in the coastal and marine waters of Bangladesh;

viii. The government can take initiatives to provide incentives (3% on whole catch) / subsidies (oils) for extracting underexploited and/or nonconventional marine fish and shellfish species; and

ix. The government can declare a Tax Holiday (up to 3%) or lower bank loan (7% to 5%) for the fishing trawlers that are fully dedicated to extracting nonconventional marine fish species in the Bay of Bengal.

6.2.2 Tuna fisheries

Challenges

i. Tuna fisheries need huge investments for buying tuna fishing vessels and gear. At the same time, it requires processing plants to process and preserve the harvested tuna which is not developed in the country;

ii. The government does not have enough data on tuna stocks, species types, and tuna fishing grounds in the Bay of Bengal;

iii. Since the tuna fisheries are in the initiation stage in Bangladesh, local fishers are not well skilled in managing tuna fishing gears and harvesting tuna in the Bay of Bengal;

iv. Tuna fisheries is a highly uncertain business in the Bay of Bengal, however, it has a positive promising prospect in the Bay of Bengal. Of its uncertainty, the stakeholders are facing challenges to take the risk to invest in this sector; and

v. Tuna fisheries are seasonal. During the tuna off-season period, valuable fishing gear is left unutilized. Due to its off-season job insecurity, investors remain reluctant to involve in tuna fishing.

Recommendations

i. Estimate tuna stock size and identify tuna fishing grounds in the high seas and ABNJ of the Bay of Bengal;

ii. The government banks should move forward to provide loans at a minimum interest for tuna ventures;

iii. The government can provide cash or fuel subsidy for the tuna fishers for a certain period;

iv. The government can provide a certain amount of incentives on tuna catch or a percentage of the total catch in the high seas and ABNJ;

v. The government should exempt tax from the tuna fishers for the first couple of years to encourage them in tuna fisheries;

vi. The government and NGOs can provide alternative income-generating activities (AIGAs) for the tuna fishers during off-season tuna fishing; and

vii. The government and other stakeholders can arrange training and skill development activities for the tuna fishers.

6.2.3 Mariculture

Challenges

i. Marine organisms are highly sensitive to water quality (i.e. salinity, temperature, pH, dissolved oxygen, nitrate, and ammonia) and are vulnerable to disease and predation;

ii. Suitable brood stock and seeds are highly required for mariculture development in Bangladesh. Unfortunately, there are no marine finfish or crab hatcheries in the country, which is more crucial for mariculture development;

iii. Many forms of mariculture do not require costly feed inputs (including some forms of finfish culture, e.g. tilapia), and this represents an advantage where mariculture is being promoted for food security reasons. However, intensive feeding with high-quality food (both live and supplementary) is required for some species (e.g. tiger shrimp and species of carnivorous finfish) and may be desirable in the case of tilapia species to increase yield, reduce grow-out times, pay-off investment in cages more rapidly and improve profitability. This may increase production costs, financial risks and the danger of disease and may not be appropriate for food security purposes. These are all vital issues to be

considered when developing production models, e.g. for mullet and sea bass, which have not been thoroughly addressed in most development initiatives to date;

iv. The food conversion ratio is as significant as the feed price. Unfortunately, feed conversion ratios and feed management practices for marine fish/shrimp are not well established in Bangladesh and need to be initiated at the same time as expanding mariculture in the country;

v. In Bangladesh, the capacity for mariculture development is not well established. At the same time, practical skills and technical knowledge for the public and private stakeholders are not well developed;

vi. Mariculture development in the coastal and offshore waters of Bangladesh requires huge financial and logistic support. The problem in most cases lies with the lack of access to the farms, i.e. Cox's Bazar, Teknaf, Satkhira, and Sundarban area, and the inadequate and costly internal delivery systems; and

vii. There are growing concerns about environmental and health safety issues from mariculture activities and cultured finfish and shellfish species.

Recommendations

i. Identification of suitable marine finfish, shellfish, aquatic algae, and coral species for mariculture in the coastal and marine waters of Bangladesh;

ii. Establishment of marine finfish and crab hatcheries for the seed;

iii. To develop mariculture, we need funds and logistic support, government-owned banks should come forward to support such initial costs for infrastructural development and mariculture operations;

iv. Provide low-interest bank loans or cash subsidies for the mariculture capacity development;

v. The government can provide 3-5% incentives for the mariculture stakeholders based on their production;

vi. Arrange extensions programs to develop stakeholders' skills and technical knowledge for mariculture;

vii. Lessons regarding the most useful techniques for breeding and culture of various types of mariculture species can be learned from the countries like China, Indonesia, Vietnam, Australia, Japan, South Korea, Philippines, Spain, etc.; and

viii. Development of Public-Private Partnership for running long-term mariculture industry.

6.2.4 Seaweed Culture

Challenges

i. The major challenge of the seaweed industry in Bangladesh includes a lack of information on seaweed cultivation and socio-economic constraints on seaweed consumption;

ii. Suitable site selection is very important for the seaweed culture as it is affected by tidal fluctuation, pollution level, habitat disturbance, etc.;

iii. We do not have enough skilled manpower for culturing seaweeds in different coastal waters and harvesting wild seaweeds which is required for larger-scale production;

iv. The government of Bangladesh does not have adequate seaweed processing plants for processing, preserving, and packaging seaweed products;

v. Infrastructure development and market facilities of seaweeds are not well developed in coastal areas which fail to woo the private sector to move forward in this business; and

vi. Though some researches are ongoing on seaweeds, however, there is a lack of enough fund for seaweed-related research.

Recommendations

i. Identification of suitable seaweed farming sites in coastal regions of Bangladesh;

ii. Exploration of suitable wild seaweed species which can be farmed in the coastal and marine waters of Bangladesh;

iii. Need to develop a wild seaweed collection site map;

iv. At present seaweeds are cultured between October/November to March/April. So, year-round cultivation is required to boost seaweed production;

v. Assessment of commercially important wild and farmed seaweed species is necessary for use in different industries like cosmetic, pharmaceutical and chemical, etc.;

vi. Introduction of integrated seaweed and aquatic animal like fish, mussels, oysters, etc. in coastal waters;

vii. Need to improve the existing seaweed farming methods using state-of-the-art technologies to increase the blue economic growth;

viii. Arrange training and workshop for the skill development of the people involved in seaweed culture;

ix. Need to provide government subsidies or incentives to attract entrepreneurs in seaweed-related business;

x. Require enough funds for seaweed-related research, awareness raising, building processing plants, etc.; and

xi. Lessons can be learned from neighboring countries such as China/Japan/Korea/Thailand, etc.

6.2.5 Marine Pearl Culture

Challenges

i. To establish a large-scale pearl culture industry in Bangladesh, it is necessary to address the potential drawbacks. The major challenges are suitable to site selection with optimum environmental conditions and identification of available pearl-producing mussels in coastal areas;

ii. Lack of knowledge, understanding, and willingness for pearl culture among coastal people fail to

develop pearl culture;

iii. Lack of enough funds and inadequate research on pearl culture in marine and coastal waters obstruct to develop successful pearl industry; and

iv. There is also a lack of state-of-the-art technological development; international market competition and market demand fluctuations in pearl culture.

Recommendations

i. Identify suitable marine pearl culture species and suitable culture sites in the coastal and marine waters of Bangladesh;

ii. Introduce sustainable and integrated marine pearl culture along with mariculture (fish, shellfish, or plants);

iii. Need funds for infrastructure development and feasibility study of marine pearl culture in coastal waters of Bangladesh;

iv. The government needs to provide technical and skill development supports for the pearl farmer; and

v. The government can provide bank loans at a lower interest rate for pearl farmers.

6.2.6 Non-renewable energy (gas, coal, and oil)

Challenges

i. Burning fossil fuels release carbon dioxide, which is directly linked to global warming – so fossil fuels are very damaging to the health of our planet. Because of all their nasty air pollution, burning fossil fuels can lead to lung problems and asthma attacks in humans. Drilling oil can be very dangerous, resulting in a large number of diseases, injuries, and deaths every year.

ii. There are lack of technical facilities and skilled manpower for the exploration and extraction of non-renewable energy sources in the coastal and marine waters of Bangladesh;

iii. There is an uncertainty in finding gas/coal/oil reserve and a sufficient amount of gas/coal/oil comparing the amount of money spent for the exploration and extraction;

iv. To keep power stations working, we need truckloads of fuel. This can make energy generation very expensive. In addition, as just a few countries hold a large number of fossil fuels, fuel prices can rise without warning;

v. Sources of energy like fossil fuels (oil, gas, and coal) are considered limited resources, and there is a strong possibility that they will run out in the future. Once the earth's supplies of fossil fuels have been used up, they can't be renewed (at least not for several hundred million years), so we won't be able to use them for our rising power needs; and

vi. The huge tankers transporting oil sometimes crash and spill their contents into the sea and nearby coast. This is disastrous for the ocean and land and can be deadly for the animals that live there.

Recommendations

i. The government needs to invite foreign companies to explore our coastal and marine waters to find the gas/coal/oil reserves;

ii. We need to develop our skills and capacities for the exploration of non-renewable resources in the coastal and marine waters of Bangladesh;

iii. We need a huge amount of budget for the exploration of non-renewable resources in the coastal and marine waters of Bangladesh;

iv. The government can negotiate with the bidding companies at a lower rate;

v. Lessons can be learned from neighboring countries like India, China, Myanmar, etc.;

vi. The government can provide cash subsidies for the local private companies for the exploration works;

vii. The government must take action to extract coal on a priority basis; and

viii. The government must take precautionary measures while doing any exploration activities in coastal and marine waters.

6.2.7 Renewable energy (solar, wind, hydro, geothermal, tidal, wave, OTEC)

Challenges

i. There are still challenges to the generation of large quantities of power in renewable energy technology compared to traditional forms of energy generation like fossil fuel. Fossil fuel still produces large quantities of electricity today, so far. This, essentially, means that it can't be solely relied upon to power the whole nation in near future;

ii. Renewable energy technologies depend on the weather (e.g., sun and wind) to be able to harness any energy. In case atmospheric conditions are not good enough, renewable energy technologies would lack the ability to generate electricity. For example, hydro generators require enough rain to fill dams for their supply of flowing water. Wind turbines require wind blowing, at least with minimum wind speed, to move their blades;

iii. Renewable energy technologies are still significantly new to the market, meaning, they still lack the much-needed efficiency. The lack of sufficient knowledge on how to effectively harness these forms of energy makes the installation and maintenance costs for such facilities quite high. These poses forecast problems, and investors may shy away from investing their money for fear of not getting returns pretty quickly;

iv. Setting up renewable energy generation facilities requires a huge financial outlay. The installation of wind turbines, solar panels, and hydroelectricity plants is relatively expensive;

v. It takes over 40 ha of panels to generate about 20 MW of energy using current solar energy generation technologies. A nuclear power plant of average size generates about 1,000 MW of energy on 259 ha, whereas a solar energy facility would produce less than 200 MW given the same amount of space. In

land-based wind energy technology, a 2 MW turbine requires 1.5 acres of space, and in the same amount of space, a nuclear facility would generate a maximum of about 850 MW.

vi. We often overlook the storage cost of renewable energy. In the case of renewable energy, we must store the energy collected by having a battery installed, or else we will lose it. The overall storage cost for the energy is about 9 cents per kilowatt-hour; however, the cost of the battery is upfront. That means US$10,000 to US$25,000 upon installation just for the battery. Some types of batteries also wear out very quickly, especially if they are being used to their full capacity regularly.

vii. To be effective, renewable energy must have a distribution network created to transfer the energy to where it is required. Those networks require non-renewable energies to be generated, which offsets the benefits that renewable energy generates for many years, if not decades, after its installation; and

viii. Renewable energy may be a better option for reducing CO_2 emissions than fossil fuels, but they are not completely free from pollution. Many renewable energy forms or their manufacturing processes emit greenhouse gases like particulates into the air, CO_2, or worse – CH_4.

Recommendations

i. Need to conduct more feasibility studies to identify potential renewable energy resources in coastal and marine areas of Bangladesh;

ii. Assessment of offshore renewable energy conversion potential to supply power in remote off-grid areas/islands;

iii. Assessment of public and private sector's interest to provide financial and technical support for the development of renewable energy projects;

iv. Assessment of national renewable energy management strategies and policies to achieve SDGs and blue economic growth;

v. Need to distribute solar and wind plants over a large geographical location to minimize electricity generation interruption because weather disruptions in one location cannot be the same in other locations;

vi. Since the inception of renewable energy, new and stable jobs have been added to most world economies. Experts project that with the ongoing rigorous campaigns to embrace renewable energy, thousands of stable jobs will be created;

vii. The government needs to cater to the initial costs of the installation of renewable energy; and

viii. The government needs to provide cash subsidies or commissions for renewable energy initiatives.

6.2.8 Hydrocarbon (gas exploration, buying ship, leasing ship)

Challenges

i. Gas exploration in the maritime waters of Bangladesh is essential for initiating extraction methods.

However, there are some challenges regarding hydrocarbon exploration and exploitation such as a lack of vessels and skilled manpower, etc.;

ii. Drilling for oil and gas has a significant impact on the surrounding ecosystem. While drilling, a large amount of hydrocarbons is exposed to the air, water, and land leading to pollution, contributing to climate change, upsetting animals, and destroying public lands set aside for everyone's benefit;

iii. The government needs enough funds to explore hydrocarbon resources in the coastal and marine waters of the Bay of Bengal;

iv. There are bidding challenges to inviting foreign partners to explore the hydrocarbon resources; and

v. There is poor coordination among governmental departments, ministries, and other public entities. The lack of institutional capability in the public and commercial sectors to explore and extract hydrocarbon resources also hinders our blue economic growth and development.

Recommendations

i. Government entities and relevant stakeholders must take responsibility to ensure environmental safety from exposed hydrocarbons and experts need to focus on the reservoir exploration with high accuracy to minimize the loss in the effort. It is also important to avoid inaccuracy while drilling and pipeline installing;

ii. The government needs to provide training and skill development programs for the related stakeholders;

iii. The government needs to negotiate with the relevant foreign partners to initiate the hydrocarbon explorations in the Bay of Bengal;

iv. The government needs to provide enough funds in the budget for hydrocarbon exploration activities; and

v. The coordination among different government ministries and departments will be strengthened to explore hydrocarbon exploration in the Bay of Bengal.

6.2.9 Gas (methyl) hydrate

Challenges

i. It is almost a challenging issue to produce methane from methane hydrate. Methane is embedded in a solid form and going to deposit in deep marine and arctic environments;

ii. Indeed, it is a challenging issue as tectonostratigraphic is concerned. Studies from geological, geochemical, and field studies, it was found that methane hydrate could also occur in multi-structural setups and different reservoir settings as the petroleum system are concerned with first primary reservoir controls like (a) concentration and form of the methane hydrate occurrence, (b) physical properties of the host rock (e.g., thickness, porosity, permeability, thermal properties, in situ stress, and strength), (c) physical properties of overlying and underlying sediments, (d) pressure and temperature environment, (e) non-uniform conditions such as geologic heterogeneity or possible communication with open faults or fractures, and (f) presence of free gas and/or free water zones above, below, or within the methane hydrate occurrence;

iii. It is important to know the geochemical properties of methane hydrate-bearing sediments for exploration and production activities in a safe manner. Its inherent quality is to predict changes in these properties during methane hydrate dissociation and after also. As far as the ecosystem is concerned, there are many problems with the development of gas hydrates, such as the processing of extracted water, possible effects of marine deposits on the seafloor or subsurface; and

iv. The government needs enough funds to explore methyl hydrate resources in the coastal and marine waters of the Bay of Bengal.

Recommendations

i. Government and relevant stakeholders must take initiatives to ensure environmental safety from exposed methyl hydrates while drilling and pipeline installation;

ii. The government needs to provide training and skill development programs for the related stakeholders;

iii. The government needs to negotiate with the relevant foreign partners to initiate the methyl hydrate explorations in the Bay of Bengal; and

iv. The government needs to provide enough funds in the budget for methyl hydrate exploration activities.

6.2.10 Energy policy/energy mix

Challenges

i. Limited incentives to accelerate the development of grid-connected energy throughout the country;

ii. Land scarcity for constructing the necessary infrastructure for renewable energy;

iii. In the current network, there is limited spare grid capacity, and the actual quantity of grid capacity available is unknown;

iv. Bangladesh has a limited mapping of wind and solar resource potential to energy mix;

v. No strict guidelines are applied for the conservation of energy considering supply and usage in Bangladesh;

vi. Commercial banks lack knowledge and are cautious about engaging in renewable energy projects, offering unfavorable loan terms and exorbitant interest rates;

vii. In government-driven procurements, there is a lack of information, making it harder to submit competitive offers;

viii. Poor coordination between government entities and a lack of institutional capability in the public and commercial sectors; and

ix. Pollution due to poor energy production and handling leads to the destruction of local habitats.

Recommendations

i. Energy policy is an important factor in economic development. Therefore, energy policy in developed

countries is an important part of the overall regulatory framework that determines the increase in global attractiveness and the incorporation of the private business sector. Lessons can be learned from other countries like China, South Korea, etc.

ii. The government needs to provide incentives for energy-mixing activities;

iii. The government needs to provide funds for the blue- and green- bond activities throughout the country and related development projects need to be introduced;

iv. Environmental safety needs to be considered while energy mixing projects are taken;

v. Efficiency needs to be increased and greenhouse gas emissions should be reduced while energy mixing; and

vi. Stakeholders' skills and expertise need to be developed.

6.2.11 Marine biotechnology and therapeutics

Challenges

i. There is a strong need to develop innovation capacity in the research and business sectors related to marine biotechnology and therapeutics. This would improve science and technology research infrastructure, providing access to a range of new research support tools and facilities to strengthen marine biotechnology. However, these facilities are still not developed in our country;

ii. It is essential to align discovery and development activities with the needs of target markets. Linking researchers to the range of end-users is essential to stimulate innovative technical challenges. Access to the ocean and the deepest of its "hot spots" remains very difficult where new robotic and technical technologies are needed;

iii. The lack of taxonomic knowledge for marine species, and the still large number of unidentified species and strains, is also a major bottleneck facing marine natural product programs;

iv. Several very important issues need to be addressed by researchers or companies: (a) what are the potential applications of the industry and the market needs of that particular activity; (b) what is the target price/kg of the final bioactive product; (c) what is the desired formulation and route of administration; (d) what is the manufacturing process and how sustainable is the supply; (e) how can the product reach the value chain? A targeted strategy in this area is essential. Small and medium-sized enterprises (SMEs) have a marketing objective and, as a result, present their discovery and development programs very early. They must have a clearly defined strategy, otherwise, the risk of failing and running out of cash quickly is high. It is important to know that the cost of technology and manufacturing processes, sometimes with poor yields, increases the cost of the market per kg and can make these products economically uncompetitive;

v. Exploration of the potential of marine biodiversity has increased, so it is a rich source of new natural compounds. Some of these compounds are already used in food, cosmetic, agricultural, chemical, and pharmaceutical products, but their diversity has not been fully characterized or used. Other possibilities exist for the use of ocean bio-resources in the markets for industrial enzymes, functional foods, cosmeceuticals, biomaterials, processes, and medical devices. Since traditional medicinal knowledge associated with marine organisms is almost non-existent, the search for biologically active compounds from marine sources has been done through a random selection of organisms. But initial studies are underway to develop directed selection methods.

vi. The main sources of marine biomass often come from species harvested from the wild and those that can be grown. Securing sustainable marine biomass will face challenges if the only source comes from wild stocks, where over-exploitation can threaten marine biodiversity as well as the future supply of target species. Strategic wildlife management coupled with plans for more coherent and effective species management is essential. If wild stocks remain viable sources of biomass, health and ecosystem services must be maintained.

Recommendations

i. The government needs to provide enough funds for marine biotechnological innovation and development;
ii. The government can provide cash subsidies for marine therapeutics development;
iii. Special departments can be dedicated to marine biotechnology and therapeutics-related research; and
iv. Potential marine species will be identified for producing bioactive compounds.

6.2.12 Tourism

Challenges

i. The main challenge for coastal and marine tourism is ensuring good collaborative relationships and functional networks among the ministries, departments, and relevant stakeholders. At present, coastal and marine tourism (CMT) is not well-developed in Bangladesh. Though some initiatives are taken, most of them are scattered and fragmented;
ii. Scarcity of systematic research on the CMT institutional arrangements;
iii. Lack of a dedicated CMT Policy and Coordination at the national level;
iv. Lack of sufficient budget allocation for the CMT development in all coastal areas;
v. Absence of community participation and lack of awareness among the residents; and
vi. Remoteness and insecurity in the potential coastal and marine tourist spots.

Recommendations

i. The principal aim is to assess the present status and how further improvement can be achieved so that Bangladesh can use its vast coastal area and marine water body in economic development through enhancing ecotourism;

ii. Encouraging Private Entrepreneurs to Invest Under PPP Initiatives due to big investment requirements and the existence of public goods and quasi-public goods;

iii. Need to preserve the sea and marine resources by conserving marine ecosystems and reducing marine pollution;

iv. The government needs to introduce an environmental management plan and integrated management decisions;

v. Promotion of local goods, local ecosystem, and culture, and implement WTP (willingness to pay) mechanism to safeguard the coastal and marine ecosystem;

vi. Assessing the impacts of socio-cultural, economic, environmental, and institutional perspectives;

vii. Improving the existing facilities and future development processes of coastal and marine tourism in Bangladesh;

viii. Designing well-structured policy guidelines and recommendations to develop sustainable coastal and marine tourism policy;

ix. Need to assess the location, access, connectivity, transportation, and utility infrastructure of targeted tourist sites;

x. Feasibility study of the area of interest through studying demand and supply profile, social and economic environment, natural hazards vulnerability;

xi. One-Stop Service for Tourists and assurance of tourist safety and security;

xii. Promoting innovative ideas for upgrading traditional and new touristic activities or attraction sites to increase the interest of both local and foreign tourists;

xiii. Emphasize local agriculture, industry development, and ecosystem protection by controlling the environmental impact of tourist activities through eco-friendly financial arrangements like tourism tax, WTP, etc.;

xiv. Arrangement of special low-interest loans or tax exemption for the first few years to the micro, small, or medium artisanal tourism businesses like hotels, restaurants, Airbnb facilities, eco-park, cruise, local goods shops, etc. by the government;

xv. Engaging more manpower in the tourism sector by encouraging them through mass campaigns and institutional training through Bangladesh Porjoton Corporation, Bangladesh Tourism Board, and different academic platforms like universities, NGOs, etc.;

xvi. Inclusion of local communities, local heritage, and culture by encouraging community-level management; and

xvii. Building an updated central tourism website by enriching it with comprehensive information about tourist spots such as their historical or natural value, scenic beauty, popular spots and activities, accommodation facilities, etc. This website will represent the tourism sector lucratively at a glance to native and foreign tourists.

6.2.13 Shipbuilding

Challenges

i. Bangladesh has faced several challenges to build ships as it is a semi-high-tech and capital-intensive sector. It is both a promising and challenging industry in the World. As a result, it is not in competitive and international standard in Bangladesh and also is in a vulnerable stage;

ii. A financial matter like lack of adequate working capital, high rate of interest on industrial and working capital loans, high bank guarantee margin, and high import LC margin;

iii. Lack of skilled manpower like available graduates, skilled supervisors, foremen, specialized welders, cutters, fitters, machine operators, and other technical skilled manpower;

iv. Insufficiency in the number of ancillary industries to support the shipbuilding industry as backward linkage by providing service and supplying ships' components;

v. Negligence in maintaining safety, health, and environmental aspect in the shipyards including the effect of harmful substances and related exposure in the shipment of materials;

vi. Quality control and assurance problems by the local shipyards hamper the trust of the foreign buyers and the next contracts;

vii. The absence of adequate backward linkage industries delays delivery and adds the extra cost of export ships;

viii. Deficiency in power supply and weak infrastructure facilities;

ix. Increased foreign dependency due to the import-based nature of export-oriented Bangladeshi shipbuilding; and

x. Absence of international standard management practice and planning process.

Recommendations

i. Growing the shipbuilding industry during periods of increasing demand is a major call for Bangladesh. To discover the potential of the shipbuilding industry in Bangladesh for sustainable blue economic growth and development some critical matters are to be defined and solved as soon as possible;

ii. Identifying ways to build ships using locally available raw materials rather than imported;

iii. Registering all shipyards and regulating the number and quality of new shipyards through the issuance of 'No Objection Certificates';

iv. Assessment of relocating the shipbuilding industry from Dhaka city to any suitable coastal areas of Bangladesh;

v. Providing low-cost skilled workforce cum proper yard management;

vi. Suggestion to develop workers' skills and technological innovation to build international standard ships;

vii. Assessment of environmental impacts due to shipbuilding activities in Bangladesh and ways to minimize them;

viii. Rigorously enforce Shipbuilding Industry Development Policy 2020 which was approved by the government in 2021;

ix. Evaluating the overall environment of shipyards every five years and to renew their work permit or certificates;

x. Looking after the interests of workers through supervision of safety, work environment, and health issues;

xi. Facilitating utility connections including electricity, water, and gas;

xii. Assisting in the establishment of ship design firms and backward/forward linkages like linkages with roads, railways, and power; and

xiii. Ensuring government support as well as attracting FDI and fostering joint ventures.

6.2.14 Ship Recycling

Challenges

i. There is a high risk of environmental pollution from chemicals like Pb, Hg, Zn, As, Cd, etc. that are derived from ship recycling activities. PCBs, asbestos, and huge quantities of oil in yard-associated sediment textures affected coastal and marine waters;

ii. Biological threat from the release of the bilge, ballast water, and invasive species;

iii. There is a lack of labor safety and basic labor training for this risky job;

iv. Risk of communicable skin diseases, respiratory diseases, and other health problems due to hazard exposure especially generated by asbestos, PCBs, heavy metals, and chemicals;

v. Poor maintenance of machinery and equipment;

vi. Repetitive and monotonous work, excessive workload, but low wages;

vii. There is often a lack of sanitation systems and pure drinking water; and

viii. In the ship recycling industry, there has no life insurance and job security for the involved stakeholders.

Recommendations

i. Establishing proper institutional arrangements including the plethora of stakeholders like organizations from the government, private sectors, NGOs, financial companies, etc.;

ii. Disclosure of information by each shipyard regarding certain information including the number of ships by country of origin, the inventory of the hazardous waste carried in each ship, the total amount of scrapped per yard by year, the deaths in the yards, number of workforces, etc.;

iii. Using contained areas to limit the access of hazardous materials to the environment;

iv. Developing environmentally sustainable ship dismantling methods;

v. Implying the polluter pays principle on the shipyards;

vi. Eco-ship design and clean recycling to avoid future disposal problems;

vii. Identification and rewarding Green Ship Recycling Yards;

viii. Pre-cleaning of vessels as far as possible before exporting them to developing countries like Bangladesh;

ix. Imparting extensive training, occupational safety, health protection, and personnel protection equipment (PPE) by the owners and contractors to avoid labors causalities;

x. Establishing proper waste removal and downstream waste management unit by each ship dismantling yard;

xi. Baseline study in terms of environmental aspect to find the level of environmental pollution and remedial measures; and

xii. Introducing grants, subsidies, or tax waivers, and another benefit from the government to uplift ship

recycling as an industry.

6.2.15 Ship transport

Challenges

i. Traveling via ship is one of the most enjoyable journeys. However, we do not have enough safety equipment on most of the ships;
ii. There are environmental concerns due to massive ship transportation throughout the country, particularly in coastal regions;
iii. In Bangladesh, we have many small islands which are located in the coastal regions, but there has no direct route from one island to another island or waterway transportation from one coastal district to another coastal district via the maritime waters of the coastal region;
iv. The number of ships for tourists and goods transportation is scant; and
v. The ship crews are not well trained and skilled.

Recommendations

i. Identifying routes for smooth ship transportation and minimizing traffic in coastal and marine waters of Bangladesh;

ii. Evaluating the existing port state measurement for ship transportation and suggestions to improve it;

iii. Assessment of environmental impacts due to increasing ship transportation in coastal and marine waters of Bangladesh;

iv. Providing enough incentives or financial support like tax exemption, subsidy by the government to local shipping companies; and

v. Adding more ships to the existing fleet, freight operators establish freight services including container liner services to carry goods to/from Bangladesh using their own as well as chartered ships and freighters.

6.2.16 Port (deep sea port)

Challenges

i. The main problem is the berth height as big ships or vessels cannot reach the port. As a result, they moored in the mid of the sea or landed in foreign countries and small vessels carry the goods to the ports;

ii. The number of ports is not sufficient for the number of ships traveling to or from Bangladesh to other countries and within the countries;

iii. There is a lack of road-rail connectivity to the hinterland;

iv. Most of the ports in Bangladesh are away from International Shipping Lanes (ISL);

v. The activities of deep sea port constructions might pose serious environmental impacts on the coastal and marine ecosystem;

vi. Lesser navigable routes due to high sediment transportation from the upstream area; and

vii. High dredging cost.

Recommendations

i. As the volume of seaborne trade is significantly increasing through the Bay of Bengal, therefore Bangladesh needs to develop its existing seaport facilities to benefit from this trade. So, identification of technical and non-technical challenges to establishing deep sea ports and ways to address them efficiently;

ii. Granting tax holidays and flexible terms and conditions for interested port operators (National or Foreign) under PPP;

iii. Selecting suitable sites for deep sea ports in any navigable channel that has deep sheltered waters, good communication links, and 24-hour access with lesser vulnerability from climatic hazards;

iv. Designing the port layout with necessary modern diversified facilities and multi-purpose terminals;

v. Preparing an exclusive budget with associated maintenance and dredging cost, labor cost, and construction facility expenditure;

vi. Assessment of existing ecosystem communities in the proposed port area and sustainable ways to preserve them;

vii. Running an environmental impact assessment (EIA) including interruption of longshore sediment transport, erosion and accretion of shoreline, siltation of channel and port basin, threats from invasive species and disturbance as well as habitat loss of local biodiversity;

viii. Training of required personnel for manning specialized posts of deep sea ports at home and abroad for capacity building; and

ix. Constructive diplomatic engagement in signing agreements/protocols amongst Bangladesh, India, North Eastern States, Nepal, Bhutan, Myanmar, and China with win-win terms and conditions for the free flow of goods to and from DSP.

6.2.17 Ocean governance

Challenges

i. The main challenge standing in the way of initiating ocean governance in Bangladesh is the lack of structured information and scattered data about MSP in Bangladesh;

ii. Lack of proper institutional framework;

iii. Interactions/conflicts among existing and emerging maritime activities as well as maritime stakeholders in coastal and marine waters of the EEZ of Bangladesh;

iv. Impacts of climate change associated with vulnerability of the coastal and marine ecosystem to natural or manmade hazards;

v. Transboundary issues regarding pollution, fish stock, mapping, etc.; and

vi. Balancing between economic growth and conservation.

Recommendations

i. Establishment of special and inclusive authority for ocean governance such as 'Ministry Ocean Affairs';

ii. Producing a legally enforceable, eco-friendly, sustainable, and statutory maritime zoning policy guideline based on scientific understanding and collaboration with stakeholders such as the 'Ocean Policy';

iii. Strong legislative protection and framework;

iv. Identifying and mapping ecologically sensitive ocean areas under the maritime zoning plan (MSP, MPA) embracing the ecosystem-based management approach;

v. Developing continuous Ocean Account and Monitor Progress;

vi. Coordination among multi-sectored bodies and various stakeholders;

vii. Inclusive meetings, workshops, and seminars to engage stakeholders and municipal administration before policymaking;

viii. Collaboration and Public-Private Partnership (PPP); and

ix. Improving institutional capacity for marine research.

6.2.18 Finance

Challenges

i. The concept of blended finance is not well developed in Bangladesh. So there are challenges to establishing a prudent, investor and development-friendly regulatory and institutional framework to ensure the governance and accountability of the mobilized fund;
ii. In the absence of a transparent and effective monitoring and evaluation process, potential investors become less interested in financing development interventions due to increased investment risks and asymmetric information;
iii. Identification, prioritization, and selection of development problem and intervention to address the problem with a credible estimate of the finance gap to implement the intervention are critical issues in achieving the expected development outcome using a blended finance framework;
iv. Fund mobilization issues such as identification of and reaching out to potential donors, private investors, and public institutions, socializing the development impact with the commercial viability of the intervention to motivate them, and negotiating the size and type of contribution to the mobilized fund also critical issues for blended finance;
v. There are challenges to developing an efficient and transparent application of innovative financial modeling and engineering tools to manage financial risks;
vi. The dearth of required technical skills is a major hindrance to addressing this challenge; and
vii. There are also risks of various issues that are related to developing a sustainable, transparent, and speedy fund transfer (to financial institutes and beneficiaries) and repayment framework.

Recommendations

i. Need to identify development goals and estimate credible investment gaps to implement blended finance;
ii. To develop a generic blended finance framework for Bangladesh;
iii. Selecting key development challenges, reviewing and contextualizing the regulatory and policy framework;
iv. Need to develop fund negotiation and commitment with clearly defined concessionary components;
v. Developing financial engineering and de-risking instruments, contingency plans, and other risk management strategies;
vi. Debt management and debt servicing should be carefully monitored;
vii. Developing a transparent and speedy process for fund transfer mechanism to FIs and providing technical support to beneficiaries;
viii. Identifying and reaching out to potential investors (climate fund, donor agencies, private sector, local FIs); and
ix. Beneficiary selection criteria and credit allocation and disbursement process and sound repayment procedure and debt management.

6.2.19 Satellite oceanography and ICT

Challenges

i. Satellite oceanography is a new management tool for ocean governance in Bangladesh. To develop its infrastructure, the government needs a huge amount of money;

ii. Understanding or interpreting ocean-related data that are received via satellite needs skilled and trained manpower;

iii. There is the uncertainty of losing kits that are dipped in the marine water or damaging kits that are used in the satellites and as a result, data production will be disturbed or stopped; and

iv. If some vessels do not use any VMS or tools or stop their signal, it might be very tough to monitor those vessels using satellite data.

Recommendations

i. The government needs a huge amount of funds for infrastructure development;
ii. Need to arrange training and skill development programs on satellite oceanography for the relevant stakeholders;
iii. Need to monitor the data produced by an expert data analyst;
iv. Strict rules and regulations will be imposed based on the findings of the satellite oceanography; and
v. Dependency on satellite data needs to be increased and physical dependency will be decreased for monitoring and surveillance of the maritime areas.

CHAPTER 7

INSTITUTIONAL ARRANGEMENT

7.1 Institutional Arrangements in the World

Blue Economy is one of the important aspects of Sustainable Ocean Governance as it refers to the sustainable use of ocean resources for economic growth and improved livelihood by maintaining a healthy marine ecosystem. To achieve sustainable ocean governance, it is important to implement the contemporary and newly developed principles and concepts including Blue Economy and Ecosystem-based management (EBM). As an implementation tool for sustainable ocean governance, Marine Spatial Planning (MSP) can play an important role to achieve the objectives of the Blue Economy. Due to various reasons, the current institutional arrangements for sustainable ocean governance as well as exploring the concept of the Blue Economy is at a very rudimentary stage in Bangladesh.

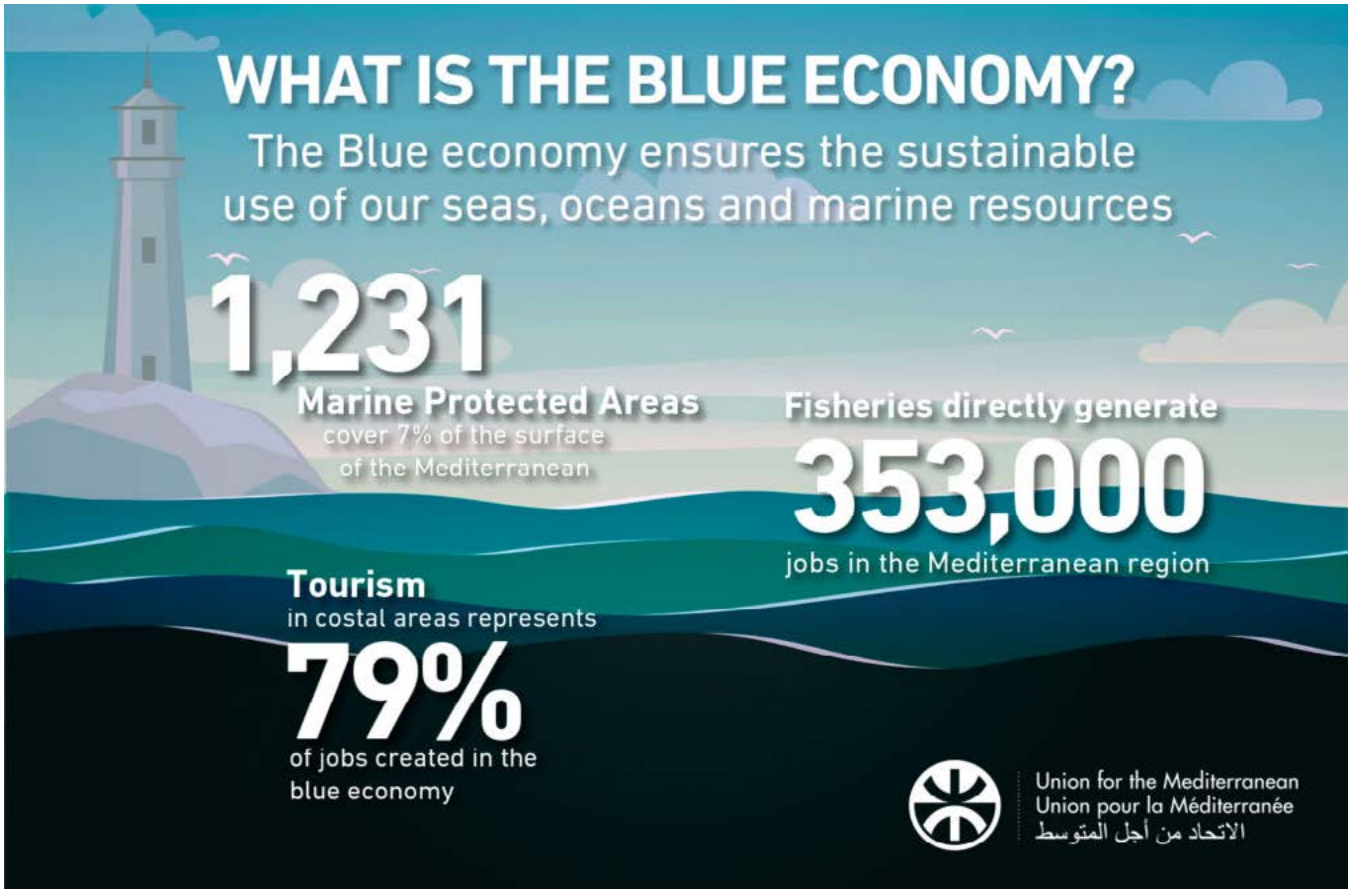


Figure 82 : Blue Economy all over the World

India

The Economic Advisory Council to the Prime Minister (EAC-PM), has taken up the initiative to evolve a policy approach to the Blue Economy. Given the gaps and involvement of several Ministries, Departments, and Agencies working in this domain, there is an urgent need for a unified and coordinated effort to

address issues because they have macro-economic implications. India made a draft Policy for India's Blue Economy. This has been formulated after several rounds of multiple deliberations with relevant Ministries, think tanks, and experts. Valuable inputs were taken from individual experts, representatives of various ministries of the government, and external experts from institutions such as the Resource Information System for Developing Countries (RIS), the National Maritime Foundation (NMF), The Energy and Resource Institute (TERI), the Federation of Indian Chambers of Commerce & Industry (FICCI) and the Indian Ocean Rim Association (IORA). The present Commission will hold office till 2022. It is for the first time since the

Commission was established in 1997, but India is not represented in the Commission. India has contributed significantly to the work of the Commission and continued to share our expertise and add value to the work. The next election will be in 2022 and the Group strongly recommended that India should have an expert elected to the Commission. India was among the first in the world to create a Department of Ocean Development in 1981, now the Ministry of Earth Sciences (MoES). Based on the experience of more than three decades, India has come a long way with the launch of new programs such as "Deep Ocean Mission," "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. MoES has joined the United Nations on the "Clean Seas Programme" to develop strategies for estimating and reducing Marine Litter/Plastic in the oceans, which is also a part of SDG-14. MoES has also signed two contracts with the International Seabed Authority (ISBA) for deep ocean exploration of minerals (Ploymetallic Nodules and Hydrothermal Sulphide) in the Indian Ocean. India has rights of exploration in 75,000 km^2 area and 10000 km^2 area for polymetallic nodules and polymetallic sulfides in the international water of the Indian Ocean.

The Council members could be the Ministers of Earth Sciences, External Affairs, Environment, Forests & Climate Change, New & Renewable Energy, Mines, Petroleum and Natural Gas, Fisheries, Science & Technology, Tourism, Defense, Commerce, Shipping, Finance, and NSA. Further, the Chief Ministers of coastal States would also be members along with the Vice-Chairman of NITI Aayog. The Presidents of FICCI, ASSOCHAM, and CII could also be invitees and the Secretary, of the Ministry of Earth Sciences, could be the Member-Secretary. The Council would be required to meet at least once a year to discuss key issues, approve plans and strategies as well as review achievements.

The executive committee may have the following terms of reference:

- Facilitate and support Ministries/Departments in the implementation of the recommendations of the National Blue Economy Council
- Undertake planning, coordination, and oversight of projects being executed by
- Ministries and State governments
- Provide support to Ministries/Departments in the development of international cooperation, and capacity building in the Blue Economy
- Facilitate Ministries/Departments in tariff setting, fisheries subsidy negotiations, and regulatory issues, wherever required.

China

The Chinese State Council

In March 2018, China launched the largest reform of the State Council in the past 40 years, in which resources and environmental reforms were prominent. The Ministry of Natural Resources has been

assembled and performed the responsibilities of owning all-natural resource assets, managing all territory utilization, and protecting and rehabilitating the ecological environment uniformly. The "two unifications" responsibilities start a new era in natural resource management in China. China is in a critical period of transferring from high-speed development to high-quality development (Figure). The resource and environmental carrying capacity and the territory space development suitability are important scientific propositions that represent the interaction and coordinated development between man and nature. Since 2010, it has gradually become a basic work for central and local governments to determine regional strategies and policies and make development planning. The resource and environmental carrying capacity refers to the comprehensive support levels of natural resource endowment conditions to human activities in a certain space and is characterized by four aspects: resources, environment, ecology, and disaster. On November 30, 2018, the Ministry of Ecology and Environment, the National Development and Reform Commission, and the Ministry of Natural Resources jointly issued the Action Plan for the Struggle for Comprehensive Governance of the Bohai Sea (Ministry of Ecology and Environment et al., 2018).

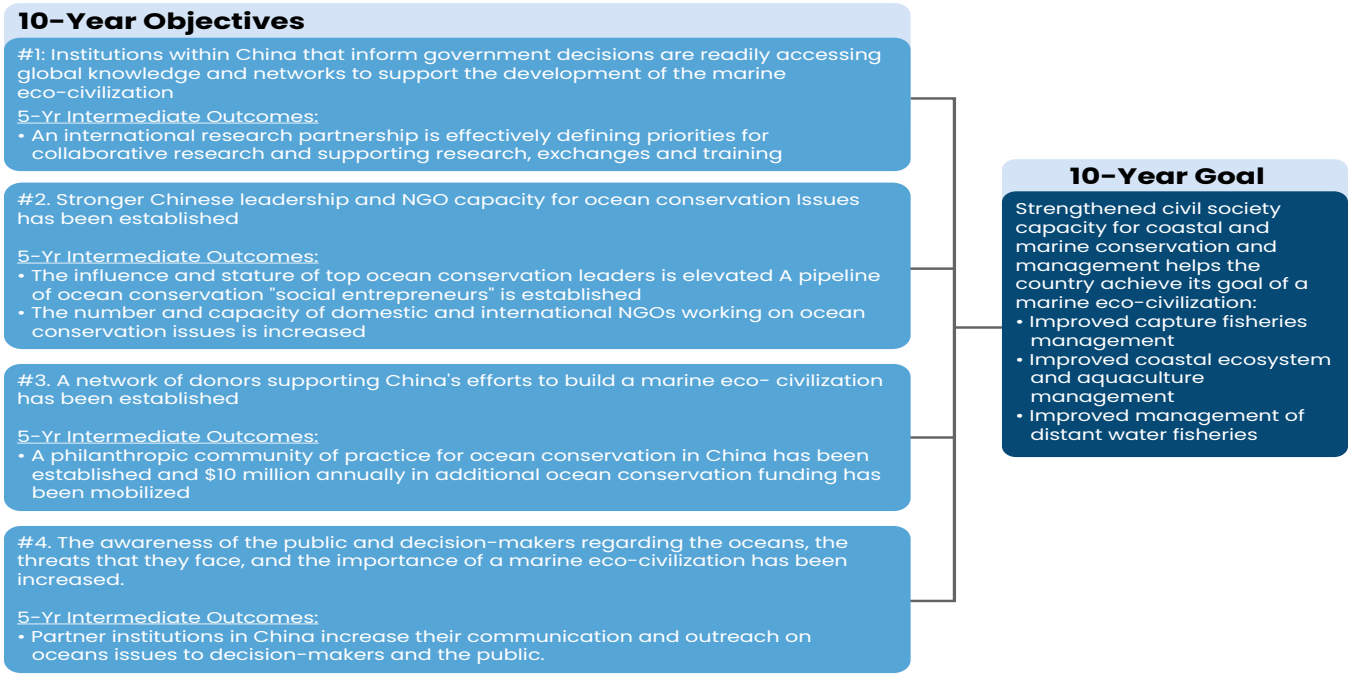


Figure 83 : China's Marine Strategy for Transferring High-Speed Development to High-Quality Development

International Council for the Exploration of the Sea (ICES)

The International Council for the Exploration of the Sea (ICES) is an intergovernmental marine science organization that meets societal needs for impartial evidence on the state and sustainable use of our seas and oceans. The goal is to advance and share scientific understandings of marine ecosystems and the services they provide and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals. ICES connects more than 5000 scientists from over 700 marine institutes in 20 member countries. Over 2500 scientists participate in activities annually. Its area of research covers mainly the North Atlantic Ocean, including the adjacent Baltic Sea and the North Sea, but also extends into the Arctic, the Mediterranean Sea, the Black Sea, and the North Pacific Ocean. Based on scientific work and the collection of marine data, ICES provides scientific advice for a wide range of recipients, including the European Commission. To this end, ICES manages a well-established data center and also publishes its data and reports so it can contribute to an increased understanding of the marine environment. Though Strategic partnerships of work in the Atlantic Ocean also extend into the Arctic, the Mediterranean Sea, the Black Sea, and the North Pacific Ocean (Figure).

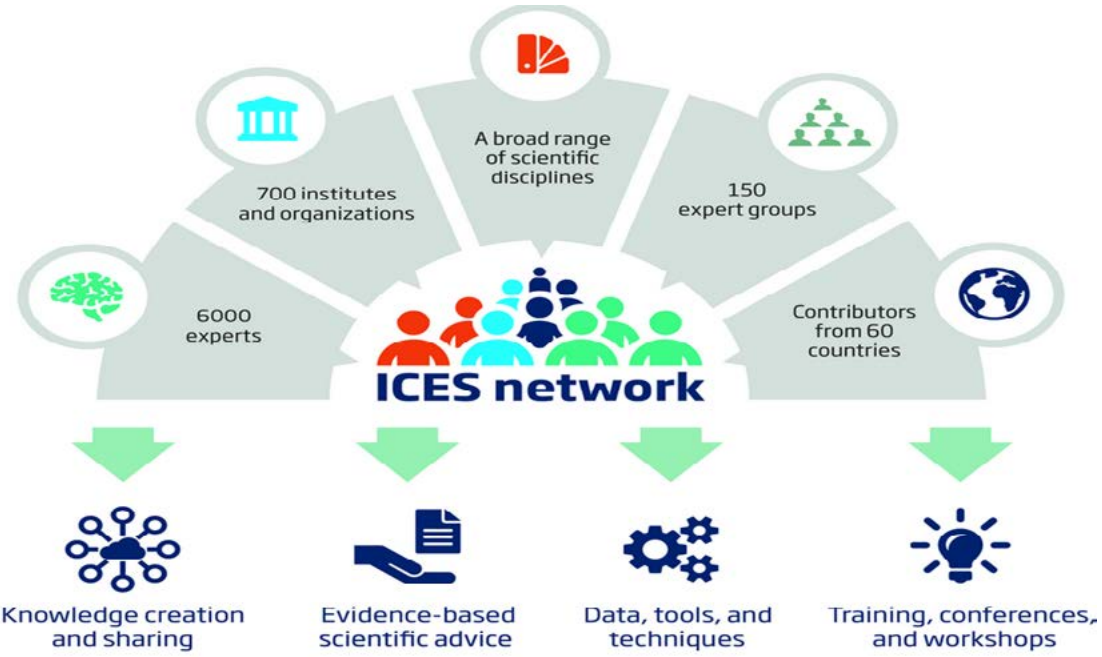


Figure 84: Strategic Partnerships of Work for the ICES Member States

Blue Economy Institutional Framework

Seychelles' BE strategy is integrated top-down within the national governance framework (Table 3) and lies under the purview of the Office of the Vice President.

Table 3. Seychelles' BE Institutional Framework

National Institutional BE Framework		
BE Departments/Agencies	**Role/Function**	**Opportunities and Limitations**
High-Level Governmental 1. Blue Economy Council	To provide leadership and strengthen Seychelles' ocean governance mechanisms while enhancing methods of coordination among key BE stakeholders	Established in 2019, the council has met once to discuss issues relating to the BE. Mandated to meet twice a year, it will serve to bring together key decision-makers within the various ministries and bodies involved in the BE.
2. Blue Economy Multi-Stakeholders Forum	To function as a think tank and make policy recommendations to the government while ensuring commitments are implemented	Established at the same time as the council, the forum will include members from the government, private sector, and NGOs. It has yet to meet.

National Institutional BE Framework		
BE Departments/Agencies	**Role/Function**	**Opportunities and Limitations**
Governmental 1. The Blue Economy Department	Primary coordination mechanism in Seychelles' sustainable development strategy in transitioning towards a BE.	The department's limited mandate means it is not directly involved in the actual implementation of projects within the different economic sectors, governmental institutions, and other bodies. It does, however, play a role in coordinating communication and monitoring BE developments.
2. The combined Departments of Environment, Tourism, Ports, and Shipping; Seychelles Fishing Authority; Trade and Economic Planning; National Institution for Science, Technology, and Innovation; Ministry of Employment, Entrepreneurship Development and Business, and more	These ministries and departments are integral in the regulation and management of key components within Seychelles' BE agenda	Ministries, departments, and agencies are perceived to be poorly managed and continuously operate in silos. Outdated systems and a lack of trained personnel have made it difficult to implement national plans effectively. Consistent implementation of the BE Roadmap across such a landscape might prove challenging.
Financial 1. Development Bank of Seychelles (DBS)	Since 2018, DBS has managed a US$12-million Blue Investment Fund established by the proceeds from the sovereign blue bond, to support the diversification and expansion of sustainable fisheries value.	There might be a lack of awareness around the purpose of this loan scheme, with DBS suggesting applicants tend to associate the scheme primarily with unsustainable activities related to the fisheries sector.
2. Seychelles' Conservation and Climate Adaptation Trust (SeyCCAT)	An independent trust fund tasked with managing the proceeds of the debt swap and blue bond, SeyCCAT funds sustainable BE-related projects in the country.	SeyCCAT has funded BE projects since 2018 but the pandemic halted the launch of new grant activities in the first half of 2020 (resumed in July). It has also indicated there are challenges in funding viable scientific and data-driven projects.

National Institutional BE Framework		
BE Departments/Agencies	**Role/Function**	**Opportunities and Limitations**
Educational 1. The University of Seychelles; Blue Economy Research Institution (BERI)	Developed to support research in environmental science, specifically relating to the BE, BERI is also linked to the James Michel Foundation, a think tank focused on the BE, climate change, and sustainable development.	BERI has a strong presence in BE research. It was part of the Nekton Mission, an underwater expedition to explore the depths of Seychelles' waters that saw the president become the world's first head of state to deliver a live address from a 124-meter depth during Nekton's submersible dive.
2. Post-secondary educational institutions such as the Seychelles Maritime Academy (SMA) and Seychelles Tourism Academy (STA)	The SMA and STA are mandated to generate a highly skilled and competent workforce to eventually become the leading regional training institutes in their respective fields.	International collaborations have helped both institutions partially achieve this mandate. The Colombo International Nautical and Engineering College (Sri Lanka) assumed management of SMA in 2013, eventually placing Seychelles on the white list of the International Maritime Organization. The STA has partnered with Ireland's Shannon College of Hotel Management to increase the presence of Seychellois in top hotel management positions. However, between 2013 and 2018, only 30 out of 63 graduates reported working in hotel establishments.

National Institutional BE Framework		
BE Departments/Agencies	**Role/Function**	**Opportunities and Limitations**
Civil Society/NGOs 1. The Citizens Engagement Platform (CEP), which has been active for the past 30 years, is the main civil society platform. The CEP formalized a framework for partnership and cooperation with the government through a memorandum of understanding (MoU) in 2017. Seychelles has some of the highest levels of NGO participation in Sub-Saharan Africa (one per 1000 people).	NGOs with an environmental or conservation background predominantly participate in the BE space. Prominent actors include Nature Seychelles, renowned for opening a BE Knowledge Centre and SIDS Youth AIMS Hub, a youth-led NGO that launched the 'Blue Economy Internship Programme' initiative. Other notable actors include WiseOceans, Marine Conservation Society Seychelles, Island Conservation Society, Seychelles Islands Foundation, The Oceans Project, and SWIOTUNA, a membership network of civil society and private sector organizations across Africa.	Although the government is generally supportive of civil society participation, there is currently no formal mechanism beyond the MOU for such engagement. While the importance of civil society in championing the BE has been recognized, the aims of most NGOs in the BE space tend to overlap, given their similar backgrounds in environmental conservation and sustainability alone. Further, the CEP has questioned Seychelles' preparedness to venture into BE to its fullest potential. Given the current education and employment constraints, members have pointed out that most Seychellois may not hold the required qualifications Additional questions around the transparency of the country's extractive industries, such as oil drilling, have also been raised as key points of concern.

Seychelles has made significant progress in implementing specific key objectives that form part of its BE roadmap. Notably, the country declared 30 percent of the country's territorial waters a Marine Protected Area in March 2020 as part of its MSP, meeting international targets ten years ahead of schedule. This announcement effectively protects the integrity of the island nation's oceanic territory, ecosystem, and resources, which is a key outcome of the BE strategy.

7.2 Existing Blue Economy-related ministry/department globally

The 'Blue Economy' is an emerging concept that encourages better stewardship of our ocean or 'blue' resources. During the primary period 3/5 years scheme for the Blue Economy program, was completed by the Ministry of ICT for technological support, the Ministry of Fisheries and Livestock, the Ministry of Water Resources, the Ministry of Shipping, the Ministry of Planning, and the Ministry of Finance**.**

Blue Economy-related ministry/department found globally-

African Union Commission (AUC)

The African Union Inter-African Bureau for Animal Resources (AU-IBAR), a specialized technical office

of the Department of Rural Economy and Agriculture (DREA) of the African Union Commission (AUC), is mandated to support and coordinate the utilization of livestock, fisheries, aquaculture, and wildlife as resources for both human wellbeing and economic development in the Member States of the African Union. The Vision of the AU-IBAR Strategic Plan 2018-2023 is an Africa in which animal resources contribute significantly to integration, prosperity, and peace. AU-IBAR's intervention in the fisheries and aquaculture sector is guided by the Policy Framework and Reform Strategy for fisheries and aquaculture in Africa (PFRS), which is aimed at improving governance of the sector for increased sustainable contribution to food security, livelihoods, and wealth creation. Also within the framework of the African Union Agenda 2063, the Africa Blue Economy Strategy environed an inclusive and sustainable blue economy that significantly contributes to Africa's transformation and growth. The Global Conference on Sustainable Blue Economy was organized in Nairobi, Kenya in November 2018. African leaders at the Conference directed the African Union to work with relevant stakeholders to develop a blueprint of Africa's Blue Economy Strategy that will guide sustainable development and utilization of resources of the Oceans, Seas, Lakes, and Rivers for blue economy growth and livelihoods. Accordingly, the African Union Inter-African Bureau Animal Resources (AU-IBAR) was requested by H.E The Commissioner of Rural Economy and Agriculture of the African Union Commission to lead the process of formulation of the Africa Blue Economy Strategy. The Africa Blue Economy Strategy1 was eventually developed and subsequently endorsed in October 2019 by the African Union Specialized Technical Committee on Agriculture, Rural Development, Water and Environment (STC-ARDWE). The Blue Economy Action Plan was elaborated in September 2020, endorsed by the African Union Specialized Technical Committee on Agriculture, Rural Development, Water and Environment (STC-ARDWE) in October 2019, and subsequently adopted by the African Union Executive Council in February 2020. In this regard, a consultancy contract was signed between the blue economy team of experts and AU-IBAR on the 24th of September 2020. The objective of the consultancy was to prepare the current Blue Governance Framework.

ASEAN

ASEAN acknowledges that the ocean and seas are key drivers of economic growth and Innovation while taking into account the need to ensure ocean sustainability and rules-based ocean governance:

- Noting the emerging significance of the Blue Economy and the different perspectives on the concept;

- Further noting that the Blue Economy is a multifaceted and cross-cutting concept that involves all three pillars of the ASEAN Community;

- Emphasizing the need for ASEAN to reach a common understanding of the Blue Economy as well as identify the scope of cooperation and activities that the ASEAN Member States are comfortable undertaking together, and with external partners;

- Further emphasizing the universal and unified character of the 1982 United Nations Convention on the Law of the Sea (UNCLOS), and reaffirming that the 1982 UNCLOS sets out the legal framework within which all activities in the oceans and seas must be carried out and is of strategic importance as the basis for national, regional and global action and cooperation in the marine sector and that its integrity needs to be maintained;

- Underscoring the importance of alignment with existing international frameworks such as the UN 2030 Agenda for Sustainable Development, making use of existing approaches and tools available from international organizations that support the Blue Economy, and recognizing the importance of ongoing work to develop an international legally binding instrument under the 1982 UNCLOS on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction; and

- Affirming the importance of upholding international law, including the Charter of the United Nations and the 1982 UNCLOS, as well as ASEAN's shared values and norms as enshrined in the ASEAN Charter, the Treaty of Amity and Cooperation in Southeast Asia (TAC), and the ASEAN Outlook on the Indo-Pacific (AOIP) for enhancing mutual trust and confidence, promoting dialogue and cooperation in inter-state relations, and taking a multilateral approach in addressing emerging challenges to maintain and promote peace, security, stability, and prosperity in the region.

PEMSEA

PEMSEA commits to assisting its partners to achieve the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA) goals. As the pioneer of integrated coastal management (ICM) in East Asia, PEMSEA provides integrated solutions for the effective management of coastal and marine areas, supporting sustainable economic growth and blue economy, ecosystem rehabilitation and protection, and adaptive and resilient communities. ICM creates positive impacts on communities through food security and livelihood opportunities, pollution and waste management, water use and supply management as well as civil society empowerment, including the youth. Through our work, we have achieved over 17% coverage of the region's coastline under ICM, impacting more than 42,000 km of the coast and over 146 million people living in coastal and watershed areas.

FAO

The concept of Blue Growth is similar in many respects to that of the Blue Economy—a concept that came out of Rio +20 in that both center on the pillars of sustainable development: environmental, economic, and social. FAO uses the term Blue Growth to emphasize the need for growth in the many Member States particularly in the fisheries and aquaculture sectors. The goals of the Blue Growth Initiative are to maximize economic and social benefits while minimizing environmental degradation from these sectors. These goals are closely aligned with the 2030 Agenda for Sustainable Development (supported by the Sustainable Development Goals (SDGs)).

UN Commission

The UN first introduced the "Blue economy" at a conference in 2012 and underlined sustainable management, based on the argument that marine ecosystems are more productive when they are healthy. This is backed up by scientific findings, showing that the earth's resources are limited and that greenhouse gases are damaging the planet. Furthermore, pollution, unsustainable fishing, habitat destruction, etc. harm marine life and are increasing day by day. The UN specifies Blue Economy as a range of economic activities related to oceans, seas, and coastal areas, and whether these activities are sustainable and socially equitable. An important key point of the Blue Economy is sustainable fishing, ocean health, wildlife, and stopping pollution. The UN iterates 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". This points out the importance of global cooperation across borders and sectors. This also indicates that governments, organizations, and decision-makers need to join forces to ensure that their policies won't undermine each other.

State Oceanic Administration (SOA), China

China has roughly 9,000 miles of coastline, nearly all of which runs from the North Korean border to the north to the Vietnamese border to the south. It also includes the coastlines of several island possessions. The Chinese government's interest in the Blue Economy concept dates back to the 11th Five-Year Plan, Beijing's strategic economic development plan, which covered the years 2006 through 2010 and included a set of specific data that covered the marine economy. Performance during this period was impressive, registering an average annual growth of 13.5% and creating some 33 million jobs by the end of 2010. Accordingly, in the 12th Five-Year Plan, spanning the years 2011 through 2015, China's supreme executive body, the State Council, issued a new set of specific targets for China's Blue Economy, including total output value growth of 8% per year, value-added growth of 9% annually, and a goal for the Blue Economy to make up 10 percent of total national gross domestic product, or GDP, by 2015. In addition, the targets strongly incentivized research, development, and innovation, specifying that research and development expenditures should account for 2% of the total output value for the marine economy as a whole. The inclusion of such specific and ambitious targets for Blue Economy sectors as part of China's strategic economic development plan suggests the degree to which it has attracted the attention of senior Chinese government officials.

Republic of Seychelles

Like many other island nations, Seychelles has jurisdiction over a large area of ocean, claiming a vast Exclusive Economic Zone (EEZ) of 1.37 million km^2 - the second-largest in Africa. The government is therefore eager to realize the optimal potential of Seychelles' oceanic territory by applying the Blue Economy concept as the foundation for economic diversification and sustainable growth. While there is as yet no universally accepted definition for the Blue Economy, for Seychelles the notion of the Blue Economy refers to those economic activities that directly or indirectly take place in the ocean and coastal areas, use outputs from the ocean, and place 'goods and services' into ocean activities, and the contribution of those activities to economic growth, social, cultural and environmental wellbeing. The Seychelles Government has played a leading role in promoting the Blue Economy concept nationally, regionally, and internationally. It has consistently championed the principles of sustainable development and the protection of biodiversity since the launching of Agenda 21 at the 1992 Rio de Janeiro Earth Summit, through to the Barbados Programme of Action of 1994 (BPOA), the Johannesburg 2002 Plan of Implementation, the 2005 Mauritius Strategy, and more recently at the RIO+20 Conference on Sustainable Development. The outcome document of this conference, entitled "The Future We Want" (2012) includes its 'Framework for action and follow-up' detailed actions related to 'Oceans and Seas' (United Nations, 2012, p. 27), emphasizing in its introductory section the importance of the conservation and sustainable use of oceans and seas.

The World Bank Group

The World Bank's overall oceans portfolio is worth over US$ 9 billion in active projects as of June 30, 2021. This portfolio includes projects such as sustainable fisheries and aquaculture, integrated coastal and marine ecosystem management, circular economy and improved solid waste management of marine plastics, sustainable coastal tourism, maritime transport, and offshore renewable energy. By setting a new course toward a Blue Economy approach, the World Bank aims to limit the impacts on ocean health of these economic sectors and to ensure that they are developed in an integrated fashion.

The Ocean Foundation

The Ocean Foundation is a partner and advisor of Rockefeller Capital Management, helping identify public companies whose products and services meet the needs of a healthy human relationship with the ocean. In 2020, The Ocean Foundation collaborated with Credit Suisse and Rockefeller Asset

Management (RAM), a division of Rockefeller Capital Management, on the launch of the Ocean Engagement Fund to help invest in the Blue Economy. TOF President Mark J. Spalding discusses this partnership and investing in a sustainable blue economy in a recent 2021 webinar**.**

Mid-Atlantic Blue Ocean Economy 2030 Forum

The Mid-Atlantic Blue Ocean Economy encompasses ocean-based industries, as well as the natural assets and ecosystem services that the ocean provides. The forum's goals and objectives include:

- Identify the most important factors driving the future of the Blue Ocean Economy and enhancing the value of marine ecosystems
- Identify relevant observing, scientific and technological innovations that would strengthen the sustainable development of the ocean economy
- Articulate the importance of a healthy and thriving Mid-Atlantic Blue Ocean Economy to our quality of life and future prosperity, and communications strategies to carry these messages forward.

The Indian Ocean Rim Association (IORA)

The objectives of IORA are as follows:

- To promote sustainable growth and balanced development of the region and member states
- To focus on those areas of economic cooperation which provide maximum opportunities for development, shared interest, and mutual benefits
- To promote liberalization, remove impediments, and lower barriers towards a freer and enhanced flow of goods, services, investment, and technology within the Indian Ocean rim.

Indian Ocean Rim Association (IORA) has identified six priority areas, namely:

1. Maritime security,
2. Trade and investment facilitation,
3. Fisheries management,
4. Disaster risk reduction,
5. Academic and scientific cooperation and
6. Tourism promotion and cultural exchanges.

In addition to these, two focus areas are also identified by IORA, namely Blue Economy and Women's Economic Empowerment.

International Council for the Exploration of the Sea (ICES)

The International Council for the Exploration of the Sea is the world's oldest intergovernmental science organization. ICES is headquartered in Copenhagen, Denmark, where its multinational secretariat staff of 51 provides scientific, administrative, and secretarial support to the ICES community.

ICES principal functions are to:

- Promote, encourage, develop, and coordinate marine research;
- Publish and otherwise disseminate results of research; and
- Provide non-biased, non-political scientific advice to member nation governments and international regulatory commissions.

Department of Blue Economy, Ministry of Fisheries and Blue Economy, Seychelles

The mandate of the Department is to provide strategic direction and coordination of the Blue Economy implementation, as part of the continued sustainable development of Seychelles.

To develop a Blue Economy as a means of realizing the nation's development potential through innovation and knowledge-led approaches, being mindful of the need to conserve the integrity of the Seychelles marine environment and heritage for present and future generations.

The Vision encapsulates 7 overarching Blue Economy principles: economic efficiency, sustainability, social equity, resilience, innovation, transparency and accountability, and partnerships.

It is articulated through 4 Strategic Priorities or Pillars:

- Strategic Priority 1: Creating sustainable wealth;
- Strategic Priority 2: Sharing prosperity;
- Strategic Priority 3: Securing healthy, resilient, and productive oceans and implementing through
- Strategic Priority 4: Strengthening the enabling environment.

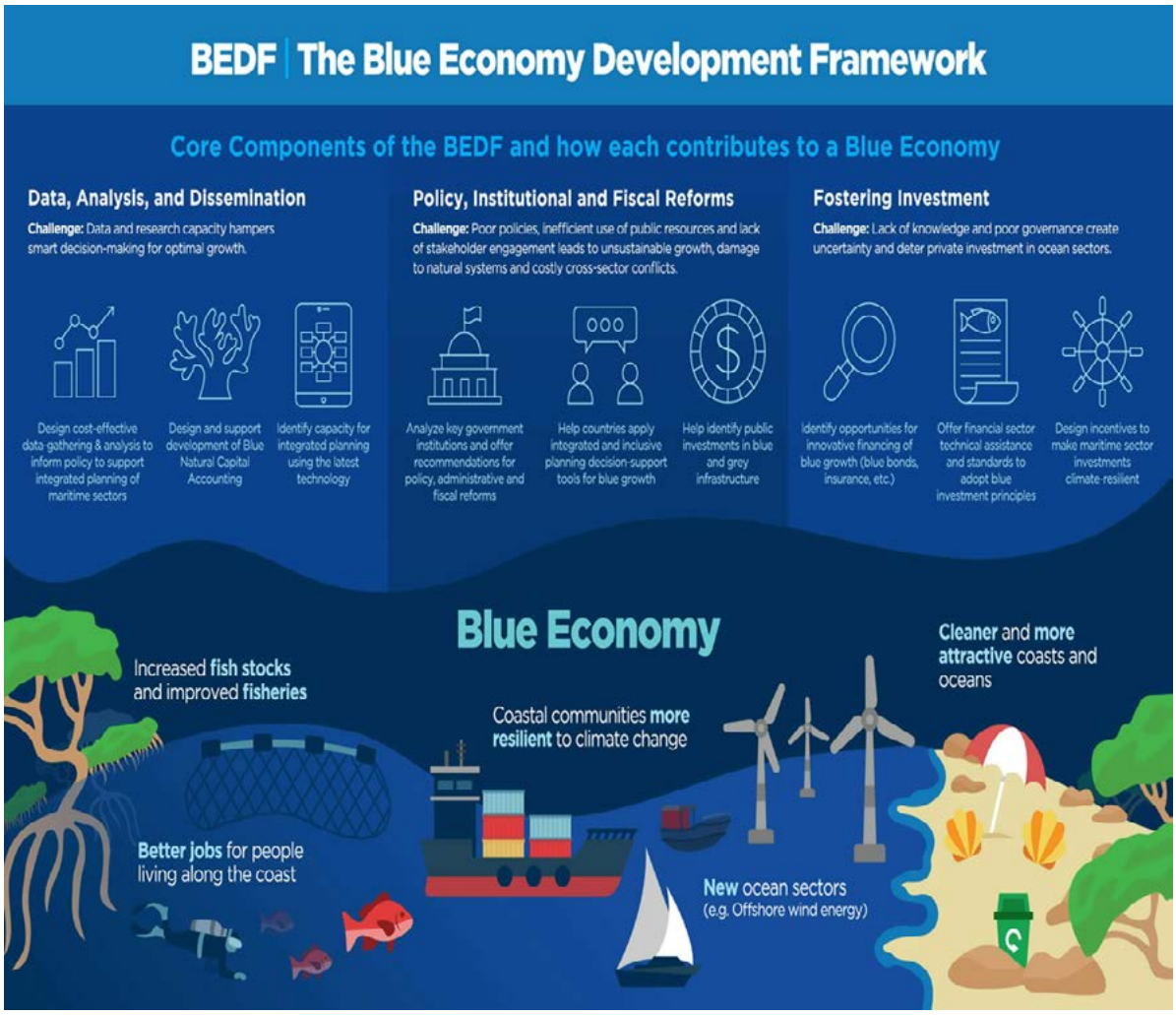


Figure 85: Blue Economy Development Framework by World Bank

7.3 Present structure of blue economy-related organizations globally

According to the World Bank, the blue economy is the "sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of the ocean ecosystem." European Commission defines it as "All economic activities related to oceans, seas, and coasts.

In many ways, Blue Growth and the Blue Economy, which emerged from Rio +20, are similar in that they both focus on the three pillars of sustainable development: environmental, economic, and social. The United Nations Food and Agriculture Organization (FAO) coined the term "Blue Growth" to underline the need for growth in the many Member States, notably in the fisheries and aquaculture sectors. The Blue Growth Initiative's goals are to maximize economic and social advantages while avoiding environmental damage from these industries. The 2030 Agenda for Sustainable Development (supported by the Sustainable Development Goals—SDGs) is closely associated with these objectives. The FAO's Blue Growth Initiative is a framework for sustainably developing fisheries and aquaculture. In the fisheries and aquaculture sectors, Blue Growth is different from business as usual.

The UN has recognized the potential of the Blue Economy as a development model which it defines as

follows: "Blue Economy is a marine-based economic development that leads to improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. At its core, the ocean economy refers to the decoupling of socio-economic development from environmental degradation". The Blue Economy in this context provides developing countries (particularly SIDS) with a framework through which they can diversify their economic base into alternative and emerging sectors and increase their resilience to external shocks. Therefore, SIDS in the Indian and Pacific oceans and the Caribbean have been at the forefront of this interpretation of the Blue Economy. On the contrary, among conservation NGOs, Blue Economy has provided a useful conceptual framework through which economic and development objectives can be tied to environmental considerations. The World Wide Fund for Nature (WWF), defines Blue Economy as follows:

Larger economies, organizations (i.e., EU, OECD), industry, and business groups favor a growth-centric interpretation of the Blue Economy. This view appears to be primarily concerned with getting economic growth from the oceans while remaining mindful of environmental restrictions. Economic valuation is a fundamental technique used in this lens to determine the value of ocean-based sectors to national, regional, and global economies. The OECD maintains a so-called and of nations that are considered uncooperative tax havens, although there are not any nations currently on the list since, by 2009, all nations on the original list had made commitments to implement the OECD standards of transparency. The OECD is leading an effort with the Group of 20 (G20) nations to encourage tax reform worldwide and eliminate tax avoidance by profitable corporations. The recommendations presented for the project included an estimate that such avoidance costs the world&; economies between $100 billion and $240 billion in tax revenue annually. The group also provides consulting assistance and support to nations in Central Asia and Eastern Europe that implement market-based economic reforms.

On the other hand, many conceptions of the Blue Economy place a premium on innovation. This lens, which is favored by the government and industry groups, focuses on research and development, investment, and monitoring. The report of the Australian Institute of Marine Science (AIMS) shows that in 2013-14, Australia's marine industries contributed US$ 74.2 billion to the national economy which accounted for 4.8 percent of the national Gross Domestic Product and directly and indirectly provided almost 400,000 jobs. In total, Australia's marine industries contributed US$ 42.0 billion to value-add in 2013-14, with a further indirect US$ 32.2 billion of value-added in other industries. By 2025, Australia's marine industries are forecast to contribute about US$ 100 billion each year to Australia's economy. In the Australian context, the 'oceans as a driver of innovation' lens is the primary lens used to interpret the Blue Economy and to a lesser extent, the 'oceans as good business' lens. The 'oceans as a driver of innovation' lens in Australia is substantiated through policy documents like the 'National Marine Science Plan. The National Marine Science Committee is coordinating this plan, which is based on the AIMS index of marine industries to forecast future growth potential and how they might be supported by the Australian science community. The 'oceans as good business' viewpoint, on the other hand, is typified by a concentration on valuation studies that strive to measure the value of Australia's maritime sectors and estimate its future growth capability. Since 2008, AIMS has been producing the AIMS Index of the Marine Industry, a regular valuation of current marine industries.

Europe's enormous territory allows it access to numerous seas and oceans, and its marine sector employs over 5.4 million people and generates almost $569.8 billion in revenue each year. 84 The 'oceans as a driver of innovation' lens is the principal lens employed by the EU to interpret the Blue Economy. In comparison to other countries, however, a lot of emphasis is placed on the 'oceans as excellent business' and 'oceans as natural capital' lenses in the United States. In truth, the EU is promoting innovation to create jobs and protect the environment, to serve its needs without endangering the health of the oceans. The European Commission developed its "Blue Growth Strategy" in 2012 to capitalize on the economic and job-creating potential of Europe's oceans, seas, and coasts. The strategy was designed to "steer the EU out of its current economic crisis" as a source of jobs, competitiveness, and greater resource opportunity that can be tapped while "safeguarding" the health of the European

seas. It also identified five focus areas for blue growth, i.e., blue energy, aquaculture, maritime, coastal and cruise tourism, marine mineral resources, and blue biotechnology. In 2017, a progress report on the implementation of the blue growth plan was released. It demonstrates that the EU has always prioritized research and innovation, with a total of US$ 911.68 million allocated to marine and maritime research and innovation initiatives between 2014 and 2016. Coastal and Marine Spatial Planning (CMSP) has also undertaken studies on certain waters (such as the western Mediterranean) to examine its Blue Economy potential (however a lack of public and private risk finance for new sectors was identified as a persistent concern). In addition, the EU Marine Strategy Framework Directive (MSFD) was enacted to safeguard marine ecology and biodiversity. The European Commission also funded expert research on sustainable Blue Economy in 2018, which proposed routes for Blue Economy development in Europe while preserving the marine and coastal ecosystem. In 2017, the EU produced a new report to highlight the results of its research and innovation in the Blue Economy. The report showed how EU-funded research and innovation projects were assisting in addressing the major issues in the establishment of a sustainable Blue Economy. Furthermore, the EU has placed a strong emphasis on sustainable maritime energy and blue biotechnology, both of which necessitate a high degree of scientific innovation. In a nutshell, the EU's attempts to grow the Blue Economy have centered on creating more jobs through innovation while not endangering the ocean's health.

The International Council for the Exploration of the Sea (ICES) is the oldest intergovernmental organization in the world concerned with marine and fisheries science. The council was first established in Copenhagen in 1902 but now operates under the terms of the 1964 Convention for the International Council for the Exploration of the Sea. Since its establishment in 1902, ICES has been a leading scientific forum for the exchange of information and ideas on the sea and its living resources, and for the promotion and coordination of marine research by scientists within its member countries.

Current ICES priorities include the expansion of scientific activity into the Arctic, Integrated Ecosystem Assessments, aquaculture, and continued work towards the environmental pillar of the European Union's integrated maritime policy, the Marine Strategy Framework Directive (MSFD).

The concept of the Blue Economy is at the forefront of SIDS development. Many SIDS have already developed national policies on the blue economy and established special government institutions to deal with the issue. Grenada's government, for example, has created a Coastal Blue Growth Master Plan and established a Blue Innovation Institute. Furthermore, it has formed a blue growth partnership called "the Blue Network" with the Netherlands' government. Cape Verde, on the other hand, has developed a government-wide strategy known as the "Blue Growth Charter," which focuses on governance, innovation, and the long-term utilization of the country's maritime resources. It also maintains a "Blue Growth Intelligence Unit" that supports the Charter and offers policy recommendations.

7.4 Present structure of blue economy-related organizations in Bangladesh

During the primary period 3/5 years scheme for the Blue Economy program, was completed by the Ministry of ICT for technological support, the Ministry of Fisheries and Livestock, the Ministry of Water Resources, the Ministry of Shipping, the Ministry of Planning, and the Ministry of Finance. Some organizations also operate blue economic activities. Such as:

- Maritime Affairs Unit from MoFA
- Bangladesh Oceanographic Research Institute (BORI) from MoST

- Department of Marine Fisheries from MoFL
- Coastal Geology Department of GSB, MoEMR
- Blue Economy Cell from MoEMR
- SPARRSO from MoD
- Marine wing from BIWTA
- MoWR Separate Marine Weather & Env. Forecasting from BMD
- Delta Plan

7.5 Institutional Arrangement for Implementation of Ocean Policy in Bangladesh

Bangladesh is a biologically diverse nation and her maritime environment is home to spectacular arrays of species, some of which are unique. Her marine area is dynamic and experiences continuous variability of physical, chemical, and biological properties ranging from days to decades. But her ocean systems are under increasing pressure from many uses such as fisheries, shipping, petroleum activities, and tourism. Action now is required to put in place a comprehensive system for integrated ocean planning and management which will reduce the risk of a progressive decline and irreversible damage to her marine systems.

Certainly, it may be necessary to provide positive direction to how Bangladesh views the use of the oceans and to the way she regulates those uses both within Bangladesh and perhaps more importantly, in the international milieu. As a nation, Bangladesh must increasingly confront issues requiring the setting of priorities among competing uses and balancing the distribution of ocean benefits between current and future generations. In the maritime sector, certain individual industries, agencies or maritime infrastructure carry out their responsibilities quite well, but there is hardly any coordination among them or with the government.

A need, therefore, exists for policies that are based on equity and stewardship of the public trust; policies that take into account the functioning of the ocean and its various subsystems; and policies that achieve balance and set priorities that ultimately will determine the success or failure of any ocean management programs. National policy formulation and decision-making in ocean development and management raise complex issues, cover a variety of rights and concomitant duties, span a range of governmental and international activities, and encompass many diverse disciplines. The approach to maritime issues and the development of a maritime culture has to be interdisciplinary with historians, lawyers, economists, and political scientists working with engineers, biologists, chemists, and physicists on common ocean interests. Above all, an Ocean Policy should outline a broad range of commitments that will translate the policy into a program of activities to help us to achieve blue economy objectives. Building on existing effective sectoral and jurisdictional mechanisms, such coordinated policy should promote ecologically sustainable development of resources, and encouragement of internationally competitive marine industries, while protecting marine biological diversity.

Ocean Policy Issues and Challenges the use of ocean resources is expected to grow. A primary goal of this policy is, therefore, to ensure that Bangladesh has the management tools in place to avoid potential conflict between ocean users. Ocean Policy would neither be solely an environment protection policy nor solely an economic development policy. It would be a policy for the ecologically

sustainable development of the oceanic economy. The policy should establish the broad principles and management approaches necessary to achieve the goal.

Since Bangladesh continues to use the 1982 UNCLOS-III as the foundation for her Ocean Policy, the Convention will serve as a prism that will dispense Ocean Policy into various levels of action and various functional and zonal issue areas. Major Ocean Policy issues that must be coordinated include navigation and overflight, protection and preservation of the marine environment, ocean resources acquisition and conservation, marine scientific research, prevention of piracy, immigration monitoring, and control, naval arms control, etc.

All the aforesaid ocean issues have been powerful constituencies at the international, national, and local levels, making the crafting of a balanced and effective Ocean Policy a special challenge.

Vision and Goals of Ocean Policy

Fundamentally, a National Ocean Policy must be a statement of a national vision, a series of goals, principles, strategies, and policy guidance. Hence, the Ocean Policy should provide a framework that would outline a broad range of commitments that will translate the policy into a program of positive actions. The policy should be targeted to give the following early tangible results:

a. The maritime jurisdictions of Bangladesh should be regionalized, based on the large marine ecosystem for integrated ocean planning and management.

b. Bangladesh should promote and facilitate the development of marine industries as core components of its economy and drivers of employment growth.

c. Bangladesh should develop a Marine Science and Technology plan, which will improve monitoring and understanding of the global ocean process that influences its marine and territorial environment.

The Vision of Ocean Policy: The vision for the Ocean Policy of Bangladesh should be to ensure a healthy sustainable ocean; nurtured, understood, and harnessed wisely for the benefit of present and future generations.

The Goal for Ocean Policy: The Ocean Policy should have the following broad goals:

a. To exercise and protect the rights and jurisdiction of Bangladesh over offshore areas and resources.

b. To understand and protect marine biological diversity, the ocean environment, and its resources and ensure that ocean uses are ecologically sustainable.

c. To establish integrated ocean planning and management arrangements.

d. To accommodate community needs and aspirations.

e. To promote public awareness and understanding so that people become ocean-minded instead of ocean-blind.

Key Initial Actions

Integrated Ocean Planning

Bangladesh's ocean ecosystem and marine biological diversity are core national assets. If their use of them is well managed, they can meet a broad range of economic, social, and cultural aspirations. The collapse of several major ecosystems and fisheries resources in other regions like Southern Bluefin Tuna, Southern Sharks, etc. with the associated economic damage and social dislocation, is a stark warning of the vulnerability of marine systems.

Conservation of Marine Biological Diversity: The main objective of the Ocean Policy should be to ensure continuing marine ecosystem health and conservation of marine biological diversity, which refers to the variety of living organisms in the estuaries and ocean, their genes, and the ecosystem of which they form a part. The tropical hot-humid climate with mild winter, an abundance of monsoon rains, surface water, and alluvial-rich soils make Bangladesh an ideal place for a high degree of biodiversity. It is said that one square kilometer of the mangrove forests in Bangladesh contains greater biodiversity than that of many countries taken together.

Regional Marine Planning: Integrated and ecosystem-based planning and management should be implemented through the introduction of a major regional marine planning process. For each marine region the plan will broadly identify:

a. Ocean resources, economic and other opportunities.

b. Current and emerging threats to ecosystem health.

c. The community and sectoral interests.

d. Priorities for the industry and economic development of the region.

Maintenance of Ecosystem Integrity: The vision and goals for Bangladesh Ocean Policy should be developed around a national strategy for ecologically sustainable development and multiple ocean uses. The ecological links between the land and ocean, as well as within and between ocean ecosystems, must be taken into account in ocean planning and management.

All human uses of the ocean result in a change in ocean ecosystems and there are direct and indirect impacts from a range of land-based activities. Hence, the main element in the decision about the maintenance of ecosystem integrity is establishing what the ecosystem characteristics are and understanding the scale and levels of natural variability. The main ecosystem at risk includes mangrove swamps, coral reefs, turtle nurseries, prawn fishing areas, and areas used in the production of algae.

Multiple Ocean Use: The priority aim of ocean use management includes the reconciliation of conflicting uses. Manning and management for multiple oceans uses involve the integrated allocation of resource access and should also ensure that such decisions are equitable,

Objective and transparent

Marine Protected Areas: A Marine protected area is an area at sea especially dedicated to the protection and maintenance of biological diversity, and natural and associated cultural resources managed through legal or other effective means. On coasts and estuaries, there is severe competition between human activities and the intricate web of marine life. The delicate mangrove swamps in the Sundarbans are part of a web of marine life. While the coral reefs of St Martin's Island are even more fragile having rich habitats for myriad life forms.

This system also provides for the recreational, aesthetic, cultural, and economic needs of the people. Bangladesh is a party to the Convention of the world cultural and natural heritage.

The Great Barrier Reef of Australia has been referred to as the largest living feature on Earth and was visible from the Moon. It consists of 2500 individual reefs and includes some 400 species of coral, and 1500 species of fish, making it the world's largest coral reef. Before conservation measures were taken, the Reefs were threatened by recreation, localized populations, and other dangers. The Barrier Reef Marine Park is being developed in sections to control the impact of human and recreational activities. There are preservation zones designed to conserve the ecosystem and protect turtle and bird nesting sites.

In scientific research zones, recreation is forbidden. Bangladesh may take the conservation measures of the Great Barrier Reef as a guideline for its marine protected areas.

Conservation of Marine Species and Habitats: Conserving the biological structure of the oceans has become one of the leading issues in ocean use management. The numerous endangered species must be encompassed within management schemes if they are to survive.

Many species have reached critical levels due to over-exploitation, damage to or pollution of habitats, competition from other species, and the introduction of alien species. The preliminary survey carried out in 1996-97 found abundant coral resources presence of economically important macro-invertebrates (e.g. sponges, gastropods, sea urchins, sea cucumbers) and other rare endangered species. The survey indicated eight species of Tuna and Skipjack and several potential species of Mackerels, Shark, Ray, Sardines, Anchovies, Shad, etc. in Bangladesh water. There is a need, therefore, to recognize in legislation "conservation dependent" species and vulnerable ecological communities.

Bangladesh Government may set up a separate Ministry. Ministry of Ocean Affairs or Ministry of Ocean Resources taking Maritime Affairs Unit from MoFA, Bangladesh Oceanographic Research Institute (BORI) from MoST, Department of Marine Fisheries from MoFL, Coastal Geology Department of GSB, MoEMR, Blue Economy Cell from MoEMR, SPARRSO from MoD, Marine wing from BIWTA, MoWR, Separate Marine Weather & Env. Forecasting from BMD and Delta Plan.

All the Maritime infrastructures, agencies and stakeholders are directly or indirectly supporting our maritime economy, in turn, the national economy. The maritime infrastructure consists of regulatory bodies, private /public sector commercial operators, repair facilities, education, training, and research institutes.

Regulatory Bodies

Several Ministries are concerned with various maritime affairs. They are -

- Ministry of Ports, Shipping & IWT;
- Ministry of Fisheries & Livestock;
- Ministry of Energy, Petroleum & Mineral Resources;
- Ministry of Forest and Environment;
- Ministry of Defence;
- Ministry of Home Affairs;

- Ministry of Industries;
- Ministry of Foreign Affairs (Maritime Affairs Unit) and
- Ministry of Finance.

Recently the government has established the Blue Economy Cell to coordinate the blue economic activities of different ministries.

Shipping Regulatory Organs: The regulatory organs under the Ministry of Shipping are, the Directorate General of Shipping, Mercantile Marine Department, and Bangladesh Inland Water Transport Authority.

Commercial Operators: The government-owned public sector commercial operators are Bangladesh Shipping Corporation (BSC), Chattogram, Mongla, and Payra Port Authority, Bangladesh Inland Water Transport Corporation (BIWTC), and Bangladesh Fisheries. Development Corporation (BFDC). Notable private commercial operators are private shipping and fishing companies, international gas exploration companies, and a limited number of tourism and aquaculture companies. Shipbuilding and Repair Facilities: The major shipbuilding and repair facilities are Chattogram Dry Dock Limited (CDDL), Khulna Shipyard Limited (KSY), Dockyard and Engineering Works Narayanganj, BN Dockyard, and other BIWTC dockyards. In the private sector number of shipyards are contributing significantly to shipbuilding.

Maritime Education and Training: Following universities, institutes and academies impart training and carry out research in maritime fields:

a. Bangabandhu Sheikh Mujibur Rahman Maritime University, Bangladesh.

b. Bangladesh Marine Academy.

c. Bangladesh Naval Academy.

d. Marine Fisheries Academy

e. National Maritime Institute (NMI).

f. Deck Personnel Training Centre (DPTC)

g. Bangladesh Institute of Marine Technology (BIMT).

h. Some Private Marine Academies/Institutes.

i. Bangladesh Oceanographic Research Institute (BORI)

In addition, some public and private universities conduct some related programs. Other Ancillary Organisation: Other ancillary organizations in support of maritime activities are Space Research and Remote sensing Organisation (SPARRSO), Bangladesh. Meteorological Department, Department of Hydrography and Survey of Bangladesh.

Enforcing Agencies: The relevant agencies responsible for the enforcement of various maritime regulations, monitoring and surveillance are Bangladesh Navy, Bangladesh Air Force, Bangladesh Coastguard Force, and Sea Customs.

Institutional Elements for Formulation and Implementation of Ocean Policy

While the government should take the lead in developing Ocean Policy, an effective policy must be shaped by the nation as a whole. The policy should be developed with considerable consultation sharing ideas with the government, the wider community, conservation groups industry, and other resource users.

There is no easy, obvious, or consensus solution to achieving a coherent and coordinated Ocean Policy. Moreover, the approach may vary from country to country. For example, France is one of the very few countries that has completely reorganized its maritime administration to form a Ministry of the Sea. However, to coordinate all the maritime activities and implementation of the Ocean Policy, possible institutional arrangements may be as follows:

a. Department of Ocean Development: In line with our neighboring country India**, the** Department of Ocean Development (DOD**)** may be created under the direct control of the Prime Minister's office, providing it considerable importance and prestige. Their activities could mainly involve marine research and development agenda and act as a watchdog for the government's implementation arrangements.

b. National Ocean Ministerial Board: This board could include various key ministries concerned with ocean affairs and oversee the implementation, prioritization, budgetary allocation, regional cooperation, and further development of Ocean Policy.

c. National Ocean Advisory Committee: The National Ocean Advisory Committee may be comprised of members with non-government interests, such as industry, science, and conservation, selected for expertise in ocean issues. Their main function could be to advise the Ministerial board on cross-sectoral and cross-jurisdictional ocean issues and be a forum for exchanging views between ocean sectors.

d. National Ocean Office: A National Ocean Office may be established to provide secretarial technical support and assist the board in the implementation and further development of Ocean Policy. The office could be constituted of government officers from various ocean-related agencies and act as the main administrative coordination point between government organizations and other commercial operators.

e. Regional Marine Plan Steering Committees: Regional Marine Plan Steering Committees, including key non-government and government stakeholders, may be established who will oversee the development of regional marine plans, working closely with the National Oceans Office.

Specific Sectoral Measures

Putting Bangladesh's Ocean Policy into action requires a partnership between all spheres of government, private sectors, scientific and wider communities. The policy itself should be owned by all citizens. The Ocean Policy should also provide guidelines for specific sectoral measures as follows:

a. Fisheries

b. Aquaculture and sea farming

c. Offshore hydrocarbon and minerals

d. Marine environment and pollution

e. Shipping and trade

f. Marine engineering and shipbuilding

g. Port Development

h. Alternative energy source

i. Marine and ecotourism

j. National heritage and marine parks

k. Marine spatial planning

7.6 How can Blue Economy be supervised in Bangladesh

7.6.1 As a separate Ministry

Ministry of Blue Economy Affairs/Ministry of Ocean Affairs/ Ministry of Maritime Affairs Bangladesh (whatever the name may be) should be established to lead and oversee coordinated efforts in unlocking the full potential of the blue economy ranging from the sustainable development of marine resources

Advantages:

1. Independent decision-making capacity. Headed by Minister.
2. A separate ministry can easily collaborate with the different educational institutes which can provide and support blue economy experts and technology.
3. More resilience than any division or any other organization.
4. Ensure the optimum exploration of the Blue Economy.
5. Easily make the proper decision. Fifteen to Sixteen ministries are working on the blue economic related activities separately. That is why the work is not being coordinated.
6. Easily conduct adequate allocation for research, develop the value chain and market, and take to a properly visible initiative to access the stocks of non-living marine resources including mineral resources.
7. Properly coordinated initiatives couldn't be taken to tap the full potential of the Blue Economy.
8. A separate ministry can easily work for proper implementation of the works more efficiently from top to bottom (Minister, State Minister, Deputy Minister, Secretary, Additional Secretary, Joint Secretary, Deputy Secretary, Assistant Secretary, Consultant, Specialist, and Researcher, etc.).

Disadvantages:

1. Very difficult to coordinate with other ministries as they are the main barriers.
2. There are lots of multi-disciplinary people working here for this reason it is challenging to make sure of good governance.
3. Ministry is very much process-oriented and sometimes it takes more time to get any approval.
4. It will take a long time to decide on a ministry.
5. Lack of adequate policies and proper planning.
6. Lack of accurate information about the amount and value of assets.
7. Lack of adequate research-based marine resources.
8. Lack of international and regional communication related to the blue economy.

7.6.2 As a Separate Division/Department under the ministry

Name of the Division/Department: Ocean Affairs Division/ Blue economy Division or Department of Ocean Affairs / Department of Blue Economy under the Ministry of Energy & Mineral Resources

Advantages:

1. Headed by Senior Secretary or Secretary.
2. The division is more functional and builds its capacity according to their requirement.
3. In some cases, Operational capacity is higher than Ministry.
4. Easy to form and manage.
5. Easier to operate than a ministry.
6. In some cases take decisions independently.

Disadvantages:

1. Depend on the ministry.
2. Coordination will be difficult.
3. Process-oriented and sometimes it takes more time to get any approval.
4. Could not take a decision and work Independently.
5. Always follow the line of the Ministry's instructions.
6. Decision-making capacity is limited.
7. It is more challenging to ensure Good Governance during operational work.
8. Decision-making capacity could be limited.

7.6.3 As a Separate Commission

Name of the Commission: Blue Economy Commission

Advantages:

1. Easy to form and operate.
2. In some cases, Operational capacity is higher than a department.
3. Comparatively, operational cost is less than any Department.

Disadvantages:

1. Decision-making capacity could be limited.
2. Depend on the ministry.
3. Coordination will be difficult.
4. Process-oriented and sometimes it takes more time to get any approval.

7.6.4 As a Separate Council

Name of the Council: Blue Economy Council

Advantages:

1. Easy to form and manage.
2. Operational cost is less than any Division or commission.
3. In some cases, operational capacity is higher than Ministry.

Disadvantages:

1. To take any decision all the time depend on the ministry.
2. Very slow to take action.
3. Process-oriented and takes more time to get approval.

7.6.5 As a separate wing of the ministry

Name of the Ministry: Planning Commission, Ministry of Planning

Name of the Wing: Blue Economy Wing

Advantages:

1. Blue economy-related strategies, policies, plans, action plans can be managed as overarching organisationall types of projects can easily successfully pass.
2. Easy to manage and coordinate.
3. Jointly collaborate with line/implementing ministry.

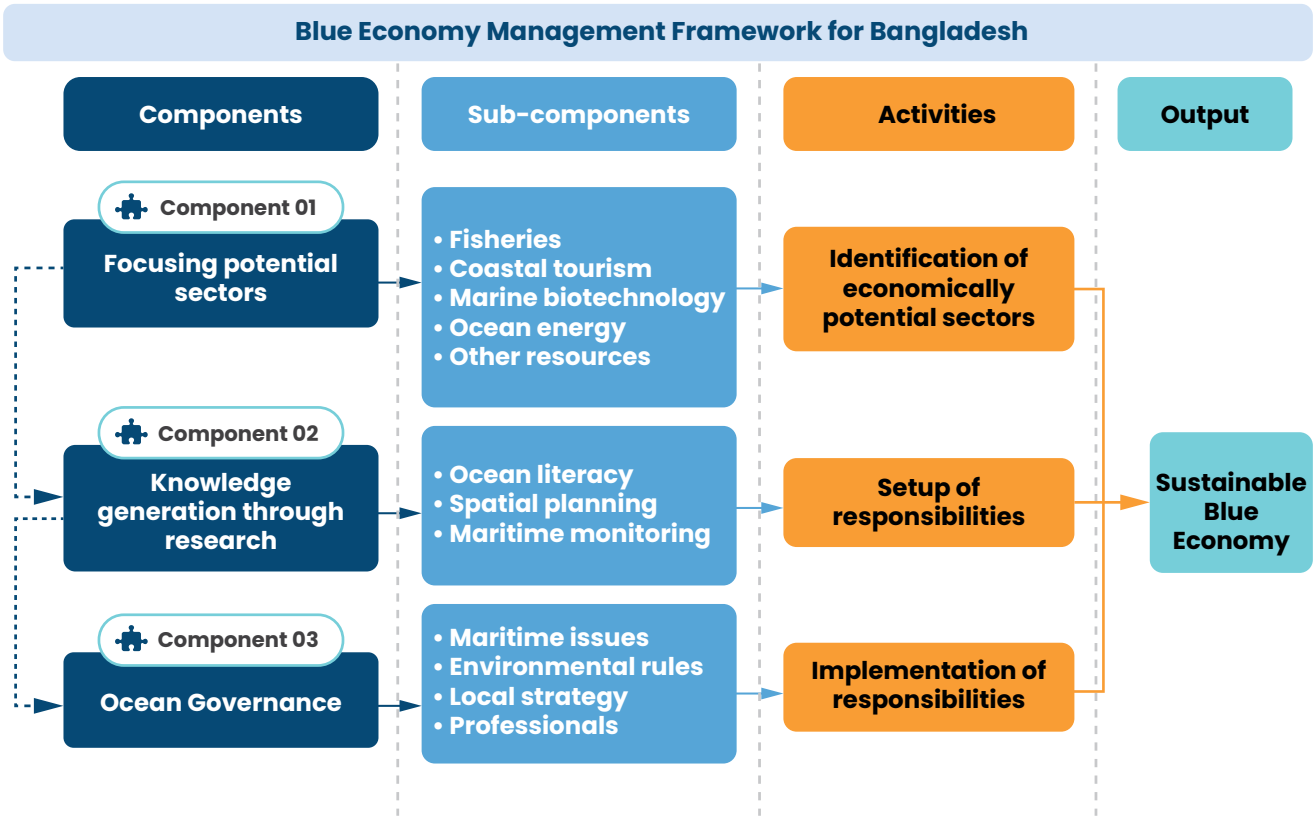


Figure 86 : Blue Economy Management Framework for Bangladesh

CHAPTER 8

PROPOSED POLICY FRAMEWORK

Proposed Policy Framework

Bangladesh's government adopted some legislation and regulatory framework for maritime and ocean governance (Table 4). These are the Territorial Water and Maritime Zones Act, Coastal Zone Policy-2005, Coastal Development Strategy-2006, Port Act 2006, Arbitration Act 2016, Merchant Ship Ordinance of 1983, Flag Ordinance Convention 1982, Inland Shipping Ordinance 1976, Protection and Conservation of Fish Act of 1950, Marine Fisheries Ordinance and Rules 1983, Wild Conservation Act-2002, Forest Act-1927, Provision of Ecologically Critical Area (ECA) Regulation 1995, the Bangladesh Petroleum Act-1974, National Energy Policy-2004, Bangladesh Water Policy-1999, Bangladesh Water Act-2013. Most of the legislation and regulations were enacted a long time ago. Some of them are updated from time to time based on the changing social, economic, cultural, and environmental circumstances, but most of the time the legal framework failed to tackle new challenges. Updating these outdated and inactive legislations is required. Department of Shipping (DOS) and Fisheries (DOF) are trying to make new shipping and fisheries act.

Table 4. Reviewed or developed policies related to the Blue Economy in Bangladesh (Source: Patil et al. 2018)

Sector	Policies	Laws and acts	Responsible institutions
Coastal Protection Climate change resilience and adaptation (including coastal protection)	Bangladesh Climate Change Strategy and Action Plan (BCCSAP) is to be completed by 2020. National Action Plan for Adaptation (NAPA) is to be completed by 2020.	The 2010 Climate Change Trust Act established the Bangladesh CC Trust, the Bangladesh CC Trust Fund, and the Bangladesh Climate Change Resilience Fund.	Ministry of Environment and Forests; Disaster Management Information Centre of Ministry of Food and Disaster Management
Existence of Biodiversity, including mangrove ecosystems ("blue forests")	Coastal and Wetland Biodiversity Management The plan is under review.	Wetland Conservation Act; Environment Conservation Act, 1995, 2000, and 2002; Environment Conservation Rules, 1997, 2000, 2001; National Conservation Strategy, 2005; National River Protection Commission Act, 2013; Forest Act, 1927; Wildlife Protection and Security Act, 2012	The Ministry of Environment and Forests; The Bangladesh National Herbarium

Sector	Policies	Laws and acts	Responsible institutions
Waste Disposal, including addressing externalities from industrial and agricultural pollution creating marine dead zones	Renewable Energy Policy, 2008 and National Energy Policy, 2004 is under review	The Bangladesh Petroleum Act of 1974 supports the planning, organizing, and implementation of exploration, exploitation, development, and production of petroleum wealth from the sea (including all territorial waters, continental shelf, and EEZ).	Ministry of Power, Energy, and Mineral Resources Sustainable and Renewable Energy Development Authority (SREDA) Bangladesh Power Development Board (BPDB) Local Government Engineering Directorate (LGED) Blue Economy Cell
Living Resources: Capture Fisheries, supporting sustainability	National Marine Fisheries Policy, undergoing consultations and review	The proposed National Marine Fisheries Policy includes provisions for the development of new laws in support of sustainable capture fisheries.	Ministry of Fisheries and Livestock, Dept. of Fisheries Bangladesh Fisheries Development Corp.; Bangladesh Coast Guard; Bangladesh Navy
Living Resources: Aquaculture, including mariculture	National Aquaculture Development Strategy and Action Plan (2013-2020) is reviewed annually. 2014 National Shrimp Policy is under review	Fish Hatchery Act 2010; Fish Hatchery Rules 2011; Fish Feed and Animal Feed Act 2010; Fish Feed Rules 2011; Fisheries Research Institute Ordinance, 1984	Ministry of Fisheries and Livestock
Tourism, including marine tourism	National Tourism Policy, 2009 is under review	Tourism Board Act, 2010 Bangladesh Tourism Protected Areas and Special Tourism Zone Act, 2010; Bangladesh Tourism Protected Areas and Special Tourism Zone Rules, 2011	Ministry of Civil Aviation and Tourism Chambers of Commerce Bangladesh Parjatan Corp. Ministry of Shipping
Shipping and Transport including measures to address marine pollution	Maritime and Shipping Strategy of Bangladesh	Clean Air Act; Import Policy Orders; 2012-2015; Payra Port Authority Act, 2013; Chattogram Port Authority (Amendment) Act, 1995; Mongla Port Authority (Amendment) Act, 1995; Navy Ordinance, 1961; Coast Guard Act, 1994	Ministry of Power, Energy and Mineral Resources Infrastructure Financing Facility Inland Water Transport Authority

Sector	Policies	Laws and acts	Responsible institutions
Ocean-based industry development and growth via access to finance	Comprehensive Credit Policy for SMEs, including encouraging investment in ocean industries	Inclusive Digital Financial Systems, 2015	Ministry of Industries Bangladesh Standards and Testing Institution Bangladesh Small and Cottage Industries Corporation Bangladesh Chemical Industries Corporation Bangladesh Bank

8.1 Organogram of Blue Economy Wing under General Economics Division

Blue Economy Cell (BEC), is the solely authorized cell to formulate ocean policy. It was formed in January 2017 as part of the Ministry of Power, Energy, and Mineral Resources' Energy and Mineral Resources Division. But the activities of the BEC are confined to holding occasional meetings since the administrative body is equipped with inadequately few officials temporarily. Though the Parliamentary Standing Committee on Power, Energy, and Mineral Resources Ministry recommended upgrading the BEC as an authority with a permanent setup, the recommendation has been ignored. Cooperation between ministries at the regional level is very important for successful blue economic development. The Blue Economy wing at GED may carry out the overarching role in developing strategies, plans and policies related to blue economy.

CHAPTER 9

BLUE ECONOMY: PROSPECT OF INSTITUTIONALIZATION THE NATIONAL PROGRESS, A CONSULTATIVE POLICY DIALOGUE

9.1 Summary

In the consultative policy dialogue, various activities related to the Blue Economy were covered in 8 major thematic areas (Marine Fisheries and Aquaculture, Marine Energy, Marine Biotechnology and Therapeutics, Marine Tourism, Ship and Port Management, Ocean Governance and Management, Marine Finance and Satellite Oceanography and ICT) which are divided into 20 research sectors such as Marine Fisheries, Tuna Fisheries, Mariculture, Seaweed Cultivation, Pearl Cultivation, Renewable Energy, Non-Renewable Energy, Energy Mix, Ship Trans Shipbuilding, Ship Recycling, Deep Sea Port and Marine Special Planning, etc. Stakeholders participating in the dialogue addressed the present role and prospects of these sectors in the overall economy of Bangladesh in detail. A long discussion was held on the obstacles to sustainable growth and development of the Blue Economy and the ways to overcome them. Through these discussions, 20 research topics were identified which would be conducted under the supervision of the Planning Commission of Bangladesh. So far, various works on the Blue Economy have been conducted fragmentally under different ministries of the Government of Bangladesh. In the dialogue, in-depth explanations and analyses were given on how the potential of the Blue Economy in Bangladesh could be institutionalized for national progress. Most of the participants agreed that the Blue Economy would need to be institutionalized very soon to extract the potential of the huge maritime areas of Bangladesh.

9.2 Programme Arrangements

A programme on "**Institutionalization of Blue Economy Bangladesh**" was taken place at Bangabandhu International Conference Center (BICC) on the 14th of May, 2022. The programme was jointly organized by SSPS, UNDP, and SIBDP 2100.

To harness the full potential of the blue economy to achieve the SDGs, the Government of Bangladesh would need policy support and policy development ideas and suggestions from the relevant stakeholders of the country. In this context, the Planning Commission, Ministry of Planning, Government of the People's Republic of Bangladesh, announced this programme.

The main purpose of arranging this programme was to gather opinions on the future institutional arrangement of the Blue Economy in Bangladesh. The programme was well-planned and perfectly organized.

Figure 87: A programme on "Institutionalization of the Blue Economy, Bangladesh

The objective of this programme was to supervise the blue economy under an institute to strengthen the blue economic growth and development of Bangladesh, where around twenty (20) individual research projects related to the blue economy would be conducted. In this programme, policy dialogues, policy briefs, and policy support-related discussions were taken place to get a pragmatic finding at the national level.

At the very beginning of the policy dialogue, Khan Md. Nurul Amin, ndc, Chief, General Economics Division, Bangladesh Planning Commission delivered the welcome speech.

9.3 Keynote Papers were presented by Dr. Md Kawser Ahmed, Member (Secretary), General Economics Division (GED), Planning Commission

Keynote Presentation on "**Institutionalization of the Blue Economy in Bangladesh: Problems, Prospects, and Actions**"

Dr. Ahmed presented his approach why institutionalization of the Blue Economy in Bangladesh was needed. He recalled the history of the Father of the Nation, Bangabandhu Sheikh Mujibur Rahman, the great architect of Bangladesh's independence and the best Bengali of the millennium who had formulated 'The Territorial Waters & Maritime Zones Act' in 1974 with his extreme foresight. He remembered that he had taken the challenge to enforce the law eight years before the declaration of the 'United Nations Convention on the Law of the Sea (UNCLOS), in 1982'. Afterward, under the visionary leadership of Hon'ble Prime Minister Sheikh Hasina, Bangladesh had been able to establish absolute and sovereign rights over the 1,18,813 km^2 area of the Bay of Bengal after the reconciliation of maritime boundaries with Myanmar and India through the verdict of the International Tribunal for the Law of the Sea (ITLOS) on 8 July 2012 and Permanent Court of Arbitration (PCA) on 14 March 2014, respectively.

Figure 88 : Dr. Kawser Ahmed is seen delivering his speech

Dr. Ahmed said, "Nearly ten years have passed since we won the huge maritime water areas and we hear the buzzword of the Blue Economy which is the blue revolution." He added that the Belgian economist, Professor Gunter Pauli had coined the phrase "Blue Economy" in 1994 to describe his business model for transforming society from one of scarcity to one of abundance with what was locally available, but it had since gained widespread acceptance as a goal of investment and policy-making. According to Dr. Pauli, in 10 years, 100 innovations would be developed which would create 100 million jobs. Dr. Ahmed mentioned that there had been no direct link between the blue economy and Dr. Pauli's concept.

Dr. Ahmed also pointed out the marine ecosystem services – ecological and economic services. He said that ecological services couldn't be measured by money only and in the two ecosystem services, one did have market value but the other didn't. He then pointed out three pillars i.e. blue economic sustainability, environmental sustainability, and social sustainability.

Dr. Ahmed mentioned that the Delta Plan 2100 and Perspective plan 2041 of the Bangladesh government aimed to regain the GDP loss due to climatic impacts and other consequences and the government had taken several 5 year-plans which were the basis of Perspective plan 2041. He reiterated that in Delta plan 2100, the government tried to decuple impacts and resources where four important factors such as economy, society, governance, and science and technology were related.

Dr. Ahmed then showed the linkage between the blue economy and SDG and mentioned that 15 or 16 goals of SDGs were directly correlated with the blue economy. He raised the question of whether Bangladesh was only working on the blue economy around the world. He noted that several countries were working on a blue economy such as a) South Africa had completed the formulation and planning of the blue economy b) India had developed their blue economy framework and created a blue economy council, c) Malaysia and Thailand were working on blue economy development and d) Trans-Atlantic countries (including all countries that fall in the Atlantic region) were working on BE together. He went on to say that in the USA, they could see one of 6 jobs was marine-related and more than 50% of the US population was residing within the 50-mile area of the coastal zone and

nearly 30 trillion US$ was coming from the blue economy. He further added that in the US GDP, the blue economy contributed USD 400 billion, and Australia, Canada, France, Japan, and Vietnam were working on the blue economy. In Vietnam, around 21% or 22% of the GDP was coming from the blue economy. For Indonesia and China, the blue economy accounted for 20% and 10% of GDP, respectively. He then pointed out that 10% of the GDP of China was coming from the blue economy which was huge. He said, "The blue economy contributes in many ways. Even a small country Ireland, planned 6 billion US$ for a blue economy 6 years ago and already completed the project. Even Australia planned in 2015 to earn 100 million US$ from the blue economy within 2025 (in 10 years) and they have already achieved it through blue economy-related activities and strategies".

Dr. Ahmed asked the audience what would happen in the ocean economy in 2030 or the next. He then narrated that blue economy-related industries or services would be expanded/increased in near future and by 2030, the blue economy-related all sectors' activities would be increased by around 40-50%, and as a result profit from the blue economy would be accelerated.

Dr. Ahmed mentioned that they had a perspective plan for 2021-2041 and a 100 years delta plan and all of them included blue economy-related themes. He added that within 2041, Bangladesh would become one of the developed countries and quoted that since 2013, Bangladesh's GDP growth was 6% to 7.2%/7.25% or more except for the period of the covid-19 pandemic. He then said that the country's Delta Plan was strongly correlated with GDP. He reiterated that if the government did not invest to cope with climate change soon, the country would have lost around 2% of its GDP and so the Government of Bangladesh had taken the Delta Plan to achieve that 2% GDP. Dr. Ahmed reported that the National Adaptation plan would be passed very soon and after then, no GDP would be lost. If this additional GDP can be added to the country's existing 7.25% GDP, the total GDP growth would be two digits i.e. more than 10%.

It's worth mentioning here that Bangladesh has won huge maritime waters after reconciling maritime disputes with Myanmar and India. However, most of these waters are untapped. Mauritius and Seychelles had several times more water areas than their land areas. Our neighboring country Sri Lanka also has more water area than land.

In Bangladesh, traditional boats (fishing boats) usually travel within a 40 m depth zone in the Bay of Bengal. They are mostly artisanal fishers or small-scale fishers. The government has produced a map using GIS that indicated areas where particular fish species abundance was higher or usually reside in those areas. From that map, it was observed that below the 50 m depth zone, there had been no significant initiatives taken to catch fish from the Bay of Bengal.

Dr. Ahmed showed a report from the Bangladesh Government (based on R. V. Anushandhani), where most of the fish were fully fished, over-fished, or moderately fished except squid and cuttlefish. He mentioned, "We almost harvest all fish resources within our 50 m depth zone areas in the Bay of Bengal from the shoreline. We know, each space has a particular carrying capacity which indicates that we have almost fished most fish from our 50 m depth zone and now the time has arrived to go beyond the 50 m depth zone to harvest fish."

He asked, "What can we do in our maritime waters except for these traditional fish catches?" He then mentioned that there were many potentials to carry on like seaweed culture, Mari culture, etc, and added that Bangladesh Oceanographic Research Institute (BORI) worked on seaweed culture for a

long time and Maritime culture would be developed in the next 5-7 years. He then said that though those activities could be done in a 50 m depth zone, they had no potential for sea ranching in our maritime areas.

As we know, beyond a 50 m depth zone/offshore waters, we can catch Tuna. The government has taken many initiatives to incept tuna fishing activities. For example, the government has brought a 28 m long ship dedicated to tuna fishing which will work on the prospect and potential of tuna fisheries in the Bay of Bengal. After then, the government will analyze the cost-benefits to decide what actions can be taken to catch tuna and tuna-like pelagic species offshore of the Bay of Bengal. To catch tuna and tuna-like pelagic species, we have pelagic and demersal long lines which are 100-150 km long. The lines have a problem as they can catch sharks also which are mostly discarded or thrown back into the sea. If we can use big vessels then we can catch a great number of Tuna.

Marine and coastal tourism is a very potential sector in Bangladesh. At present we do not have big cruise ships. We have some small cruise ships for local tours mostly in St. Martin's Island and Chattogram. Bangladesh has many small islands but doesn't have shipping facilities to travel to those islands. We need to develop tourist facilities on those islands. If we can open a maritime cruise from St. Martin's island to Kuakata or Sundarbans or vice-versa, then it might help to earn huge revenue. Recently, the government has taken action to open cruise ships from Bangladesh to Sri Lanka to Bangladesh.

Renewable energy in Bangladesh is not very well. We get a very insignificant amount of wind energy in our country as it is not strong enough on our land or sea all year round. When the active period starts in the sea, then 6/7 days long, there is a strong wind that can produce wind energy. During the inactive period, there is no strong wind.

Gas hydrate has been found in the maritime waters of the Bay of Bengal, and some parts of West Bengal, Orissa, and Andhra Pradesh. There is the potential for a huge amount of gas hydrate in the Bay of Bengal. It is reported that 900 Trillion Cubic Feet (tcf) of gas hydrates are found in the vicinity of the Mahananda basin and Andaman Nicobar Island where 300 tcf is recovered. In contrast, around 300 tcf of gas hydrate can be found in the maritime waters of Bangladesh in the Bay of Bengal. Among them, there is around 100 tcf recoverable Methane hydrate which can be a geo-hazard if it is broken. It can trigger climate change if it is broken. According to Dr. Ahmed, it might not be possible to harvest gas hydrate before 2040. It might also be very critical to understand the geo-hazard of the Methane hydrate before harvesting it.

According to him, there is another potential for marine biotechnology and marine therapeutics using marine resources. Up to now, this sector is not well developed in Bangladesh. Proper actions and strategies need to be taken to develop this sector.

Moreover, the government of Bangladesh has stepped forward to develop the shipbuilding industry. A few days back, the government of Bangladesh sanctioned some money for it. Chattogram port maintains around 3.2 million cargo until 2021. The number will be increased to 1.9 million if the Bay terminal is built. Matarbari port will not be completed before 2020, which means Chattogram and Bay terminal will manage all of these cargoes. After 2041, when our Matarbari and Payra ports will be operational, we will need to think about the capacity of our ports and assess the feasibility of whether we would need to build new ports.

Yet now we could not properly explore hydrocarbon resources. We have around 10 tcf of gas. If we assume, Bangladesh uses of 1 tcf gas per year, then after 10 years, there will be no gas at all. We still do not know the exact amount of gas reserved in our maritime water areas. At the same time, the types of gas are also unknown to us. However, with the existing land base gas and coal, and imported gas, the government blends all of these to produce energy and move ahead. We have around 1050 million metric tons of coal in Joypurhat and Jamalganj. Another 5738 million metric tons of coal reserves need to be extracted soon. In 2050, most of the countries in the world will go for clean energy and restrict coal use to zero carbon emission. If we start to extract and use our coal later then it might not be possible to use our coal resources. That means our coal will remain unutilized. There is also an alarming issue that in 2055, there will not be any import or export of oil or gas. Developed countries like Russia, America, etc. will stock their oils for the next 100 years and stop exporting the same. Dr. Ahmed emphasized the issue that in 2059 there would be no oil or gas. The oil or gas trade will also be stopped. However, there will be only coal at that time or 140-200 years coal will be available. At present Bangladesh has around 7.8 billion tons of coal and 156 tcf of gas. We need to take strategic actions to use our coal and oil as developed countries will restrict coal utilization after 2050.

Coal extraction methods can be the open pit and close pit types. In the open pit method, 90% of coal can be recovered. If the government can extract 90% of coal, then we can use it for producing 15 KMW of electricity for the next 130 years. However, it is a very expensive method because in open-pit methods we need to displace a huge number of people from their birthplaces, uproot trees, dig cultivable lands, etc. the government needs to compensate the affected people for the open-pit coal extraction. In contrast, the close pit method can be used but if we use the close pit method, then only 20% of coal can be recovered that can be used for the next 32 years. Statistically, this coal amount would be nearly 1 billion tons though we have 7.8 billion metric tons.

Figure 89 : Guest in the Programme - Institutionalization of the Blue Economy in Bangladesh: Problems, Prospects, and Actions

Marine-related different sectors will open a new horizon for the unemployed people in the country. Different activities in fisheries, mariculture, marine biotechnology and therapeutics, tourism, and shipbuilding industries, will create numerous job opportunities. At the same time, all of these activities need to be carefully managed to reduce potential impacts between or among different marine-

related sub-sectors. In this case, Marine Spatial Planning (MSP), integrated coordinated planning, will be needed to identify where small-scale fishers or commercial fishers will catch fish, where mariculture cages will be kept or shipbuilding industries will be established, in which area gas exploration will be conducted or which areas need to be protected or conserved, and so on. MSP is not a segregated matter. In collaboration and coordination with different government departments, ministries, and related stakeholders, MSP will be formed. This will need to be formed very soon. For the MSP, we need to collect data and developed a strategy for it.

In his presentation, Dr. Ahmed proposed establishing a separate ministry or a separate wing for better management of BE. He showed some examples of other countries that had already formulated and institutionalized BE in their national policy.

Then the platform was open for the participants to discuss the potential of the blue economy, challenges, and institutionalization in national progress. Most of the participants enthusiastically participated in the open discussion.

9.4 Questions and Comments regarding the Keynote Presentation 1

An open discussion session was taken place after the valuable speeches given by the honorable chairperson and other guests. During that open session, stakeholders from different institutions shared their valuable opinion, thoughts, and suggestions which made the session vivid and worthwhile It was an extraordinary example of a splendid and successful event. The event ended perfectly with the cooperation of everyone. Several participants welcomed the proposal to establish a separate Institution for the Blue Economy.

Figure 90 : Questions and Comments on the Keynote Presentation

Dr. Md Monirul Islam, Professor, and Chairman, Department of Fisheries, University of Dhaka, welcomed the proposal for the institutionalization of the blue economy in Bangladesh. He said that the government still could not tap the huge potential of the Blue Economy, so it was very important for the government of Bangladesh to set up a separate ministry or department to harness the potential of the blue economy.

Dr. Tapan Dey, Deputy Conservator of Forest, Forest Department, emphasized the conservation of the resources. He proposed creating a structural body for the conservation of marine resources. He also wished to institutionalize the Blue Economy in Bangladesh.

Dr. Zakir Hossain, Additional Secretary, reported that after the maritime victory in 2017, a blue economy cell was formed under the Ministry of Energy & Mineral Resource Division. He added that the blue economy cell was supposed to work in 5 specific fields – coordinating, conducting monthly assemblies, preparing monthly progress reports, identifying short-, medium, and long-term plans, and creating a complete blue economy cell. He then mentioned that though a complete blue economy cell formulation was declared in 2017, it was not created and it was not clear how it would work. So, he emphasized institutionalizing the BE as a national mandate.

Mr. Kamrul Sheikh welcomed the proposal and proposed to create a distinct institute named 'Ocean Affairs Authority rather than a coordinated body. He raised a question to collect data for the MSP. He reported that there had no data bank where relevant data could be found for the blue economy-related research. So he requested to create a data bank and share the collected data. He proposed Bangladesh Navy (BN) could collect hydrography, seabed, depth, sound, temperature, etc. related data for the data bank or cell. He also emphasized taking the action for the MSDI.

Mr. Nazmul Ahsan, Chairman, Bangladesh Oil, Gas & Mineral Corporation (Petrobangla) reported that liquefied natural gas (LNG) was very important for the country. He emphasized conducting surveys in onshore and offshore areas. He reported that though we had 26 blocks, only work had been done in two blocks. He requested the relevant stakeholders to take the necessary quick actions to work on other blocks. He also proposed the start of the bidding round this year. He also talked about the multi-plan survey.

Dr. Badrul Islam, University of Dhaka, was very optimistic about the blue economy institutionalization in Bangladesh. He shared the story of 1974 when 6 foreign companies came to explore oil and gas in Bangladesh. He criticized that Myanmar had already discovered gas fields, whereas, Bangladesh was waiting. So he proposed to take quick action for the blue economy institutionalization.

Mr. Sayeed Mahmood Belal Haider, Director General, BORI, reported that there had been no coordination among the blue economy-related different sectors. He suggested collecting baseline data for the MSP. He also reported that there were inter-ministerial conflicts in the blue economy-related activities. Thus, he agreed to institutionalize the blue economy in Bangladesh and suggested creating a ministry of Ocean Affairs for the institutionalization of the blue economy. He also proposed to reduce carbon emissions and take action against the same.

Mr. Sayed Eshtiak, Director, Sea Resources, Rangs Group, reported that there was prolongation for any type of data dissemination. He mentioned that for governmental bureaucracy or complexity,

sometimes it would become very difficult to conduct any research. He suggested creating value-added products from tuna fishing and mentioned that that would require a lot of money. He also proposed to create products like *surimi* from Tuna. He also suggested becoming a member of the Global Seafood Alliance. Mr. Eshtiak also proposed to share the data for research purposes. He mentioned the hassles that they faced due to lack of data support, lack of logistical support, and governmental bureaucracy. He reported that the land-based economy had already been saturated and so he proposed to create a single ministry for the blue economy. He believed it would help to harness the potential of the blue economy in Bangladesh. He suggested providing job opportunities for eligible persons.

Dr. Reshad Ekram Ali, Former Director General, Geological Survey of Bangladesh, welcomed the proposal of blue economy institutionalization. He mentioned the government would need research vessels to conduct scientific studies in the Bay of Bengal. He also suggested if the government had a big research vessel (100 m), then scientists of all disciples could have worked together. He used the term 'ship blend' for the blue economy-related sectors.

Dr. Harun, University of Dhaka, proposed the name 'Ministry of Fisheries and Marine Affairs' for the blue economy institutionalization in Bangladesh.

Another participant, an enthusiastic women journalist reported conserving the coastal environment, coastal-dependent people's lives, livelihood, and social development while blue economy institutionalization. She said that institutionalization was very important but everybody should keep in mind that the people from the coastal area should not have any detrimental effect on their life journey while implementing the whole process of the Blue Economy. She also added that planning should be done in a co-interactive way.

Retired Army Officer **Captain Muktadir** suggested starting the work as early as possible. He mentioned the necessity of starting the work at the Prime Minister's Office as soon as possible.

Prof. Dr. Abdul Wahab, Team Leader/Senior Scientist, World Fish agreed with the theme but he suggested an independent ministry. He also mentioned that the name of the Ministry should be the Ministry of Fishery and Marine Affair.

Professor Dr. A Q M Mahbub, Vice-Chancellor, Bangabandhu Sheikh Mujibur Rahman Science and Technology University, Gopalganj, reported that Bangladesh has limited resources. He added that our neighboring countries like Myanmar and India had already started working in their maritime waters, so Bangladesh should hurry to explore the maritime water areas, otherwise, we would lose our valuable resources, particularly oil and gas if India or Myanmar extracted them. He also proposed to develop our manpower to explore and extract marine resources. He suggested keeping naval peace with neighboring countries. He also suggested developing geopolitics or geo-strategy.

Dr. Mahmud, Celestial Tech, requested to check the feasibility to start the blue economy-related activities under the Prime Minister Office's from July 2022 if possible.

One of the participants of the program talked about pollution such as microplastic, biological cells, blood, and stem pollution in coastal and marine waters.

Dr. Mohammad Raknuzzaman, Department of Fisheries, University of Dhaka, also welcomed the proposal of blue economy institutionalization and suggested creating manpower to extract the

potential of the blue economy. He also emphasized maritime research and education.

Dr. Yunus, Bangladesh Fisheries Research Institute, agreed with the institutionalization of the blue economy. He suggested starting the blue economy-related activities very soon. He proposed to buy a big research vessel.

Dr. Aftab Alam Khan, Professor & Head of the Department, of Oceanography and Hydrography, BSMRMU, mentioned that we had a lack of skilled manpower to harness the potential of the blue economy. He also talked about seismic data for gas exploration in the Bay of Bengal. He mentioned that we would need to develop our interpolation skills to understand seismic data.

Dr. Sitesh Chandra Bachar, Dean, Faculty of Pharmacy & Professor, Department of Pharmacy, University of Dhaka, talked about the importance of pharmaceuticals, the potential of seaweeds, and the livelihood of coastal people. He emphasized agar production from seaweeds, iodine extraction from seaweeds, drugs, anticancer, and other product extractions from marine plants and animals.

Dr. Sharif Akhteruzzaman, Professor, Genetic Engineering and Biotechnology Department, University of Dhaka, proposed the term 'Blue Biotechnology. He reported that many resources were almost extinct. He raised the issue of biodiversity conservation and maintaining genetic cell preservation. He further asked to identify, classify, and barcode marine plants and animals to understand the marine resources in the Bay of Bengal. He proposed to develop genetic research and create an industry where blue biotechnology could be used. He asked to increase the fund for research, coordination, and management.

Ms. Zahanara Islam, Chairman, Zahanara Green Agro, proposed to start blue economy-related studies from primary school to higher studies. She was also very concerned about ocean health.

Mr. Kazi Sarowar talked about marine pollution and the death zone in the Bay of Bengal. He reported that massive pollution could be expanded on the northern coast due to ship recycling in that particular area and as a result, heavy metals, and microplastics could be mixed in the coastal waters and polluted our Bay of Bengal. He suggested that the blue economy could be institutionalized under Armed Forces Division or Prime Minister's Office. He also proposed that it could work as an umbrella including all blue economy relevant stakeholders.

Commodore Mahmudul Hasan focused on the importance of Blue Economy literacy in every sector. He said that well-educated or well-trained people should work in that sector so that it could be managed and operated easily.

Rear Admiral Mahbub, Chief Hydrographer, Naval Headquarters, Bangladesh Navy, welcomed the blue economy institutionalization proposal.

Dr. Mohammad Abdul Baki, Pro-Vice Chancellor, Noakhali Science, and Technology University, welcomed the proposal of blue economy institutionalization. He suggested that seabass (Koral/vet), crab, and pomfret (Rup Chanda) species could be used as suitable candidates for mariculture in Bangladesh.

9.5 Keynote Presentation by Mr. Aminul Arifeen, Project Manager, Social Security Policy Support Programme, UNDP

Keynote Presentation on "**Blue Economy and Prospect of Social Protection in Bangladesh**"

Mr. Arifeen welcomed the honorable chair, distinguished guests on stage, the departmental head of the General Economic Division, honorable guests, and colleagues. He praised the presentation given by Dr. Kawser Ahmed, Member (Secretary), General Economic Division, Ministry of Planning. He mentioned Dr. Ahmed had talked about three pillars and he (Dr. Ahmed) had left one pillar untouched for him and that was Social Sustainability. And he covered that very topic of Social Sustainability in his presentation. He said they could refer to *Blue Economy and Prospects of Social Protection in Bangladesh* as *Blue economy and Business Case for Social Protection for Bangladesh*. In his short presentation, he tried to describe how a business case could be made from that.

He pointed out that many issues were coming up in the discussion but there were living and non-living things in the ecosystem of the blue economy. He referred to Dr. Ahmed's presentation where he talked about the non-living thing at the macro level and added that many people had talked about the living thing, particularly people and the environment and that was a part of social security. He said that he was talking about research on the blue economy but there was not much research on that topic in Bangladesh. He even thought very minimum research works were globally done on Blue Economy but very pragmatic research was needed on that particular topic.

He pointed out that he had found by browsing the internet that Bangladesh had about three crore people living in the coastal area in 19 districts and they lived in 32 percent of the land mass area which was 19 percent of the total population and the population density was about seven hundred and fifty in 743 per square kilometer. According to him, at present, if we assume that the population is about 16 crores or 17 crores, then by 2050 we can assume that our population will be 20 crores or more. And at that time the coastal-urban area will have a population of 30.2 million. And the alarming thing about climate change is that if it happens, there will be a massive internal migration and coastal people may move up and that will not be any good for any country.

He raised a question in his presentation on the condition of social protection and the possibility of the same though Bangladesh has 100 Economic Zones, deep sea ports and so many things in place. He covered in his presentation that if there was economic growth, there was a political economy and there was the issue of financing as well. He quoted the name of Gunter Pauli, a Belgian economist who had written in 1994 that 100 innovations were possible in 10 years in a Blue Economy and it could create 100 million jobs. So, in that context, he added that our honorable Prime Minister was not only concerned about resource generation or economic sides but also, she was very careful about social sides.

He then added that if we looked at our trajectory, one of the big things was that we were moving forward and that had already been discussed. He further added that they noticed Bangladesh was one of the 49 champion countries which had very limited natural resources and that was the wonder of the world. He noted that in that natural scarcity of resources if they could access marine resources, it would be a great source of financing in the social sector.

Mr. Arifeen said that the first social security strategy was approved in 2015 by the Cabinet division and the Hon'ble Prime Minister and if they noticed, since then the top priority in all policy documents was employment. He further said earlier it was poverty, then the employment of people was emphasized, and jobless growth was discouraged so that the people could be at work.

Then he added that if they considered the social level, no one would be left behind in the fight against poverty, which would affect equality and inequality, a topic that is currently being heavily debated. He emphasized the need for the social and financial inclusion of vulnerable populations, which included all those who lived in remote areas of islands and other difficult-to-reach areas, ethnic minorities, people with disabilities, and populations in areas that were vulnerable to shock, including those that might be caused by a pandemic, a change in the climate, a disaster, or a health issue. If these populations were invested in the blue economy, there would be significant opportunities for national economic growth, he said. And economic growth will increase the government's financing capacity in the social sector.

Figure 91: Mr. Aminul Arifeen is seen delivering his presentations

He then cited Dr. Ahmed by name and said that he had discussed Social Sustainability while discussing the definition of a Blue Economy. He stated that he discovered the word "Sustainability" used frequently, including in documents from the World Bank, the UN, and the government, and that economic progress improved lives and also created jobs. As Dr. Ahmed also stated, institutionalization or an institution was determined by a variety of economic sectors and related policies as a whole. Instead of bringing them under one roof and ensuring the sustainability of maritime resources, he meant various sectors, he said.

He further mentioned the use of ocean resources and contributing to inclusive economic growth i.e. the inclusive economy with everyone and employment and well-being while conserving the health of the ocean, were other things that the government of Bangladesh stated. He then pointed out that had come up in their conversation, and their esteemed admiral had stated that a dead zone had been found, thus there was a problem with the health of their ocean that they needed to look at.

He told the crowd that he had looked around and discovered information on Google that revealed the extent of the blue economy as an industry. It was 4.1% in India, 12% in Sri Lanka, 10% in China, 28% in the Maldives, and 1% in Pakistan. Finding data, he claimed, was quite challenging. He also noted that research was still moving forward globally and had received a lot of attention immediately after 1994. He pointed out that fishing was the largest industry in Pakistan, and that fishing was also the main industry in Myanmar (2%), Thailand (30%), the Philippines (3.4%), Indonesia (28%), and Malaysia (discussed). Although the USA had 1.8% of the world's GDP, Australia had 3.7%, and Malaysia had 23%, he claimed that the US economy was the world's best.

He claimed that if the blue economy could contribute 4% to Bangladesh's economy and with the current GDP size of approximately 465 billion, they could invest 18+ billion dollars if they could institutionalize then. And if Bangladesh wanted to reach 1 trillion then it could contribute a quarter billion to the economy, he noted. He also mentioned the name of Dr. Ahmed who had said in his presentation that in countries across Asia-Pacific, Mediterranean and Atlantic areas, the national economies are hugely benefited from the ocean economy, therefore blue economy-focused ocean trade and business had then been a growing concern for the world.

He continued by stating that the inclusive enhancement of everyone's quality of life would be a component of the Blue Economy and that in another location, you would see "create jobs, reduce poverty, and end hunger, and that would fall inside the domain of social protection." He added that if they took a wider view of social protection, it might in some cases interfere with the SDGs.

He also talked about no poverty, zero hunger, food security, health, well-being, etc. He also covered gender equality, working environment, economic growth, inequalities, climate actions, Justice, and strong institutionalization. He posed the question that whether the blue economy and social protection could be linked. He mentioned the icon of icons of SDGs was No Poverty because others were very much interlinked with SDG-1 and social protection issues were very much related to SDGs 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, and 17, and SDG 14 was the source of living standard of people by creating the opportunity of energy and mineral resources, employment, food, nutrition, and urban growth centers and trade. If Bangladesh was able to explore the strategy for Sustainable Diversified Blue Economy then what could happen? Bangladesh would experience less poverty, sustainable food security and nutrition, and a transformative resilient and shock-responsive nation.

A blue economy could give sustainable livelihood, a decent job, higher income, improved health, and quality. education, higher equality, disaster response, climate resilience, political stability, and social cohesion, he added. "If everyone gets a job and earns, there will be equality. Safety and expended fiscal space are critically needed in financing. And sir (Dr. Ahmed) ended the presentation with economic fiscal space and economic opportunity.
Now if I look into the area of the business case then inclusive social protection is said to be in the blue economy among the SDG 14 indicators if I keep aside investment and business contribution to GDP, he said.

He then added that for increased fiscal space, if he saw where the investment and business cases were, and if he saw that it was in the coastal embankment, land reclamation, Delta plan; in deep-sea port connectivity, special economic zones along with trade and transport and with each of them, there was the capacity and employment opportunities. He mentioned that GDP would not only be based on Dhaka and which was a port city and the population could go there and so a push-pull migration could happen i.e. there could be a push from Dhaka or a port city could pool the population and become a financial hub (financial hub means as many sectors like banking, formal, and insurance all sectors can be there), if it could create opportunity in that way. He pointed out that there could be tourism, hotels, resorts, and accommodation and added that the tourism sector, fishing capacity, fish processing industries, Micro, Small and Medium Enterprises (MSME), and the informal sector and their adjuncts would be developed.

He mentioned the name of Dr. Ahmed and said that he had discussed oil, gas, and mineral exploration critically and others had also discussed renewable energy and power hubs, effluent treatment plants, etc. He also mentioned the name of the Admiral who had said that a dead zone had been found because of the absence of oxygen in the seawater. He said that education and medical institutions, climate and environment, jobs and insurance, and taxation would increase and asked if it increased, what would happen?

The welfare state that they said would be developed by 2041 would provide universal social protection through the life cycle that he had shown earlier, their investment would increase there, he added. He said that If they could make a welfare state, everyone's income would increase, everyone would get employment, and everyone would be on income and food security, nutrition security would go up, and particularly protein deficiency would decrease.
According to him food security means not only staple food rice or other issues, but nutrition would also increase, there would be a sustainable livelihood, and the issue of employment and pension would come forward because as labor employment increases, these formal things would come forward. Social insurance and allowance would come, and health, education, rights and safety, equitable resource distribution, and political stability would increase. And above all, there would be a strong bond of the social contract between the state and citizens which is stated in article 16 of the constitution where the state must protect the rights of every citizen and provide social protection to every citizen and the citizens also have a duty to the state to maintain and benefit the state economically through taxation.

He then said that a lot had happened in that day's discussion yet he had some food for thought, he had said something that should be there. He added institutional coordination, structure body whatever you said was about the sustainable blue economy because if there were around 25 ministries involved and many ministries were headed by the Prime Minister herself and many had come under the leadership of the Prime Minister.

He then noted that in social protection, there were 39 ministries and there was a coordination body; a Central Management Committee. He said that decision was made on any research or small findings or any other things in there and then the decision was informed to the cabinet division in the cabinet meeting and if that was approved by the cabinet division then it became obligatory in other ministries. He informed the audience that National Social Security Strategy (NSSS) Action Plan 2021-26, Phase II had been prepared and approved by the CMC, and the Honourable Prime Minister of the Government of Bangladesh had her consent on the approved plan, which was not obligatory for the social protection. Ministries gave their demands and implemented the plans as per their demand and such things might happen in the future.

The Blue Economy was not merely the ocean and related issues of non-living things, but rather invariably linked to living things and the people living sea shore areas, maintaining their daily livelihood on the ocean, he said. He added that it was therefore from the social protection perspective, the food for thought could be: inclusivity from a financial inclusion perspective, creating job opportunities both in formal and informal sectors, urban business growth centers to become population pull centers, tourism, trade, bank, insurance, engagement of private sector, and non-state sectors for bringing a transformative change in country's economy and standard of living of the people of inhabitants, and a shock-resilient adaptive population by correct targeting the extremely vulnerable population and ensuring that Leave No One Behind (LNOB).

He pointed out that not only the government would do it there, but the non-state actors have also a role to play. He raised a question of how to mobilize required resources, and how to invest, explore, and make proper utilization of ocean resources including expansion of fiscal space. He then added political economy had to decide what he wanted to do and where he wanted to go. He then mentioned that sir (Dr. Ahmed) had raised a wonderful question i.e. what would happen in 2050 and he needed to have a clear vision on that aspect. What should his vision be if he was gone in 10 years? Government should have a critical political business case. And if a governing body promoted it then everyone could work accordingly, he added. He also asked how to ensure socioeconomic and environmental sustainability by maintaining the ocean ecosystem which talked about health.

It worked to keep that ecosystem in order. What would be the institutional coordination shape or arrangements or structure to govern the blue economy, he asked, and above all what were the international best practices? He then said that maybe in the future, there could be a dialogue about international best practices and they could discuss which ones they should adopt and which ones they should not. He then concluded the presentation by thanking all present on the occasion and uttered Jai Bangla Jai Bangabandhu.

9.6 Questions and comments regarding keynote presentation 2

Figure 92 : Questions and Comments on the Keynote Presentation 2

Mr. Sayeed Mahmood Belal Haider, Director General, BORI, commented on maritime education for the social security of the blue economy.

Additional Secretary, Blue Economy Cell, asked how blue economy could be added to different classes of social security. He also asked how the blue economy could be used to achieve SDGs.

Cdre Mahmudul Hasan, Consultant, Payra Port Authority, talked about the social security of the coastal people. He suggested providing training to develop the skills and expertise of the people involved in blue economy-related activities.

Ms. Zahanara Islam, Chairman, of Zahanara Green Agro, reported that her industry tried to create different products from seaweeds and other marine plants for the coastal people.

Mr. Sydul Islam Sarkar, Assistant Professor, Department of Oceanography, University of Chittagong, suggested defining the blue economy in the context of Bangladesh for the protection of social security.

One of the participants reported how the blue economy could be a barrier to social security and how it could overcome the need to be considered. He also suggested taking necessary actions and strategies for the protection of the coastal people.

Speech by the Guest of Honor, **Rear Admiral (Retd.) Md Khurshed Alam**, BN, Secretary (MAU), Ministry of Foreign Affairs, Government of the People's Republic of Bangladesh

In the policy dialogue, Mr. Alam told that there was a lack of coordination when it came to the blue economy. He said that the blue economy was not only fishing in the marine areas, but was also infrastructure development, mining natural energy, and maritime transport.

Mr. Alam said Chattrogram port had become very busy as its annual container handling capacity had risen to three million. He added that the port might lose such capability soon in absence of proper manpower as the number of containers was growing.

Mr. Alam also added that Pangaon Inland Container Terminal in Dhaka's Keraniganj was also facing a road conjunction problem. He suggested separating ocean contribution from the national GDP to understand the importance of the blue economy. He reported that the blue economy could contribute around 6.5% to GDP.

Speech by the Special Guest, **Ms. Zuena Aziz**, Principal Coordinator (SDG Affairs), Prime Minister's Office, Government of the People's Republic of Bangladesh

Ms. Aziz said that different ministries were working on the blue economy components separately but it had become urgent to form a unique or independent authority to ensure its contribution to GDP. "This authority can be a ministry or a council."

She said the fishing industry would expand riding on the blue economy and fishermen would be trained as investors would buy large fishing vessels to cope with the transformation period.

Speech by the Chief Guest, **Dr. Ahmed Kaikaus**, Principal Secretary to the Hon'ble Prime Minister, Government of the People's Republic of Bangladesh

Dr. Ahmad said, "Once, our markets were built on the banks of rivers for better transport facilities but the World Bank advised developing road transport and avoiding railway. As a result, we are facing traffic jams every day. Now, we need to focus on marine or river transports."

He added that major investment would also be needed from private entrepreneurs if the authorities would go for developing and utilizing the blue economy components.

Concluding Speech given by Chairperson, **Mr. Pradip Ranjan Chakraborty**, Secretary, Planning Division, Ministry of Planning.

In the concluding session of the policy dialogue, Mr. Chakraborty said it was time to turn the marine areas with resources into proper blue economy components and create employment opportunities, ecosystem, and cultural services for a good annual turnover. He mentioned that the government was working on that.

9.7 Conclusions

In Bangladesh yet now various activities of the Blue Economy have been conducted fragmentally under different ministries of the Government of Bangladesh. In the consultative policy dialogue, in-depth explanations and analyses were given on how the potential of the Blue Economy in Bangladesh can be institutionalized for national progress. Bangladesh is far behind in utilizing the full potential of its marine resources due to the absence of an independent authority that can manage and capitalize on them, say experts and policymakers.

There is one important factor to consider for Bangladesh: that, with the increase of the population of the country, it would be gradually more dependable on sea resources than those in the landmass. Sea resources offer a new window of opportunity for Bangladesh. To feed the people from the sea resources, Bangladesh requires to push policies in cooperation with other countries to protect the ocean from the effects of climate change, pollution, and overfishing. We need to preserve the ecosystems of the seas which are reportedly being degraded at an unprecedented rate.

Given the possibility of the acquisition of wealth from the sea, Bangladesh needs to develop policies and laws to strengthen national institutions which could deliver solutions to implement its Sustainable Development Goals. Goal 14 of the United Nations Sustainable Development Goals (UN SDGs) highlights the need for the conservation of the ocean and sustainable use of marine resources. Goal 14 also serves to meet seven other UN SDG goals including poverty, food security, energy, economic growth, infrastructure, reduction of inequality, cities and human settlements, sustainable consumption and production, climate change, biodiversity, and means of implementation and partnerships. The Blue Economy can serve as an untapped source of sustainable and environmentally respectful solutions.

In the dialogue, it was decided that an independent authority (separate ministry/department or wing) could be established in achieving sustainable growth and development by centralizing various

References

ADB (Asian Development Bank). (2021). ADB Issues First Blue Bond for Ocean Investments. https://www.adb.org/news/adb-issues-first-blue-bond-ocean-investments (accessed: 13 August 2022).

AfDB (African Development Bank). (2022). African Economic Outlook 2022: Supporting Climate Resilience and a Just Energy Transition in Africa. African Development Bank Group. https://www.afdb.org/en/documents/african-economic-outlook-2022 (accessed: 13 August 2022).

AfDB/OECD/UNDP. (2015). African Economic Outlook 2015: Regional Development and Spatial Inclusion. African Development Bank, OECD, and United Nations Development Programme. OECD Publishing, Paris.

Ahammad, H., & Sujauddin, M. (2017). Contributions of ship recycling in Bangladesh: an economic assessment. IMO-NORAD SENSREC Project, IMO, London, UK, 67p.

Alam, M. S., Liu, Q., Schneider, P., Mozumder, M. M. H., Uddin, M. M., Monwar, M. M., ... & Barua, S. (2022). Stock Assessment and Rebuilding of Two Major Shrimp Fisheries (*Penaeus monodon* and *Metapenaeus monoceros*) from the Industrial Fishing Zone of Bangladesh. *Journal of Marine Science and Engineering*, *10*(2), 201.

Alam, M. W., Xiangmin, X., Ahamed, R., Mozumder, M. M. H., & Schneider, P. (2021). Ocean governance in Bangladesh: Necessities to implement structure, policy guidelines, and actions for the ocean and coastal management. *Regional Studies in Marine Science*, *45*, 101822.

Alderton, P. M. (1999). Port management and operations. Informa Pub. London, Hong Kong: LLP, pp. 121.

Alves, C., Silva, J., Pinteus, S., Gaspar, H., Alpoim, M. C., Botana, L. M., & Pedrosa, R. (2018). From marine origin to therapeutics: The antitumor potential of marine algae-derived compounds. Frontiers in Pharmacology, 9, 777.

Appeltans, W., Ahyong, S. T., Anderson, G., Angel, M. V., Artois, T., Bailly, N., ... & Costello, M. J. (2012). The magnitude of global marine species diversity. *Current Biology*, *22*(23), 2189-2202.

Attri, V. N. (2018). New and Emerging Investment Opportunities Under Sustainable Blue Economy. Business Forum, Sustainable Blue Economy Conference. Nairobi, Kenya.

Australian Government. (2012). Australia's Submission to the Rio+20 Compilation Document, Rio+20 United Nations Conference on Sustainable Development. Canberra: Australian Government.

Bangladesh Bank. (2020). Annual Report (2019 – 2020). Financial Institutions Division, Ministry of Finance, Government of the People's Republic of Bangladesh Dhaka. https://www.bb.org.bd/pub/annual/anreport/ar1920/full_2019_2020.pdf

Baul, T. K., Datta, D., & Alam, A. (2018). A comparative study on household level energy consumption

and related emissions from renewable (biomass) and non-renewable energy sources in Bangladesh. Energy Policy, 114, 598-608.

Behnam, A. (2012). Building a blue economy: strategy, opportunities, and partnerships in the Seas of East Asia. In *The East Asian Seas Congress*. *Changwon City, Republic of Korea*.

Belton, B., Karim, M., Thilsted, S., Collis, W., & Phillips, M. (2011). Review of aquaculture and fish consumption in Bangladesh. Studies and Reviews 2011-53. The WorldFish Center.

BIDA (Bangladesh Investment Development Authority). (2019). Shipbuilding. https://bida.gov.bd/shipbuilding (accessed: August 13, 2022)

Billah, M. & Naher, K. (2021). Seaweed has great potential, but no investors. https://www.tbsnews.net/features/panorama/seaweed-has-great-potential-no-investors-257548 (accessed: August 13, 2022)

Blue Economy Caribbean. (2018). Caribbean Blue Economy: An OECS Perspective. Presentation. BEC, New Energy Events. http://newenergyevents.com/blue-economy-caribbean/wpcontent/uploads/sites/25/2018/11/BEC_Showcase_OECS.pdf (accessed: August 13, 2022)

Brakenhoff, R. 2015. Outlook for Offshore Energy: Short-term dip, long-term rise. Oil & Gas Financial Journal. https://www.ogj.com/home/article/17294834/outlook-for-offshore-energy (accessed: August 13, 2022)

Cervigni, R., & Scandizzo, P. L. (2017). The Ocean Economy in Mauritius: Making It Happen, Making It Last. World Bank, Washington, DC.

Choi, Y. R. (2017). The blue economy as governmentality and the making of new spatial rationalities. Dialogues in Human Geography, 7(1), 37–41.

Climate Bond Initiative. (2021). Record $ 269.5 bn green issuance for 2020: Late surge sees pandemic year pip 2019 total by $3 bn. https://www.climatebonds.net/2021/01/record-2695bn-green-issuance-2020-late-surge-sees-pandemic-year-pip-2019-total-3bn (accessed August 13, 2022)

Colgan, C. S. (2017). The blue economy of the Indian Ocean: Context and challenge. *Journal of Indian Ocean Rim Studies*, *1*(1), 7-37.

COM. (2014). A European strategy for more growth and jobs in coastal and maritime tourism. COM(2014) 86 final.

Committee of the regions. (2013). Blue growth opportunities for marine and maritime sustainable growth. Brussels: Committee of the regions.

Conathan, M., & Moore, S. (2015). Developing a blue economy in China and the United States. *Center for American Progress, Washington, DC*.

Costello, M. J., Coll, M., Danovaro, R., Halpin, P., Ojaveer, H., & Miloslavich, P. (2010). A census of marine biodiversity knowledge, resources, and future challenges. *PloS one*, *5*(8), e12110.

Coto- Millan & Martinez-Budria. (1999). An approach to the contribution of the port system to the Spanish economy. In: P. Coto-Millan (Ed.), Maritime transport applied economics, Madrid: Civitas Ediciones, 157-164.

Coulter, A., Cashion, T., Cisneros-Montemayor, A. M., Popov, S., Tsui, G., Le Manach, F., ... & Pauly, D. (2020). Using harmonized historical catch data to infer the expansion of global tuna fisheries. Fisheries Research, 221, 105379.

CRI (Centre for Research and Information). (2014). Bangladesh on the international stage. 10p.

CSIRO (Commonwealth Scientific and Industrial Research Organization). (2008). Blue GDP: ocean-based industrial development and growth. Canberra: Commonwealth Scientific and Industrial Research Organization.

Curtis, T. P., Sloan, W. T., & Scannell, J. W. (2002). Estimating prokaryotic diversity and its limits. *Proceedings of the National Academy of Sciences*, *99*(16), 10494-10499.

CVASU (Chattogram Veterinary and Animal Sciences University). (2022). CVASU Research Vessel. https://cvasu.ac.bd/pages/cvasu-research-vessel (accessed: August 13, 2022)

Das, J., & Shahin, M. A. (2019). Ship Breaking and its Future in Bangladesh. *Journal of Ocean and Coastal Economics*, *6*(2), 9. https://doi.org/10.15351/2373-8456.1110

Davis, S. J., Lewis, N. S., Shaner, M., Aggarwal, S., Arent, D., Azevedo, I. L., ... & Caldeira, K. (2018). Net-zero emissions energy systems. *Science*, *360*(6396), eaas9793.

Dawczynski, C., Schubert, R., & Jahreis, G. (2007). Amino acids, fatty acids, and dietary fiber in edible seaweed products. *Food Chemistry*, *103*(3), 891-899.

DCF (Data Collection Framework). (2008). Council regulation. European Commission (EC) No 199/2008.

DoF (Department of Fisheries). (2021). Pilot Project on Tuna and Similar Pelagic Fishing in Deep Sea. https://fisheries.portal.gov.bd/site/page/f8a78087-73c3-4ccd-8c45-2b96f503d923 (accessed: August 13, 2022)

DoF (Department of Fisheries). (2022). National Fish Week 2022 Compendium (in Bangla). Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh. 160p.

EC (European Commission). (2012). Blue Growth: Opportunities for marine and maritime sustainable growth. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions. L. P. O. o. t. E. Union

EC (European Commission). (2013). Action plan for a maritime strategy in the Atlantic area, delivering smart, sustainable, and inclusive growth: communication from the Commission to the European Parliament, the Council, the European Economic, and Social Committee, and the Committee of the Regions. COM(2013) 279, final. Directorate-General for Maritime Affairs and Fisheries.

EC (European Commission). (2017). Report on the Blue Growth Strategy: Towards a more sustainable growth and jobs in the blue economy. Brussels: European Commission Report No.: SWD (2017), 128

EC (European Commission). (2019). The EU Blue Economy Report. 2019. Publications Office of the European Union. Luxembourg.

Eikeset, A. M., Mazzarella, A. B., Davíðsdóttir, B., Klinger, D. H., Levin, S. A., Rovenskaya, E., & Stenseth, N. C. (2018). What is blue growth? The semantics of "Sustainable Development" of marine environments. *Marine Policy*, *87*, 177-179.

EIU (The Economist Intelligence Unit). (2015). The Blue Economy: Growth, opportunity and a sustainable ocean economy. An economist intelligence unit briefing paper for the World Ocean Summit 2015. London. https://www.greengrowthknowledge.org/research/blue-economy-growth-opportunity-and-sustainable-ocean-economy (accessed: August 19, 2022)

Energy Tracker Asia. (2021). Solar and Wind Power Potential in Bangladesh. https://energytracker.asia/solar-and-wind-power-potential-in-bangladesh/ (accessed: August 15, 2022)

EU (European Union). (2012). The EU Blue Economy Report. 2012. Publications Office of the European Union. Luxembourg.

Fanning, L. P., Chowdhury, S. R., Uddin, M. S., & Al-Mamun, M. A. (2019). Marine fisheries survey reports and stock assessment 2019. Department of Fisheries, Government of Bangladesh. 224p.

FAO (Food and Agriculture Organization). (2011). Review of the state of the world marine fishery resources. Rome: FAO Report No.: 569.

FAO (Food and Agriculture Organization). (2014). State of the World Fisheries and Aquaculture: Opportunities and Challenges.

FAO (Food and Agriculture Organization). (2016). The State of World Fisheries and Aquaculture 2016: Contributing to Food Security and Nutrition for All. Rome.

FAO (Food and Agriculture Organization). (2020). The State of World Fisheries and Aquaculture 2020. Sustainability in action. Rome

FAO (Food and Agriculture Organization). (2021). Fishery and Aquaculture Statistics. Global production by production source 1950–2019. Food and Agriculture Organization of the United Nations. Rome, Italy.

GED (General Economics Division). (2015). Seventh Five-Year Plan FY2016 – FY2020. Accelerating Growth, Empowering Citizens. General Economics Division (GED) Planning Commission Government of the People's Republic of Bangladesh. http://www.plancomm.gov.bd/sites/default/files/files/plancomm.portal.gov.bd/files/aee61c03_3c11_4e89_9f30_d79639595c67/7th_FYP_18_02_2016.pdf

GED (General Economics Division). (2018). Bangladesh Delta Plan 2100 - Bangladesh in the 21st Century. General Economics Division (GED) Planning Commission Government of the People's Republic of Bangladesh. https://oldweb.lged.gov.bd/UploadedDocument/UnitPublication/1/756/BDP%202100%20Abridged%20Version%20English.pdf

Global Industry Analysts Inc. (2022). Marine Biotechnology - Global Market Trajectory & Analytics. https://www.strategyr.com/market-report-marine-biotechnology-forecasts-global-industry-analysts-inc.asp (accessed: August 13, 2022)

GMI (Global Market Insights). (2021). Commercial Seaweed Market size to exceed $ 95 bn by 2027. https://www.gminsights.com/pressrelease/commercial-seaweed-market (accessed: August 13, 2022)

Grimm, K., & Fitzsimmons, J. (2017). Research and Recommendations on Communication about the Blue Economy. Spitfire. http://oceanfdn.org/wp-content/uploads/2019/12/Blue-Economy-Communications-Research-Recommendations-10.6.17-TM.kg_.pdf (accessed: August 13, 2022)

Gullón, B., Gagaoua, M., Barba, F. J., Gullón, P., Zhang, W., & Lorenzo, J. M. (2020). Seaweeds as a promising resource of bioactive compounds: Overview of novel extraction strategies and design of tailored meat products. *Trends in Food Science & Technology*, *100*, 1-18.

Hansen, E., Holthus, P., Allen, C., Bae, J., Goh, J., Mihailescu, C., & Pedregon, C. (2018). Ocean/Maritime Clusters: Leadership and Collaboration for Ocean Sustainable Development and Implementing the Sustainable Development Goals. World Ocean Council.

Harrison, J., Pickle, A., Virdin, J., & Vegh. T. (2017). North Carolina's Ocean Economy: A First Assessment and Transitioning to a Blue Economy. Raleigh, NC, and Durham, NC, USA: North Carolina Sea Grant, and Nicholas Institute for Environmental Policy Solutions, Duke University.

Hasan, M. M., Hossain, B. S., Alam, M. J., Chowdhury, K. A., Al Karim, A., & Chowdhury, N. M. K. (2018). The prospects of a blue economy to promote Bangladesh into a middle-income country. *Open Journal of Marine Science*, *8*(03), 355.

Hossain, K. A. (2017). Ship recycling practice and annual reusable material output from Bangladesh ship recycling industry. *Journal of Fundamentals of Renewable Energy and Applications*, *7*(5), 6.

Hossain, M. (2022). Achieving Sustainable Energy Targets in Bangladesh. https://www.un.org/en/chronicle/article/achieving-sustainable-energy-targets-bangladesh (accessed: March 6, 2022)

Hossain, M. A., Sultana, N., Azimuddin, K., Hussain, M. G., & Mazid, M. A. (2004). Selection of freshwater pearl mussel species for mantle transplantation in Bangladesh. Bangladesh Journal of Fisheries Research. 8(2), 113–116.

Hossain, M. S., Chowdhury, S. R., Navera, U. K., Hossain, M. A. R., Imam, B., & Sharifuzzaman, S. M. (2014). Opportunities and strategies for ocean and river resources management. Dhaka: Background paper for preparation of the 7th Five Year Plan. Planning Commission, Ministry of Planning, Bangladesh.

Hossain, M., Alamgir, M., Uddin, S., & Chowdhury, M. (2020). Seaweeds for Blue Economy in Bangladesh. *Food and Agriculture Organization of the United Nations*. 87 p.

Hunt, B., & Vincent, A. C. (2006). Scale and sustainability of marine bioprospecting for pharmaceuticals. AMBIO: *A Journal of the Human Environment*, 35(2), 57–64

Hussain, M. G., & Hoq, M. E. (Eds.). (2010). Sustainable management of fisheries resources of the Bay of Bengal. Support to Sustainable Management of the BOBLME Project, Bangladesh Fisheries Research Institute.

Hussain, M. G., Failler, P., Karim, A. A., & Alam, M. K. (2018). Major opportunities for blue economy development in Bangladesh. Journal of the Indian Ocean Region, 14(1), 88-99.

Hydrocarbon Unit. (2021). Energy Scenario of Bangladesh 2019-20. Energy and Mineral Resources Division, Ministry of Power, Energy and Mineral Resources. https://hcu.portal.gov.bd/sites/default/files/files/hcu.portal.gov.bd/publications/753d455d_3c37_43df_9ce6_6f80bdc0e982/2021-03-16-11-10-66fbccf16c104e594c24f303097aa65f.pdf (accessed: August 19, 2022)

ICS (International Chamber of Shipping). (2015). Shipping and world trade: driving prosperity. http://www.ics-shipping.org/shipping-facts/shipping-and-world-trade (accessed: August 19, 2022)

IEA (International Energy Agency). (2020). IEA World Energy Outlook 2020. IEA publications. France.

https://iea.blob.core.windows.net/assets/a72d8abf-de08-4385-8711-b8a062d6124a/WEO2020.pdf (accessed: August 13, 2022)

Incois. (2020). India's blue economy policy. https://incois.gov.in/documents/Blue_Economy_policy.pdf (accessed: August 19, 2022)

International Monetary Fund. (2018). Regional economic outlook. Asia Pacific: Good times, uncertain times, a time to prepare. Washington, DC, USA. https://www.imf.org/en/Publications/REO/APAC/Issues/2018/04/16/areo0509 (accessed: August 20, 2022)

IOC/UNESCO, IMO, FAO, & UNDP. (2011). A Blueprint for Ocean and Coastal Sustainability. Paris: IOC/UNESCO.

IRENA (International Renewable Energy Agency). (2016). Innovation Outlook: Offshore Wind. Abu Dhabi.

Islam, M. M., & Hasanuzzaman, M. (2020). Introduction to energy and sustainable development. In Energy for sustainable development (pp. 1-18). Academic Press.

Islam, M. M., & Shamsuddoha, M. (2018). Coastal and marine conservation strategy for Bangladesh in the context of achieving blue growth and sustainable development goals (SDGs). Environmental Science and Policy, 87, 45-54

Islam, M. W., & Sarker, T. (2021). Sustainable coastal and maritime tourism: A potential blue economy avenue for Bangladesh. Asian Development Bank Institute. ADBI Working Paper 1293. Tokyo: Asian Development Bank Institute.

ITF (International Transport Forum at the OECD). (2015). ITF Transport Outlook 2015. Paris.

Jackson, J. B., Kirby, M. X., Berger, W. H., Bjorndal, K. A., Botsford, L. W., Bourque, B. J., Bradbury, R. H., Cooke, R., Erlandson, J., Estes, J. A., & Warner, R. R. (2001). Historical overfishing and the recent collapse of coastal ecosystems. S*cience*, *293*(5530), 629-637.

Jia, Z., Wang, B., Song, S., & Fan, Y. (2014). Blue energy: Current technologies for sustainable power generation from water salinity gradient. *Renewable and Sustainable Energy Reviews*, *31*, 91-100.

Keen, M. R., Schwarz, A. M., & Wini-Simeon, L. (2018). Towards defining the Blue Economy: Practical lessons from pacific ocean governance. *Marine Policy*, *88*, 333-341.

Khairul, A., & Husnain, A. (2011). Power crisis & its solution through renewable energy in Bangladesh cyber journals: Multidisciplinary. Journals in Science & Technology. Journal of Selected Areas in Renewable and Sustainable Energy.

Kildow, J. T., Colgan, C. S., Scorse, J. D., Johnston, P., & Nichols, M. (2014). State of the US ocean and coastal economies 2014.

Lutz, S., Barnes, R., Kurvits, T., Lutz, S. J., & Martin, A. H. (2014). Fish carbon: Exploring marine vertebrate carbon services. Grid-Arendal. https://policycommons.net/artifacts/2390429/fish-carbon/3411771/ (accessed: August 19, 2022)

McGlade, J., Werner, B., Young, M., Matlock, M., Jefferies, D., Sonneman, G., ... & Gee, D. (2012). *Measuring water use in a green economy, a report of the working group on water efficiency to the International Resource Panel*. United Nations Environment Programme. Nairobi: UNEP.

Metro economies. (2021). Economic Valuation of Reef Ecosystems in the MAR Region and the Goods and Services they Provide. Final Report. Inter-American Development Bank.

Midwestern University. (2022). Marine Pharmaceutical: The Clinical Pipeline. https://www.midwestern.edu/departments/marinepharmacology/clinical-pipeline (accessed: August 19, 2022)

Ministry of Ecology and Environment, the National Development and Reform Commission, & the Ministry of Natural Resources. (2018). Action Plan for the Struggle for Comprehensive Governance of the Bohai Sea. Beijing: Ministry of Ecology and Environment.

MODEC. (2015). Floating Production Systems. http://www.modec.com/about/industry/oil_gas.html (accessed: August 19, 2022)

MoFA (Ministry of Foreign Affairs). (2014). Press Release: Press statement of the Hon'ble Foreign Minister on the verdict of the Arbitral Tribunal/PCA. http://old.mofa.gov.bd/media/press-statement-hon%E2%80%99ble-foreign-minister-verdict-arbitral-tribunalpca

MoFA (Ministry of Foreign Affairs). (2019). Blue economy development of sea resources for Bangladesh. https://mofa.gov.bd/site/page/8c5b2a3f-9873-4f27-8761-2737db83c2ec/OCEAN/BLUE-ECONOMY--FOR-BANGLADESH

Mohammad, H. (2015). Achieving Sustainable Energy Targets in Bangladesh. The Magazine of the United Nations.

Mohanty, S. K., Dash, P., Gupta, A., & Gaur, P. (2015). Prospects of Blue Economy in the Indian Ocean. New Delhi, India

MPEMR (Ministry of Power, Energy, and Mineral Resources). (2004). National energy policy. Government of the People's Republic of Bangladesh. Dhaka. https://gtcl.org.bd/wp-content/uploads/2018/02/NATIONAL-ENERGY-POLICY.pdf (accessed: August 19, 2022)

Mulazzani, L., & Malorgio, G. (2017). Blue Growth and ecosystem services. Marine Policy, 85, 17–24.

Mwanza, K. (2018). African Fishing Communities Face "extinction" as Blue Economy Grows: Experts. Thomas Reuters Foundation. https://www.reuters.com/article/us-africa-oceans-blueeconomy/african-fishing-communities-face-extinction-as-blue-economy-grows-experts-idUSKCN1NV2HI (accessed: August 19, 2022)

National Development and Reform Commission. (2011). Development Planning of Blue Economic Zone in Shandong peninsula. Beijing: National Development and Reform Commission.

National Marine Science Committee. (2015). National marine science plan 2015-2025: Driving the development of Australia's Blue Economy. Townsville. https://www.marinescience.net.au/nationalmarinescienceplan/ (accessed: August 19, 2022)

NBS (National Bureau of Statistics). (2019). Visitor Arrival Statistics December 2019. Government of Seychelles. Statistical Bulletin.

NOAA (National Oceanic and Atmospheric Administration). (2013). National Coastal Population Report: Population Trends from 1970 to 2020. U.S. Department of Commerce. http://stateofthecoast.noaa.gov/features/coastal-population-report.pdf (accessed: August 13, 2022)

NOAA (National Oceanic and Atmospheric Administration). (2022). Submarine cables. https://www.

gc.noaa.gov/gcil_submarine_cables.html (accessed: August 20, 2022)

Nobi, M. N., & Majumder, M. (2019). Coastal and marine tourism in the future. *Journal of Ocean and Coastal Economics*, *6*(2), 12.

Obura, D. O., Burgener, V., Nicoll, M. E., Ralison, H. O., & Scheren, P. (2015). The Northern Mozambique Channel. Setting the foundations for a regional approach to marine governance. A background document. WWF International and CORDIO East Africa. 13 p.

Obura, D., Burgener, V., Owen, S., & Gonzales, A. (2017). Reviving the Western Indian Ocean economy: Actions for a sustainable future (p. 64). *Gland, Switzerland: WWF International*. pp. 13-14. https://www.greengrowthknowledge.org/resource/reviving-western-indian-ocean-economy-actionssustainable-future (accessed: August 19, 2022)

OECD (Organization for Economic Co-operation and Development). (2016). The Ocean Economy in 2030. Paris: OECD Publishing.

OECD (Organization for Economic Cooperation and Development). (2018). The State of Blended Finance 2018. https://www.oecd.org/water/OECD-GIZ-Background-document-State-of-Blended-Finance-2018.pdf (accessed: August 19, 2022)

Oyer, M., & van Leeuwen, J. (2019). Social License to Operate in the Blue Economy. Resources Policy. (62), 102-113.

Parsan, N., & Friday, A. (2018). Master Planning for Blue Growth in the Caribbean: A Case Study from Grenada. Presentation at the Blue Economy Caribbean.

Patil, P. G., Virdin, J., Colgan, C. S., Hussain, M. G., Failler, P., & Vegh, T. (2018). Toward a Blue Economy: A Pathway for Sustainable Growth in Bangladesh (No. 126654, pp. 1-96).

Pauli, G. (2009). The Blue Economy - A Report to the Club of Rome. Nairobi: UNEP.

Pauli, G. A. (2010). The Blue Economy: 10 years, 100 innovations, 100 million jobs. Paradigm publications, New Mexico.

Pranathi, A. V., & Gonchkar, P. (2019). The study of the blue economy as an emerging sector for employment generation in India. Asia Pacific Journal of Research, I(XCVII), 89–90.

PwC (Price Waterhouse Cooper). (2018). Strengthening Africa's Gateways to Trade: An analysis of port development in sub-Saharan Africa. https://www.pwc.co.za/en/assets/pdf/strengtheningafricas-gateways-to-trade.pdf (accessed: August 19, 2022)

Rahman, M. (2022). Can gas hydrate presence be a game changer in the Bay of Bengal? https://thefinancialexpress.com.bd/views/views/can-gas-hydrate-presence-be-a-game-changer-in-the-bay-of-bengal-1642688841 (accessed: August 19, 2022)

Rahman, M. A., Parvej, M. R., Rashid, M. H., & Hoq, M. E. (2015). Availability of pearl-producing marine bivalves on the south-eastern coast of Bangladesh and cultural potentialities. Journal of Fisheries. 3(3), 293-296.

Rahman, M. R. (2013). Regional cooperation in maritime security: A view from the Bay of Bengal. Annual international studies convention 2013, organized by Jawaharlal Nehru University (JNU), New Delhi, India.

Rahman, M. R. (2017). The blue economy and maritime cooperation in the Bay of Bengal: Role of Bangladesh. Procedia Engineering. 194, 356-361.

Ram, J. (2018) The Blue Economy: A Caribbean Development Opportunity. Caribbean Development Bank.

Rengasamy, K. R., Mahomoodally, M. F., Aumeeruddy, M. Z., Zengin, G., Xiao, J., & Kim, D. H. (2020). Bioactive compounds in seaweeds: An overview of their biological properties and safety. ***Food and Chemical Toxicology**, **135***, 111013.

Rio+20 Pacific Preparatory Meeting. (2011). The "Blue Economy": A Pacific Small Island Developing States Perspective Apia, Samoa. Apia: Rio+20 Pacific Preparatory Meeting.

Ruiz, I. B. (2018). Blue Economy: Not just for Fish. Deutsche Welle. https://www.dw.com/en/blue-economy-not-just-for-the-fish/a-42850624 (accessed: 13 August 2022)

Sadekin, M. N. (2021). Potentials of Blue Economy in Bangladesh. The Daily Asian age. https://dailyasianage.com/news/267684/potentials-of-blue-economy-in-bangladesh (accessed: August 19, 2022)

Sajid, E., & Siddiqui, K. (2022). Big potential in the Bay as 17-103 TCF gas hydrates were found. https://www.tbsnews.net/bangladesh/gas-hydrate-found-bay-bengal-353539 (accessed: August 19, 2022)

Salim, T. (2014). Maritime-axis development to boost RI's GDP. The Jakarta Post. http://www.thejakartapost.com/news/2014/12/30/maritime-axis-development-boost-ri-s-gdp.html

Santikajaya, A. (2014). Indonesia: a potential leader in the Indian ocean. The Diplomat. https://thediplomat.com/2014/12/indonesia-a-potential-leader-in-the-indian-ocean/ (accessed: August 20, 2022)

Sarker, S., Bhuyan, M. A. H., Rahman, M. M., Islam, M. A., Hossain, M. S., Basak, S. C., & Islam, M. M. (2018). From science to action: Exploring the potentials of Blue Economy for enhancing economic sustainability in Bangladesh. ***Ocean and Coastal Management**, **157***, 180-192.

Segal, T. (2021). Green Bond. https://www.investopedia.com/terms/g/green-bond.asp (accessed: August 19, 2022)

Senaratne, M. (2020). The Blue Economy: Charting a New Development Path in Seychelles.

Shemon, W. S. (2017). Problems & Prospects of Bangladesh Shipping Industry: A Comparative Overview. Bangladesh Maritime Journal. 1(1), 49–69.

Shetol, M. H., Rahman, M. M., Sarder, R., Hossain, M. I., & Riday, F. K. (2019). Present status of Bangladesh gas fields and future development: A review. ***Journal of Natural Gas Geoscience**, **4***(6), 347-354.

Silver, J. J., Gray, N. J., Campbell, L. M., Fairbanks, L. W., & Gruby, R. L. (2015). The blue economy and competing discourses in international oceans governance. The Journal of Environment & Development, 24(2), 135–160.

Smith-Godfrey, S. (2016). Defining the Blue Economy. Maritime Affairs: Journal of the National Maritime Foundation of India. 12 (1), 58–64.

Spalding, M. J. (2016). The new blue economy: The future of sustainability. Journal of Ocean and Coastal Economics. 2(2), 8–21.

SREDA (Sustainable and Renewable Energy Development Authority). (2022). Renewable energy: Present status. Power Division, Ministry of Power, Energy & Mineral Resources. http://www.renewableenergy.gov.bd/ (accessed: August 19, 2022)

STCW (International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers). (2018). The White List. http://www.stcwonline.com/stcw/stcw-thewhite-list. (accessed: August 19, 2022)

STECF (Scientific, Technical and Economic Committee for Fisheries). (2013). The Economic Performance Report on the EU Aquaculture sector (STECF-13-29). Publications Office of the European Union, Luxembourg, EUR 26336EN, JRC86671, 383 p.

Surís-Regueiro, J. C., Garza-Gil, M. D., & Varela-Lafuente, M. M. (2013). Marine economy: A proposal for its definition in the European Union. Marine Policy, 42, 111-124.

Suttle, C. A. (2013). Viruses: unlocking the greatest biodiversity on Earth. ***Genome.*** 56, 542–544.

Tareq, A., Shaikh, M., Sen, S., & Xuefeng, W. (2021). Deep Sea Port and the National Development: Perspective of Bangladesh. SSRN Electronic Journal.

Taylor, S. F., Roberts, M. J., Milligan, B., & Ncwadi, R. (2019). Measurement and implications of marine food security in the Western Indian Ocean: an impending crisis? Food Security, 11(6), 1395-1415.

The Daily Star. (2022). Electricity is now in every house. https://www.thedailystar.net/news/bangladesh/news/electricity-now-every-house-2987601 (accessed: August 19, 2022)

Tosun, J. (2017). Energy Policy. Oxford Research Encyclopedia of Politics.

Uddin, M. N., Rahman, M. A., Mofijur, M., Taweekun, J., Techato, K., & Rasul, M. G. (2019). Renewable energy in Bangladesh: Status and prospects. Energy Procedia, 160, 655-661.

Ullah, M. H., Hoque, T., & Hasib, M. M. (2012). Current status of the renewable energy sector in Bangladesh and a proposed grid-connected hybrid renewable energy system. International journal of advanced renewable energy research, 1(11), 618-627.

UNCTAD (United Nations Conference on Trade and Development). (2014). Small Island Developing States: Challenges in Transport and Trade Logistics. Background note to the third session of the Multi-Year Expert Meeting on Transport, Trade Logistics, and Trade Facilitation. Geneva, 24–26 November

UNCTAD (United Nations Conference on Trade and Development). (2016). The oceans economy: Opportunities and challenges for small island states. Geneva: United Nations Conference on Trade and Development.

UNCTAD (United Nations Conference on Trade and Development). (2018). Review of Maritime Transport 2018. p. 23. https://unctad.org/en/PublicationsLibrary/rmt2018_en.pdf (accessed: August 19, 2022)

UNECA (United Nations Economic Commission for Africa). (2016). Africa's Blue Economy: A Policy Handbook. UNECA: Ababa, Ethiopia.

UNEP (United Nations Environment Programme). (2011). Decoupling natural resource use and environmental impacts from economic growth. International Resource Panel, Sustainable Consumption, & Production Branch. UNEP/Earth print.

UNEP, FAO, IMO, UNDP, IUCN, World Fish Center, & GRID Arendal. (2012). Green Economy in a Blue World. Nairobi: UNEP.

UNEP. (2015). Blue Economy: Sharing Success Stories to Inspire Change. www.unep.org/greeneconomy (accessed: August 19, 2022)

United Nations. (2016). Blue economy concept paper. Paper presented at the Blue Economy Summit., Abu Dhabi, United Arab Emirates. https://sustainabledevelopment.un.org/content/documents/2978BEconcept.pdf (accessed: August 19, 2022)

United Nations. (2017). Factsheet: People and Oceans. https://www.un.org/sustainabledevelopment/wp-content/uploads/2017/05/Ocean-fact-sheet-package.pdf (accessed: August 19, 2022)

UNWTO (United Nations World Tourism Organization). (2014). Tourism in Small Island Developing States (SIDS): Building a More Sustainable Future for the People of Islands.

USEIA. (2022). Bangladesh. https://www.eia.gov/international/overview/country/BGD (accessed: August 19, 2022)

Vega, A., & Hynes, S. (2017). Ireland's ocean economy. https://www.nuigalway.ie/semru/documents/semru__irelands_ocean_economy_2017_online.pdf

Voyer, M., Schofield, C., Azmi, K., Warner, R., McIlgorm, A., & Quirk, G. (2018). Maritime security and the Blue Economy: intersections and interdependencies in the Indian Ocean. Journal of the Indian Ocean Region, 14(1), 28-48.

Walker, T. (2018). Securing a Sustainable Oceans Economy: South Africa's Approach, Pretoria: ISS.

Whisnant, R., & Reyes, A. (2015). Blue economy for business in East Asia: Towards an integrated understanding of Blue Economy. Quezon City, Philippines.

Winder, G. M., & Le Heron, R. (2017). Assembling a Blue Economy moment? Geographic engagement with globalizing biological economic relations in multi-use marine environments. Dialogues in Human Geography, 7(1), 3–26.

World Bank, World Development Indicators. (2018). GDP (Constant 2010 US$). https://data.worldbank.org/indicator/NY.GDP.MKTP.KD (assessed: August 19, 2022).

World Bank. (2012). Hidden Harvest-The Global Contribution of Capture Fisheries. Report No. 66469-GLB. Washington, DC.

World Bank. (2013). Fish to 2030—Prospects for Fisheries and Aquaculture. World Bank Report Number 83177-GLB. Washington, DC

World Bank. (2016). First Global Integrated Marine Assessment (World Ocean Assessment). United Nations Division for Ocean Affairs and the Law of the Sea. http://www.un.org/depts/los/global_reporting/WOA_RPROC/WOACompilation.pdf (accessed: August 19, 2022).

World Bank. (2017). What is the blue economy? https://www.worldbank.org/en/news/

infographic/2017/06/06/blue-economy (accessed: August 19, 2022).

Worldometer. (2022). Bangladesh oil. https://www.worldometers.info/oil/bangladesh-oil/ (accessed: August 19, 2022)

WTTC (World Travel and Tourism Council). (2016). Travel and Tourism Economic Impact Summary 2016.

WTTC (World Travel and Tourism Council). (2021). Global economic impact & trends 2021. https://wttc.org/Portals/0/Documents/Reports/2021/Global%20Economic%20Impact%20and%20Trends%202021.pdf (accessed: August 19, 2022)

WWF (World Wide Fund for Nature). (2015). Principles for a sustainable Blue Economy. https://wwf.panda.org/wwf_news/?247477/Principles%2Dfor%2Da%2DSustainable%2DBlue%2DEconomy (accessed: August 19, 2022)

Young, R. D. (2014). Louisiana leads the country in the domestic maritime industry, report shows. http://www.nola.com/business/baton-rouge/index.ssf/2014/04/louisiana_leads_country_in_dom.html

Zakaria, N. G., Ali, M. T., & Hossain, K. A. (2012). Underlying problems of ship recycling industries in Bangladesh and way forward. *Journal of Naval Architecture and Marine Engineering*, *9*(2), 91-102.

Zhao, R., Hynes, S., & He, G. S. (2014). Defining and quantifying China's ocean economy. *Marine Policy*, *43*, 164-173.

Zhou, Z., Benbouzid, M., Charpentier, J. F., Scuiller, F., & Tang, T. (2013). A review of energy storage technologies for marine current energy systems. *Renewable and Sustainable Energy Reviews*, *18*, 390-400.

Zhu, C., Southgate, P. C., & Li, T. (2019). Production of pearls. In *Goods and services of marine bivalves* (pp. 73-93). Springer, Cham.

Annex

Policy Dialogue on "Institutionalization of Blue Economy in Bnagladesh" held on 14 May 2022 in Carnival Hall, Bangabandhu International Conference Centre, Sher-e-Bangla Nagar, Dhaka 1207 organized by SSPS Programme, UNDP, and SIBDP 2100

Speakers

- ✓ Khan Md Nurul Amin ndc, Chief, General Economics Division, Planning Commission
- ✓ Dr. Md Kawser Ahmed, Member (Secretary), General Economics Division (GED), Planning Commission
- ✓ Mr. Aminul Arifeen, Project Manager, Social Security Policy Support Programme, UNDP
- ✓ Rear Admiral (Retd.) Md Khurshed Alam, BN, Secretary (MAU), Ministry of Foreign Affairs, Government of the People's Republic of Bangladesh
- ✓ Ms. Zuena Aziz, Principal Coordinator (SDG Affairs), Prime Minister's Office, Government of the People's Republic of Bangladesh
- ✓ Dr. Ahmad Kaikaus, Principal Secretary to the Hon'ble Prime Minister, Government of the People's Republic of Bangladesh
- ✓ Mr. Pradip Ranjan Chakraborty, Secretary, Planning Division, Ministry of Planning

Participants

Government Stakeholders of Bangladesh Inland Water Transport Authority (BIWTA), Bangladesh Council of Scientific and Industrial Research (BCSIR), Department of Fisheries (DoF), Bangladesh Fisheries Research Institute (BFRI), Blue Economy Cell, Energy & Mineral Resource Division, Bangladesh Tourism Board, Poverty Analysis and Monitoring Wing, General Economics Division, Planning Commission, Bangladesh Oil, Gas & Mineral Corporation (Petrobangla), Marine Fisheries Survey Management Unit, DoF, International Economics Wing, General Economics Division, Bangladesh Planning Commission, Law and Justice Division, Bangladesh Secretariat, SDG Affairs Unit, Prime Minister's Office, high profile experts of Armed Forces Division, Port Authority, University and Training Institutes, Research Institutes/ Organizations, Private Organizations, International Organizations and other stakeholders of Bangladesh Securities and Exchange Commission (BSEC), Geological Survey of Bangladesh, Mouza & Plot Based National Digital Land Zoning Project, Ministry of Land, Forest Department, Zahanara Green Agro, Jatio Muktijoddha Council (JAMUKA), and Bangladesh Ocean Going Ship Owners' Association (BOGSOA) were the participants. activities related to the blue economy.

Government Stakeholders (Not According to Seniority)

1. Chairman, Bangladesh Inland Water Transport Authority (BIWTA), BIWTA Bhaban, 141-143 Motijheel C/A, Dhaka-1000.
2. Chairman, Bangladesh Council of Scientific and Industrial Research (BCSIR), Dr. Qudrat-I-khuda road, Dhanmondi, Dhaka.
3. Director General, Department of Fisheries (DoF), Matsya Bhavana, Kakrail Road, Dhaka-1205.
4. Director General, Bangladesh Fisheries Research Institute (BFRI), Head Quarter, Mymensingh-2201.
5. Chief (Additional Secretary), General Economics Division, Bangladesh Planning Commission, Sher-e-Bangla Nagar, Dhaka

6. Additional Secretary, Blue Economy Cell, Energy & Mineral Resource Division, Bangladesh Secretariat.
7. Chief Executive Officer (Additional Secretary), Bangladesh Tourism Board, Level- 9&10, Parjatan Bhaban, Dhaka 1207.
8. Additional Secretary, Poverty Analysis and Monitoring Wing, General Economics Division, Bangladesh Planning Commission.
9. Chairman, Bangladesh Oil, Gas & Mineral Corporation (Petrobangla), 3 Kawran Bazar Rd, Dhaka 1215.
10. Joint Chief (All), General Economics Division, Bangladesh Planning Commission.
11. Captain Mohammad Ali Chowdhury, BCGM, ndc, afwc, psc, BN, Blue Economy Cell, Energy & Mineral Resource Division, Bangladesh Secretariat.
12. Principal Scientific Officer, Marine Fisheries Survey Management Unit, Department of Fisheries (DoF), Agrabad, Chattogram.
13. Deputy Chief, International Economics Wing, General Economics Division, Bangladesh Planning Commission.
14. Mr. A K M Emdadul Haque, Deputy Secretary (Opinion-4), Law and Justice Division, Bangladesh Secretariat, Dhaka 1000.
15. Mr. Md. Didarul Alam, Deputy Secretary & PS to Principal Coordinator (SDG Affairs), Prime Minister's Office.
16. Mr. Mohammed Nurul Haque, Deputy Director (Geology), Ministry of Power, Energy & Mineral Resources, Energy & Mineral Resources Division, Geological Survey of Bangladesh, Segunbagicha, Dhaka.
17. Senior Assistant Chief (All), International Economics Wing, General Economics Division, Bangladesh Planning Commission.
18. Mr. Touhiduzzaman Khan, Assistant Project Director, SIBDP-2100, General Economics Division Armed Forces Division (Not According to Seniority)
19. Assistant Chief of Naval Staff (Logistics), Naval Headquarters, Bangladesh Navy Banani, Dhaka.
20. Rear Admiral Nazmul Hassan, OSP, NPP, ndc, ncc, psc, Commander of Chittagong Naval Command, Naval Headquarters, Banani, Dhaka.
21. Rear Admiral KS Hossain, Bangladesh Navy.
22. Managing Director, Chittagong Dry Dock Limited (CDDL), Airport Rd, Chattogram 4205.
23. Chief Hydrographer, Naval Headquarters, Bangladesh Navy, Banani, Dhaka-1213.
24. Cdre Md. Joynal Abedin, Director Naval Training.
25. Capt Moazzem Hossain, Bangladesh Navy. Port Authority (Not According to Seniority)
26. Chairman, Chittagong Port Authority, Bandar Bhaban, Chattogram-4100.
27. Chief Hydrographer, Payra Port Authority, Kalapara, Patuakhali-8650.
28. Cdre Mahmudul Hasan, Consultant, Payra Port Authority, Kalapara, Patuakhali-8650. University and Training Institutes (Not According to Seniority)
29. Vice-Chancellor, Bangabandhu Sheikh Mujibur Rahman Maritime University (BSMRMU), Plot# 14/06-14/23, Pallabi Mirpur-12, Dhaka-1216.
30. Vice-Chancellor, Bangabandhu Sheikh Mujibur Rahman Science and Technology University (BSMRSTU), Gopalganj.
31. Pro-Vice Chancellor, Noakhali Science and Technology University, University Road, Noakhali 3814.
32. Dean, Faculty of Pharmacy & Professor, Department of Pharmacy, University of Dhaka.
33. Dean, Earth and Environmental Sciences Faculty & Professor, Department of Disaster Science and Climate Resilience, University of Dhaka.
34. Professor and Chairman, Department of Meteorology, University of Dhaka.

35. Professor and Chairman, Department of Pharmacy, University of Dhaka.
36. Professor & Head of the Department, Oceanography and Hydrography, Bangabandhu Sheikh Mujibur Rahman Maritime University, Bangladesh (BSMRMU), Plot# 14/06-14/23, Pallabi Mirpur-12, Dhaka.
37. Mr. Sydul Islam Sarkar, Assistant Professor, Department of Oceanography, University of Chittagong, Chattogram.
38. Dr. Moniruzzaman Khandaker, Supernumerary Professor, Dept. of Botany, University of Dhaka.
39. Dr. Niaz Ahmed Khan, Professor, Development Studies, University of Dhaka.
40. Dr. Mohammad Abu Eusuf, Professor, Development Studies, University of Dhaka.
41. Director, Institute of Energy, University of Dhaka.
42. Professor and Chairman, Department of Fisheries, University of Dhaka.
43. Dr. Shamsur Rahman, Professor, Department of Fisheries, University of Dhaka.
44. Dr. Sharif Akhteruzzaman, Professor, Genetic Engineering and Biotechnology Department, University of Dhaka.
45. Dr. Md. Anwar Hossain Bhuiyan, Professor, Department of Geology, University of Dhaka.
46. Dr. M. Badruzzaman Bhuiyan, Professor, Department of Tourism and Hospitality, University of Dhaka.
47. Professor and Chairman, Department of Zoology, University of Dhaka.
48. Professor and Chairman, Department of Fisheries Biology and Genetics, Sher-e-Bangla Agricultural University, Sher-e-Bangla nagar, Dhaka 1207.
49. Dr. Badrul Imam, Honorary Professor, Department of Geology, University of Dhaka.
50. Dr. Nurul Islam Nazem, Professor (LPR), Department of Geography & Environment, University of Dhaka.
51. Mr. Mehedi Mahmudul Hasan, Associate Professor, Department of Fisheries and Marine Science, Noakhali Science and Technology University, University Rd, Noakhali 3814.
52. Mr. Md. Jobaer Alam, Associate Professor, Department of Oceanography, University of Dhaka.
53. Assistant Professor and Chairman, Department of Oceanography, University of Dhaka.
54. Principal, Marine Fisheries Academy, Chattogram, Ishanagar, Karnaphuli-4000
55. Mr. Makidul Islam Khan, Research Associate, International Centre for Ocean Governance (ICOG), Faculty of Earth and Environmental Sciences, University of Dhaka.
56. Dr. Seema Rani, Ex-research Associate, International Centre for Ocean Governance (ICOG), Faculty of Earth and Environmental Sciences, University of Dhaka. Research Institutes/Organization (Not According to Seniority)
57. Director, International Centre for Climate Change and Development (ICCCAD), Plot-16, Block-B, Aftabuddin Ahmed Road, Bashundhara R/A, Dhaka.
58. Executive Director, Bangladesh Centre for Advanced Studies (BCAS), House # 10, Road # 16A, Gulshan-1, Dhaka-1212.
59. Director General, Bangladesh Oceanographic Research Institute (BORI), Marine Drive Road, Khunia Palong, Rabeta, Ramu, Cox's Bazar.
60. Research Director, Policy Research Institute (PRI), House 16 (4th Floor), Road 10/A, Block H, Banani, Dhaka.
61. Naval Architect, Bangladesh Oceanographic Research Institute (BORI), Marine Drive Road, Khunia Palong, Rabeta, Ramu, Cox's Bazar.
62. Dr. Haseeb Md. Irfanullah, NbS Expert, International Centre for Climate Change and Development (ICCCAD), Plot-16, Block-B, Aftabuddin Ahmed Road, Bashundhara R/A, Dhaka.
63. Scientific officer, Physical and Space Oceanography, Bangladesh Oceanographic Research Institute (BORI), Marine Drive Road, Khunia Palong, Rabeta, Ramu, Cox's Bazar.

64. Senior Scientific Officer, Geological Oceanography, Bangladesh Oceanographic Research Institute (BORI), Marine Drive Road, Khunia Palong, Rabeta, Ramu, Cox's Bazar.
65. Scientific officer, Chemical Oceanography, Bangladesh Oceanographic Research Institute (BORI), Marine Drive Road, Khunia Palong, Rabeta, Ramu, Cox's Bazar.
66. Senior Scientific officer, Biological Oceanography, Bangladesh Oceanographic Research Institute (BORI), Marine Drive Road, Khunia Palong, Rabeta, Ramu, Cox's Bazar.
67. Mr. Mir Kashem, Scientific officer, Environmental Oceanography, Bangladesh Oceanographic Research Institute (BORI), Marine Drive Road, Khunia Palong, Rabeta, Ramu, Cox's Bazar.
68. Dr. Salimulah Khan, Director General, National Institute of Biotechnology (NIB), Savar.
69. Dr. Mohidul Islam, Bangladesh Fisheries Research Institute (BFRI), Head Quarter, Mymensingh-2201. Private Organization (Not According to Seniority)
70. Chief Executive Officer & Managing Director, Celestial Tech, Plot-#95, Block- K, Shorawardi Avenue, Baridhara Diplomatic Zone, Dhaka-1212.
71. Hydrospatial Advocate, Celestial Tech, Celestial Tech Plot-#95, Block- K, Shorawardi Avenue, Baridhara Diplomatic Zone, Dhaka-1212.
72. Managing Director, Bangladesh Steel Re-Rolling Mills Ltd (BSRM), Ali Mansion 1207/1099, Sadarghat Road, Chattogram.
73. Chairman, Ananda shipyard & Slipways Ltd, Ananda Group (9th floor), 10/1, City Heart, 67 Naya Paltan, Dhaka-1000.
74. President, Tour Operators Association of Bangladesh (TOAB), Lions Business Center, 105/E West Agargaon (2nd Floor), Agargaon Administrative Area, Sher-E-Bangla Nagar, 60 Feet Road, Dhaka.
75. Mr. Syed M. Ishtiak, Director, Sea Resources, Rangs Group, RANGS Bhaban, 117/A, Level-02, Old Airport Road, Tejgaon, Dhaka. International Organizations (Not According to Seniority)
76. Mr. Martijn van de Group, Delegated Representative, Water Management, Embassy of the Kingdom of the Netherlands in Bangladesh.
77. Prof. Abdul Wahab, Team Leader/Senior Scientist, World Fish, House 335/A (Old) 42/A (New), Road 114, Gulshan-2, Dhaka 1212.
78. Dr. Ishtiak Sobhan, World Bank, Dhaka Office
79. Dr. Woo Jun, World Bank, Dhaka Office
80. Naoki Matsumura, JICA Office, Bangladesh Other Stakeholders (Not According to Seniority)
81. Chairman, Bangladesh Securities and Exchange Commission (BSEC), Securities Commission Bhaban, E-6/C, Agargaon, Sher-e-Bangla Nagar Administrative Area, Dhaka-1207.
82. Dr. Sirajur Rahman Khan, Director General (Retd.), Geological Survey of Bangladesh.
83. Mr. Md. Kafil Uddin, Project Director (Retired Additional Secretary), Mouza & Plot Based National Digital Land Zoning Project, Ministry of Land.
84. Dr. Reshad Md. Ekram Ali, Former Director General, Geological Survey of Bangladesh (GSB) & Adjunct Faculty, Department of Disaster Science and Climate Resilience, Dhaka University.
85. Dr. Tapan Dey, Deputy Conservator of Forest, Forest Department.
86. Ms. Zahanara Islam, Chairman, Zahanara Green Agro, New Circuit House Road, Cox's Bazar.
87. Mr. Maj Wakar Hasan, Jatio Muktijoddha Council (JAMUKA), Jatio Muktijoddha Council, National Scout Bhabon (11 & 12th Floor), 60, Anjuman Mufidul Islam Road, Kakrail, Dhaka-1000.
88. Mr. Azam J Chowdhury, Chairman, Bangladesh Ocean Going Ship Owners' Association (BOGSOA), Office 11/B, Block CWS(A), Road 30, Gulshan-1, Dhaka.