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MARITIME CAMPUS

A QUARTERLY MAGAZINE OF
BANGABANDHU SHEIKH MUJIBUR RAHMAN
MARITIME UNIVERSITY, BANGLADESH

Flowing Forever ...
Bangabandhu and Riverine Bangladesh

Blue Economy for Bangladesh
Future Potential, Constraints and Ways to Overcome

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Application of GIS and Remote Sensing in Maritime Region

INFOGRAPHICS

The High Seas

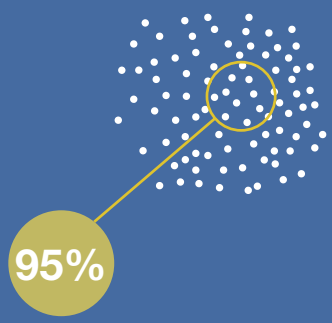
The High Seas is the area of the ocean beyond the jurisdiction of any state.

Just 1.18% of its waters are fully protected

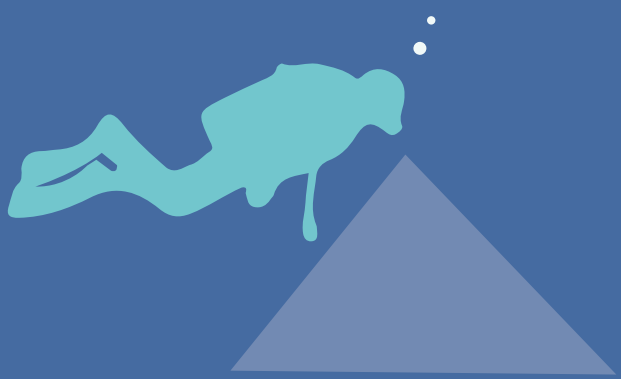
The High Seas covers nearly **2/3 of the ocean** and almost **1/2 the planet**

The **UN** is negotiating a new legally binding treaty **to protect marine biodiversity in the High Seas**

This is a once-in-a-generation opportunity to give these waters **legal, sustainable and enforceable protection.**

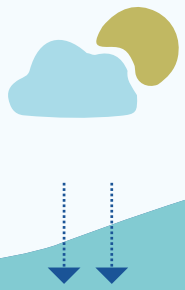


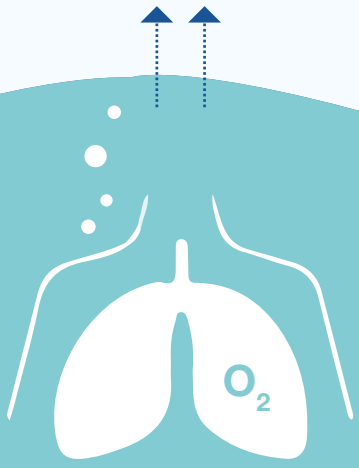
The High Seas contains about **95% of the habitat** occupied by life on Earth in all its forms-from **microscopic plankton** to the gigantic **blue whale**



Less than one millionth of the water column and seabed in the High Seas has **been studied in detail**

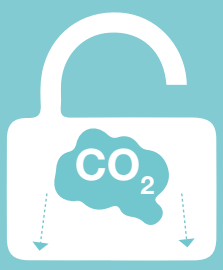
Some of the essential services provided by the High Seas:





The ocean provides around **1/2 of our oxygen**

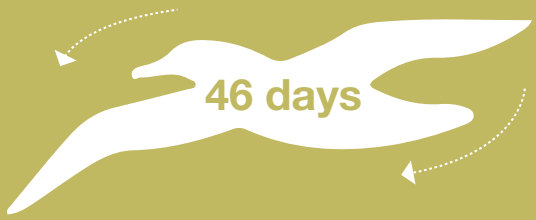
90% of the world's trade is carried by sea, with **huge ships** crisscrossing the High Seas



The High Seas ecosystems capture and store an estimated **1.5 billion tons of CO_2 every year**

Nearly **10 million tonnes of fish** are caught in the High Seas each year

Much of the marine life in the High Seas is highly migratory



The **wandering albatross** can circumnavigate the globe **in 46 days**

Each year **humpback whales** travel up to **5000 km** from their Polar feeding grounds to breed in warmer regions

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Editorial

The Bay of Bengal holds the future of the Blue Economy, yet there are obstacles to overcome

The peaceful resolution of maritime disputes with India and Myanmar opened a great opportunity for the country to explore and extract the vast resources in the coastal and marine waters of Bangladesh. Sustainable management of these resources can give the country the optimal benefits towards economic development. Since we are still in infancy in exploring and exploiting maritime resources in the Bay of Bengal, our 'Lead Story' recommends to establish appropriately structured institutions with a strong political will, which in return can enhance the management of maritime resources. Besides proposing measures to overcome them, the 'Lead Story' also examined the constraints on the Blue Economy to thrive in Bangladesh.

Bangabandhu opened his Unfinished Memoirs with an existential description of his birthplace in reference to a river, the Madhumati. His ancestors earned their living by trading with Kolkata using river routes. The rivers of Bengal, it seems, were like a family tapestry that encapsulated successes and tragedies of the family tree of Bangabandhu Sheikh Mujibur Rahman. To commemorate the great leader's birth centenary, an article about Bangabandhu's link with rivers of Bangladesh featured in the magazine's "Focus" section.

Governments all across the world have recognised the need of investing in ecosystem protection. To keep up with the rest of the world, efforts must be made to examine government, donor, and other influential players' policies on ecosystem services. In this regard, the article in our 'Academia' section proposes to follow the EU model in formulating policies for ecosystem services.

Additionally, the 'Campus Canvas', 'Maritime Bangladesh' and 'Around the World' sections will inform you about all the important maritime events and developments happened during the second quarter of 2021.

Finally, I'd like to thank the Chief Patron of our magazine, the Hon'ble Vice-Chancellor, for his essential support in bringing this issue of Maritime Campus to light. I'd also like to express my gratitude to all of the departments for their support in giving information about their activities.

Finally, I want to express my appreciation to the members of the Editorial Board for their unwavering commitment to publishing this magazine as soon as possible, despite the current COVID-19 pandemic.

Thanking you

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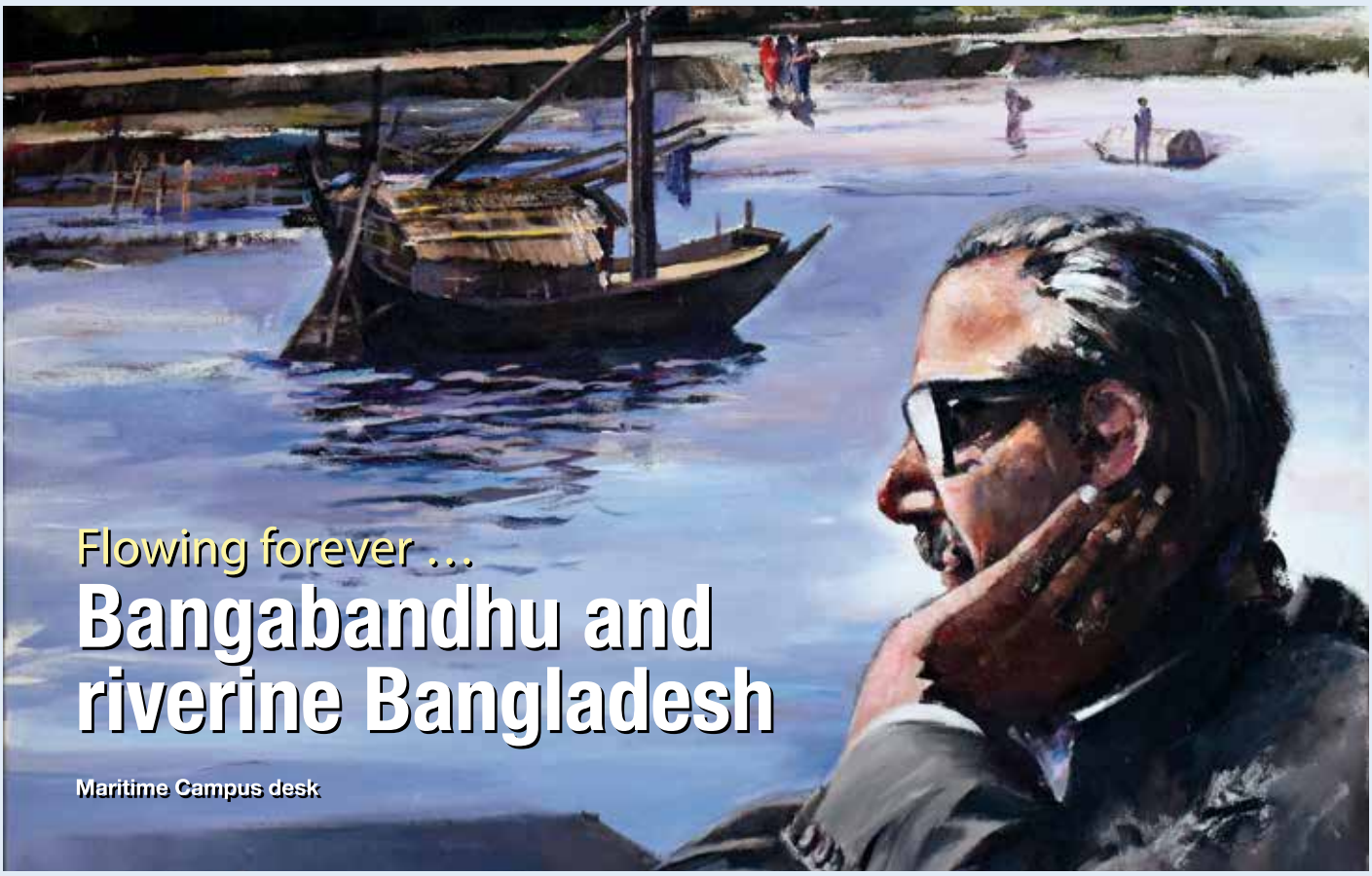

Flowing forever …

Bangabandhu and riverine Bangladesh

Maritime Campus desk

It's interesting that Bangabandhu opened his Unfinished Memoirs (published in 2012) with an existential description of his birthplace in reference to a river, the Madhumati, which divides and connects the two southern districts of Faridpur and Khulna in Bangladesh. Nobody in his clan knew how or why the clan's founding patriarch, a religious man named Sheikh Burhanuddin, came to dwell on the Madhumati's bank many years ago, during Mughal times. Some of Bangabandhu's forefathers were merchants having trades through rivers. Sheikh Kudrotullah's boats used to carry merchandise from Faridpur to Kolkata through meandering rivers during the time of the East India Company, when indigo cultivation became a key conduit of extractive colonial economy in the Bengal delta. They frequently encountered an extortionist Englishman and his native collaborators. These clashes resulted in violence and, eventually, a famous court battle in which Kudrotullah triumphed. Because the event became part of local legend, the colonial court ordered the disrespectful Englishman to pay a symbolic fine, which was minor but historically significant.

The rivers of Bengal, it seems, were like a family tapestry that encapsulated the Sheikh clan's successes and tragedies. In fact, not only rivers, but the stories of Bengal's land were intricately linked to the Sheikhs' life. During British colonial times, the Sheikhs lost their riches over several generations as a result of a series of dramatic court cases involving property disputes with neighbours. The Sheikhs' history was a narrative of Bengal's pastoral land and the rivers that serve as its hydrological, social, and commercial membranes, much like those of other clans.

In many ways, Bangabandhu's early political life was a Homeric voyage across the Bengal delta, which was crisscrossed by rivers and canals. The majority of these excursions were made by boat, steamboat, or train. Before and after the Partition, he travelled from Gopalganj to Kolkata, Dhaka to Barishal, Khulna to Faridpur, Narayanganj to Tangail, and other places across Bengal, advocating for a homeland for the subcontinent's Muslims and, afterwards, for the rights of Bengalis oppressed by an oppressive Muslim League regime in East Pakistan. These political voyages provided him with a deep understanding of the Bengal delta's hydro-anthropological pulse, or genius loci, a Latin phrase for a place's spirit.

There was no launch terminal in Gopalganj at the time. On occasions, Bangabandhu had to travel there by train, arriving at the modest Haridashpur railway station, just a few kilometres from his family's house in Tungipara. A boat on the Madhumati River would frequently cover this final length on the way home. During his boat journeys, he would not only internalise the spirit of riverine Bengal, but also strike up a dialogue with the boatman, learning about the challenges of ordinary life in rural Bengal, according to some of his recollections.

"The people of this riverine country would never find it difficult to fall asleep on a boat," Bangabandhu once said of his trip on the Madhumati River. This simple but deep phrase summarises his sense of Bengali people's organic, harmonic merging with the riverine nature, an existential philosophy that would gradually but surely establish the framework for his political philosophy of fairness, coexistence, and sacrifice.

If Richard Eaton's description of East Bengal's mass embrace of the Islamic faith as part of an agro-religious phenomenon—"a religion of the plough," inspired by the holy men who settled in this region and carried on agricultural activities with the help of native labour—is convincing, Bangabandhu's interpretation of Bengali culture as a result of the deltaic geography of Bengal is plausible. As president of the Awami League, Bangabandhu chose the boat as his party's electoral emblem in October 1970, just before the election of the Pakistan National Assembly. Nothing, in his opinion, could more accurately express the soul of the Bengal delta than the boat.

Archer K. Blood, the author of The Cruel Birth of Bangladesh (2002) and American Consul General in Dhaka in 1971 (much chastised by the Nixon administration for his pro-Bangladesh views during and after the Liberation War), admired Bangabandhu's ability to speak of "my people, my land, my forests, my rivers" like a messianic figure. When he saw "Bengal's face"... "incomparably beautiful and tragic," he wished to return, not as a shankhachil, but as a political rescuer to assist the downtrodden people of East Pakistan. Bangabandhu was described by Archer Blood as follows: "Mujib's appearance screamed raw power, a power derived from the masses as well as his own imposing personality. With ruggedly attractive features and passionate eyes, he was taller and broader than other Bengalis." Bangabandhu learned to perceive things in life, as well as Bengal's pastoral beauty, with a mournful glance, and in the process developed an inherent talent to listen, after suffering from severe eye troubles early in his youth and being bespectacled since the age of sixteen. His damaged eyes heightened his capacity to hear Bengal's rivers, wind, verdant terrain, and, most importantly, its people. He could also listen intently to the misery of political prisoners who were imprisoned alongside him for hours on end.

He was inspired by his mentor Huseyn Shaheed Suhrawardy's effort to visit numerous ground zeros of atrocities before and after Partition, when Hindus and Muslims were engaged in communal violence across the subcontinent, and toured many regions of East Bengal himself to spread the message of religious harmony. In many respects, Bangabandhu's excursions around Bengal took on a greater significance for him, prompting his lifelong empathy for the oppressed. Experiencing Bengal's land and water, for him, meant gaining unique insights into people's daily difficulties and suffering within Pakistan's asymmetric economies. Bengalis and delta dwellers, he believed, had a common ethos of struggle and survival.

When the authoritarian Muslim League government in East Pakistan endeavoured to quiet Bengali dissent and crush popular discontent after Partition, Bangabandhu organised mass resistance on behalf of the East Pakistan Muslim Student League. During the campaign, he chastised his communist colleagues for their heavy-handed philosophy, saying, "People walk on the ground, and you guys fly in jets above their heads with your heady theories." Of course, it was a symbolically veiled condemnation of gods performing politics from the sky, posing as Karl Marx. Bangabandhu meant that being among the people, on their boats and in their rice fields, the sources of their livelihood, was a way of gaining their sympathy and touching their hearts.

This was the epitome of his sacrifice ethic. True self-sacrifice is never awarded from on high. It can happen inside, on the lake, in a boat, on the ground, or on the grass. Empathy blossomed within him, from below, where rivers, canals, lands, and villagers' survival stories intertwined. Bangabandhu believed that true compassion could never blossom in the sky or by looking down on the poor from the throne of gods. For compassion, it was necessary to become muddy and wet.

Yet, as he voiced the terrible fatalism of the Bengal delta's people, Bangabandhu was not afraid to criticise what he witnessed from the land, from the river, and from where people truly lived. He wondered in his autobiography how a land so fertile, so resourceful, could simultaneously be home to perpetually poor masses, who unintentionally let others exploit them, who could never take charge of their own fate due to self-defeating infighting, jealousy, and betrayal. This may have been a frightening, haunting remark on the August 1975 catastrophes.

To comprehend Bangabandhu's activist worldview and political evolution, one must first comprehend how he saw the Bengal delta's land-water topography and its impact on the formation of a diverse and struggling people. It's no coincidence that he is remembered as "rivers" through a poem of Annada Shankar Ray: Jotodin robe Padma, Jamuna, Gouri, Meghna bohoman, totokal robe kirti tomar Bangabandhu Sheikh Mujibur Rahman (as long as the rivers Padma, Jamuna, Gouri, Meghna continue to flow, the legend of Bangabandhu Sheikh Mujibur Rahman will not cease to shine).

Blue Economy for Bangladesh:

Future potential, constraints and ways to overcome

Maritime Campus desk

Introduction

The Blue Economy is a concept that has opened numerous windows of opportunity of economic development to lead a developing country towards a developed status. This concept has opened the doors for improving human welfare, creating employment opportunities, alleviating poverty, ensuring national food security, protecting environmental balance and finding solutions for adverse impacts of climate change. Bangladesh, being part of the Indian Ocean Rim countries, is at the earliest stage of development of the Blue Economy. The concept of the Blue Economy is being assessed from a new angle after the peaceful resolution of maritime boundary disputes with Myanmar and India with the establishment of sovereignty over 118,813 square kilometres of maritime territory, 200 nautical miles of Exclusive Economic Zone (EEZ), and 354 nm continental shelves. In 2014, during an international workshop on the Blue Economy, it was highlighted to Bangladesh that it should move forward with a 'Bay of Bengal partnership for Blue Economy' for securing sustainable development amongst the coastal and littoral states with an inclusive Blue Economy. The workshop underscored six broad categories as the integral parts of the Blue Economy of Bangladesh, which are: a) food and livelihood, energy, tourism, maritime trade and shipping; b) coastal protection; c) artificial islands; d) greening coastal belts; e) human resource; f) maritime surveillance and spatial planning.

Marine Food Production

The total marine water area of Bangladesh is 284,813 square kilometres, with a coastal belt of 710 kilometres in length and 118,813 square kilometres of the Exclusive Economic Zone (EEZ), which extends from the baseline to 200 nautical miles seaward. In 2016, about 626,528 metric tons of fish were found in this vast body of water, which was16.15% of the total fish production of Bangladesh that year. According to several surveys, 149 fish species, 13 shrimp species and 14 different species of other crustaceans and molluscs are found in the marine waters of Bangladesh.

Much of Bangladesh's export revenue comes from marine fisheries, which amounted to the USD505.80 million or 3.65% of its GDP in 2017. Bangladesh exports ten categories of fishery products to over 55 countries. Currently, around 5.16 lac fishermen are engaged in marine and coastal areas and 8.33 lac sea fish farmers are engaged in shrimp farming in Bangladesh.

The dependency of future food security and export earnings of

Bangladesh will significantly shift over coastal and marine resources. Due to the limitations of natural water systems, it is unlikely that the future needs of the country will be met without major changes. In order to sustainably increase the volume of existing marine food production, issues such as distance fishing, modern fisheries technology, mariculture, innovative farming, product diversification and value creation, fish stock assessment, ecosystem-based fisheries management, live feed culture and production, disease and health management, and marine biotechnology can be taken into account.

Bangladesh needs significant improvements in distance fishing and fishing technology, as the majority of fishing boats and vessels in Bangladesh fish to depths of up to 40 metres in coastal areas, limiting the scope for distance fishing for them. Moreover, the lack of fishing gears and larger tonnage boats also hinder deep sea fishing. The addition of deep-sea fishing gears like longline and hook fishing and the use of modern gear and vessels to harvest high quality species such as tuna and other large pelagic fish can open the door to more foreign currencies and increased domestic protein consumption.

Existing aquaculture systems in Bangladesh, such as shrimp farming, mostly follow traditional and extensive methods which follow a low stocking density and minimal inputs that produce low yields. It is necessary to introduce modern farming techniques like semi-intensive techniques to boost up the existing level of production. The introduction of brackish and marine aquaculture also offers many prospects for Bangladesh. Breeding and farming of sea bass, mullets, sea bream, hilsa shad, grouper, oyster, mussel, lobster, etc. can be initiated as high-valued aquaculture species, as they have a massive demand. Mass cultivation of various types of seaweeds can also be positioned as an important source of seafood.

Innovative farming techniques, such as off-shore cage farming can be introduced with simple methods and minimal costs to breed valuable species such as sea bass, mullet, Hilsa, sea bream, etc. Aquasilviculture or 'integrated mangrove-aquaculture' for farming shrimp and crabs was found in mangrove regions in favourable locations without harming the environment. 'Integrated multi-tropic aquaculture' can be implemented as another system where wastes from target species like fish can be used as nutritional materials for other species, such as organic matters for oysters/mussels and inorganic nutrients for seaweeds. Such innovative farming systems can be introduced to further strengthen marine food production through environmental sustainability, economic diversification and social acceptance in some selected areas of Bangladesh, which are suitable.

Traditionally different types of marine fish and only some specific varieties of crustaceans like shrimp, crab and lobsters are consumed as protein intakes in Bangladesh, and species like sole, ray, mollusks, aquatic reptiles and mammals, seaweeds, echinoderms, etc. do not have domestic consumption and are not considered for exports. These unexplored varieties provide ample opportunity to grow the fishery basket of exports of Bangladesh and for domestic consumption in the form of fish cutlets/fingers/cakes/balls/sticks, producing fish oils/sauces, shrimp skewer, squid rings, etc. as well. Wastes generated from fish processing can be used to produce fish meal, silage and compost, and some value-added products such as oil, amino acids, minerals, chemicals and enzymes like bioactive peptides, collagen and gelatin.

The fisheries resources of the Bay of Bengal have to be surveyed regularly for assessing the stock, which can be utilised to formulate optimal harvesting strategy, monitor the productivity of exploited fish stocks and devise strategies for sustainable fisheries conservation and management of the existing fish stocks.

Ecosystem-based fisheries management is a systematic approach of fisheries management in a specific geo-location that contributes to the resilience and sustainability of the ecosystem and recognises the physical, biological, economic and social interactions. This approach at the same time balances the needs of fishing communities with sustainability of species and minimises pollution at the specified ecosystem.

Cultivation of live feed is still a bottleneck for Bangladesh, which can be resolved by employing appropriate technology for sustaining the mariculture industry. Developing disease-resistant stocks, improvement of husbandry, application of bio-security and eco-friendly health management techniques like probiotics, immune-stimulants, organic farming, avoiding excess antibiotics can be considered for disease and health management of fish stocks. Marine biotechnology can be applied to improve growth rate, enhance reproduction, controlling of diseases through vaccines, probiotics, SPF and SPR stocks. Bangladesh needs to improve in the application of modern bio-technology for enhancing the existing state of marine food production.

Some constraints need to be addressed immediately to improve the existing stage of marine food production in a sustainable fashion.

Bangladesh needs significant improvements in distance fishing and fishing technology.

There are 74 registered merchant ships and 124 registered shipyards in Bangladesh.

Overexploitation of mollusc species, major commercial species in coastal and marine waters should be met. Absence of rules and regulations on by-catch or trash fish issues are causing a decline in biodiversity. Only limited numbers of commercially important species are cultured due to domesticated brood and larval availability, hatchery and farming facilities, technological supports, thus creating a state of void when it comes to mariculture. Since 1984, the country has not witnessed any comprehensive surveys on available fish stocks in the Bay of Bengal, which has created a knowledge vacuum about standing stock and maximum sustainable yield values amongst the policymakers. Deep-sea fishing is impossible due to the absence of adequate modern craft and gears. There is neither any specific Marine Protected Area (MPA) in the Bay of Bengal for conservation of species, nor any Ecosystems Approach to Fisheries Management (EAFM). The presence of middlemen in the fish chain is posing a hazard to fishing. These middlemen trap fishers to long-term debt bondage due to the limited access to formal credit, and force them to destructive fishing for incurring more profit. The absence of application of marine biotechnology, coordination, rampant marine pollution through pollutant discharges and uncontrolled ship breaking activities, extreme weather conditions attributed to climate changes and widespread poverty are all playing their roles as constraints against the growth of the marine fisheries sector.

The institutions associated with fisheries and coastal resources management can play a significant role in ensuring the conservation of present resources for the future. Appropriately structured institutions with a strong political will can enhance the management of resources like fisheries. Interaction and cooperation amongst the governments, agencies and resource users as well as community involvement in resource management should be increased due to the benefits arising from sharing responsibilities and ownership. Formal institutions provide the platform for cooperation between resource users and the authorities, local communities and other stakeholders for managing the maritime resources.

Institutional changes are required in Bangladesh for realising its plans for fisheries recovery and marine ecosystem. In this light, the relevant authorities can introduce regional institutional management councils, where all important stakeholder groups will be well represented and the best available tool is used in the decision-making process for marine fisheries management. Within such a framework, fishing limits will not exceed scientifically affixed sustainable levels, and the fishermen will need to comply with these limits. The stakeholder groups will include government, independent researchers and scientists, industry and civil society.

Incentives can be introduced to improve fishing income without raising effort in fishing and aggregate fish catch through the allocation of individual fishing quotas such funding programmes for removing excess, fishing capacity and promotion of alternative employment opportunities. Workforce training would not only enhance the success of this initiative but would also remove most of the existing subsidies to the fishing industry.

The expansion, effective implementation and enforcement of MPAs throughout the EEZs, the implementation of uniform management and enforcement mechanisms across all water bodies in Bangladesh, promotion of educational opportunities for scientists and fisheries managers to learn from the experiences of other nations in maritime resource management and the establishment of a public process for data sharing and transparency on fisheries practices, catch, stock status, and ecological impacts can bring in a true paradigm shift in fisheries management in the Bay of Bengal.

Shipbuilding

Maritime shipping is the most secure, cost-effective and environmentally sound mode of international trade. 90% of the external freight trade of Bangladesh is done through the seas. There are 74 registered merchant ships and 124 registered shipyards in Bangladesh. Bangladesh also has an emerging shipbuilding industry, where the majority of the shipyards can design and build ships up to 3,500 deadweight tonnage, and eleven of them are capable of building ships up to 10,000 DWT. Bangladesh has started to compete with China and India with lower labour and overhead cost, where about fifty thousand skilled and one hundred thousand semi-skilled workers are now employed in the shipbuilding industries.

Bangladeshi shipbuilding companies are working within significant financial constraints with a lack of capital and limited investments. Financial institutions and entrepreneurs see huge risks in investing in this industry. It has to pay higher interest (12-16%) than the garments sector (7%). The industry requires 16% of its export earnings as a bank guarantee, whereas other sectors require around 1-2%. It is 0% in competing countries like the Republic of Korea, China, India and Japan. Bangladeshi banks require international and local banks as guarantors for this business, and they also charge higher fees for creating Letter of Credit (LC) accounts, which are substantially lower in other shipbuilding countries. These constraints raise the cost of building ships in Bangladesh tthan the cost in other countries. Safety and environmental aspects including management culture are poorly regulated. An insufficient number of ancillary industries, lack of Research and Development (R&D), skilled manpower, model testing facilities, and inadequate supply of utility supplies like electricity and gas makes it unfavourable for Bangladeshi shipbuilders to create scope of price competitiveness in the international market.

In order to sustain in the shipbuilding markets, the industry requires government patronage through the means of subsidy, and it also requires help to set up an adequate number of ancillary industries. At the same time, it requires a fresh set of policies with employee rights, safety and health, and sustaining environment following IMO regulations. The shipbuilding facilities situated around Narayanganj, Dhaka should be shifted towards coastal areas. The country also needs to replace the thirty-year-old sea-going vessels that incur higher maintenance costs with newer ones.

Tourism

Bangladesh has immense potentials to garner benefits from the tourism sector, which creates jobs, drives exports, and generates prosperity across the world. The contribution of tourism to the GDP of Bangladesh was 4.3% or USD10,567.4 million in 2017, created over 2.8% of total employment in the country. The main tourist destinations of Bangladesh are the sites which are included in the UNESCO Heritage List, historical and archaeological sites, natural sites like hilly regions and the sea beach, and the mangrove forest of Sundarbans. Bangladesh reformed its tourism policy in 2010 to boost tourism by meeting the demands of the private sector and tourism professionals and to develop Eco-tourism through conservation of natural resources and promote the well-being of the community and preservation of cultural values of the local community.

Despite the initiatives, the tourism sector of Bangladesh is plagued with unplanned development of the industry, inadequate knowledge and professionalism, lower level of co-operation and innovation. The need for government support has resulted in poor infrastructures such as the shabby condition of transport and utility services. The airline sector is plagued with mismanagement, with a lack of branding and professionalism, which are essential to draw tourists. Sometimes security concerns, absence of necessary tourist information also hinder growth in the tourism sector.

It is essential to take initiatives to develop infrastructural facilities, facilitate easy access to the different destinations with standard accommodation, growing corporate culture to develop professionalism, liberalise air transportation and visa processing, reduce bureaucratic tangles, develop a sense of security, creating social awareness and responsiveness and create an attractive brand image of Bangladeshi tourism for the growth of tourism sector in Bangladesh, which will create new jobs and contribute to the overall development of the country.

New technology

Bangladesh has to embrace new technology, in the form of biotechnology, to extract the full benefits of the Blue Economy in a sustainable manner. Marine biotechnology is the creation of products and processes from marine organisms through the application of bioinformatics, molecular cell biology and genetic engineering. Marine biotechnology is one of the latest biotechnology approaches, which has been developed rapidly since the 1980s. The scope for the application of marine biotechnology in Bangladesh is highly promising but very few initiatives have been taken so far.

There remains the risk of unintended extraction of marine species associated with blue biotechnologies. This field has not been properly defined and not regulated adequately. The major obstacles that remain ahead of the implementation of marine biotechnology are lack of funding, absent infrastructures, absent workforce (quantity/quality), deficiency of information, policy landscape, political vision, indigenous skilled capacity, scientific research capacity, scientific research strategy, and so on.

Locally generated or internationally sourced funds could be allocated to specific projects through specific funding for Blue Economy activities. A coordinated research and development strategy is needed to address specific sector requirements towards the broader implementation of the Blue Economy. Capacity building, effective international collaboration, and expertise transfer from foreign academic organisations and technology providers are essential to create the ground for the sustainable implementation of biotechnology, in a wide range of sectors, such as aquaculture, seaweeds, pharmaceuticals, chemical industries, pollution control, biofuel, and the job market.

Modern biotechnological tools for rearing and enhancing the production of aquatic species can meet the global demands of seafood, and enhance aquaculture farming at the same time. Several fishes do not spawn spontaneously when placed under captive conditions. In the past, fish gonadotropin, a combination of multiple hormones that stimulate reproduction, was produced in small amounts by extraction and purification from crude preparations of thousands of pituitary glands. At present, large quantities of highly purified gonadotropin can be produced in the laboratory by using recombinant DNA technology. The gender of fishes can be regulated using genetic engineering till they reach maturity.

The beach in Cox's Bazar is the main attraction of the town with an unbroken length of 150 km (93 mi) also termed the "longest natural unbroken sea beach" in the world.

With the evolving climate change, Bangladesh has been frequently facing extreme climatic events, such as erratic rainfall, flooding, drought, sea-level rise, cyclones, and salinity intrusion.

The conventional fish breeding technique is based on selecting the fish for breeding so as it achieves the desirable traits. However, this process is time-consuming and unpredictable. New molecular tools have been developed to genetically modify the fishes to achieve the particular traits in the shortest possible time. In this way, through the use of recombinant DNA faster-growing and/or disease-resistant varieties of fish or molluscs can be bred. Transgenic research on commercially important fish species is mainly focused on improving growth rates by transfer of growth hormones, which shortens the production cycle, lower production costs, and reduces pollution in the aquaculture facility.

Plant-based protein sources are a sustainable option over trash fish of wild species for fish meal, as they are very limited. However, most plants have anti-nutritional characteristics which are unfavourable for feed utilisation. These concerns can be addressed through genetic engineering. Traditional disease diagnosis of the fishes involves analysis of cells and tissues of organisms, which is a time-consuming affair. Molecular biology provides valuable information which can enhance the understanding of the diseases and direct us towards a quick prognosis and treatment. Recombinant techniques can be used to prevent ice crystal formation in the blood and protect fish from freezing. Molecular tools can be used to improve the methodologies for defining species, stocks and populations.

Seaweeds are marine algae which are rich sources of food, fodder and a host of industrially important chemical compounds. Globally, seaweed is a billion-dollar industry. They are an important part of marine ecology, where they use photosynthesis and use sunlight to produce food and oxygen from carbon dioxide and water.

Biotechnology researchers have been able to isolate bioactive substances from the marine environment, which have great potential for treating various human diseases as medicines. Some of these substances can also be consumed as food supplements. Marine organisms are also a source of different chemicals that can be used in food processing, have important useful industrial properties. These chemicals have applications in different manufacturing processes, water treatment, waste treatment and agricultural applications. The marine microorganism can play a huge role in checking pollution as well. Immobilised cells of the bacterium Pseudomonas chlororaphis produce a chemical compound that speeds up the breakdown of toxic compounds in seawater. Some marine organisms produce eco-friendly chemicals like biopolymers and bio surfactants which can be used in environmental waste management and treatment. Some organisms like microalgae are also considered biofuels, whose residual biomass after oil extraction can be used as feed or fertiliser or fermented to produce ethanol or methane.

Biodiversity

Bangladesh is ranked 3rd largest in aquatic biodiversity in Asia behind China and India, with approximately 300 species of fresh and brackish water fish species. Marine biodiversity plays a key role through ecosystem services. The loss of marine biodiversity weakens the ocean ecosystem and its ability to withstand disturbances caused by climate change and fails to play its role as a global ecological regulator. Establishing baselines to study and monitoring climate change impacts on biodiversity, ensuring alternative income for the communities engaged in fishing or fry collection during the breeding seasons of fishes, identification of the impacts of climate change, desertification, floods and other processes on the integrity of ecosystems and species and develop suitable management plans and developing action plans for reducing levels of pollution can help preserve the biodiversity of the Bay of Bengal.

Climate change challenges

Bangladesh has been identified as one of the most severely climate change affected countries in the world, where evidences have surfaced which mark considerable changes in different parameters associated with climate change. Climate change affects the productivity, habitats and biological process of the Bay of Bengal ecosystem. Bangladesh Climate Change Strategy and Action Plan (BCCSAP, 2009) is built on six main pillars which provide the best strategies and plan to tackle climate change, which are: food security, social protection and health, comprehensive disaster management, infrastructure, research and knowledge management, mitigation and low carbon development, capacity building and institutional strengthening.

A number of barriers to climate change adaptation in coastal and marine fisheries sector of Bangladesh exist, like poorly designed boats, inaccurate weather forecasts, weak radio and other signals for communication, lack of awareness. Formal institutions can play a major role in implementing and resourcing various forms of adaptation and/or interventions for adapting to climate change. Coastal afforestation programmes have been implemented by the Ministry of Environment and Forests of Bangladesh to reduce the vulnerability. Implementation of sustainable fishing, fish breeding technologies, awareness building, and smooth flow of climate-related information with the concentrated and coordinated efforts of different organisations can play very important roles to adapt the climate change challenges in the coastal and marine fisheries sector of Bangladesh.

Conclusion

The peaceful resolution of maritime disputes has opened a grand opportunity for the country to explore and extract the vast resources in the coastal and marine waters of Bangladesh. Sustainable management of these resources can give the country the optimal benefits towards economic development. Bangladesh has a very suitable position to extract the full advantage of the Blue Economy based in the Bay of Bengal, but it has to take a sustainable approach. A sustainable approach can make Bangladesh a successful benchmark of the Blue Economy for the developing world, where the Blue Economy will be a means of maritime resources and a path of providing secured life to the most vulnerable coastal people of Bangladesh.

Ecosystem Services

From natural capital to the benefits of society

W H Kutubuddin

Introduction

Ecosystem Services (ESS) are known as the benefits that can be obtained from nature such as food, water, climate regulation, etc. in form of provisioning, regulating, supporting and cultural services. It helps to connect the people to nature. Scholars have pointed out that understanding the connection to nature can improve and make the management of ecosystems sustainable. At the same time, sustainable ecosystem services can give solutions to current problems of humans like climate change. Therefore, governments around the world have recognised the importance of investing in safeguarding ecosystems and Bangladesh has many things to learn from such endeavours.

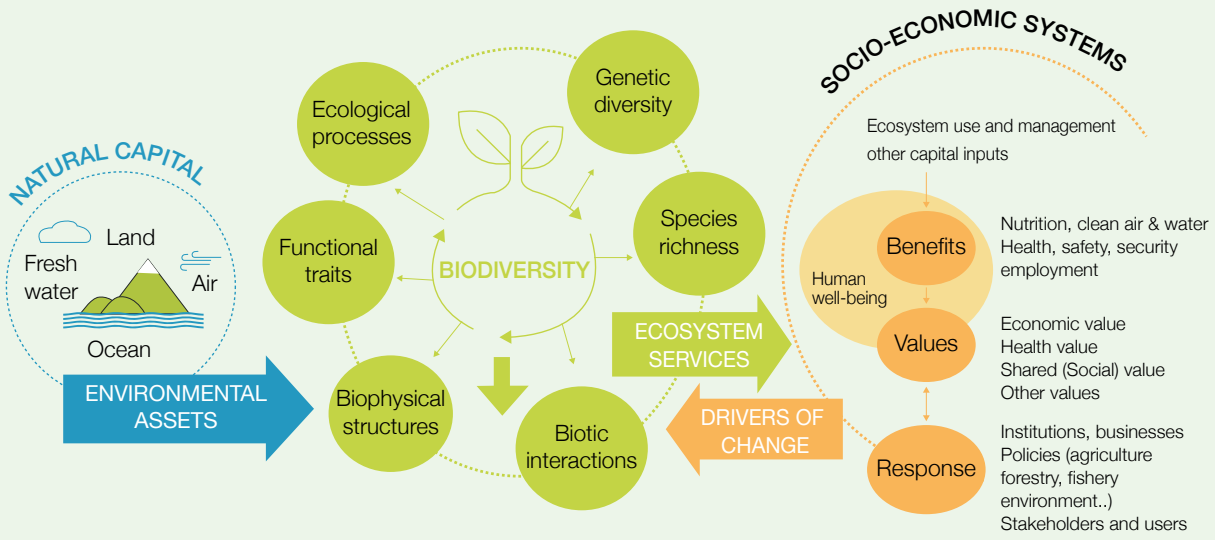

Figure 1: Use of ecosystem and management

The various benefits that we enjoy from nature are basically ecosystem assets in the form of food, water, recreational and cultural benefits, pollination, climate regulation, air quality regulation, and disease control. In a general sense, the living and non-living resources of land, ocean, air and water (in all forms) are the natural capital of our country and can be termed as environmental assets. In this situation, biodiversity that encounters drivers of change fall into two categories: direct and natural, and indirect and social. These drivers create an impact on biotic interactions, biophysical structures, functional traits, ecological processes, genetic diversity, species richness of the natural capital changing ecosystem services that influence the state of human well-being. However, human well-being can be safeguarded through the balanced use of ecosystem and management as depicted in the figure-1. Although the society at large is aware of the importance of coastal and marine ecosystem services. However, these services and service-producing ecosystems are facing increasing pressures and threats from human activities. For example, about 50% of salt marshes, 35% of mangroves, 29% of seagrasses, and 30% of coral reefs of the world have either been degraded or lost globally.

Importance of Natural Capital

Natural capital is the compilation of ecosystem assets that consist of both living and non-living components of nature, such as animals, plants, water and minerals. The essential natural capital needs to be preserved in order to ensure that ecosystem services continue to support human well-being and life on earth.

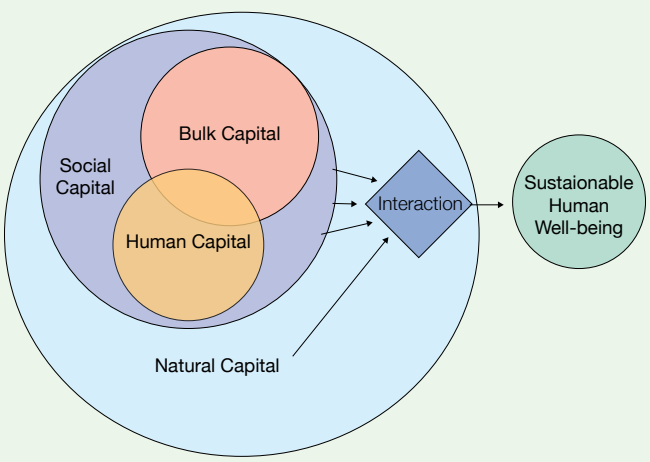

Figure 2: Built, social, human and natural capital Interacting to produce human well-being

Classification and Economics of Ecosystem

According to Costanza and Daly, the natural capital along with built, human, and social capital generates ecosystem services essential for sustaining socioeconomic development and supporting human well-being as shown in the Figure 2. The living and non-living segments of the ecosystem do not survive in isolation, rather they continuously interact with one another being closely linked to each other. In fact, sustainable human wellbeing can be achieved when people in general act sensibly to safeguard the environmental degradation using various man-made infrastructure, machinery, equipment and built-up land including knowledge, skills and experience.

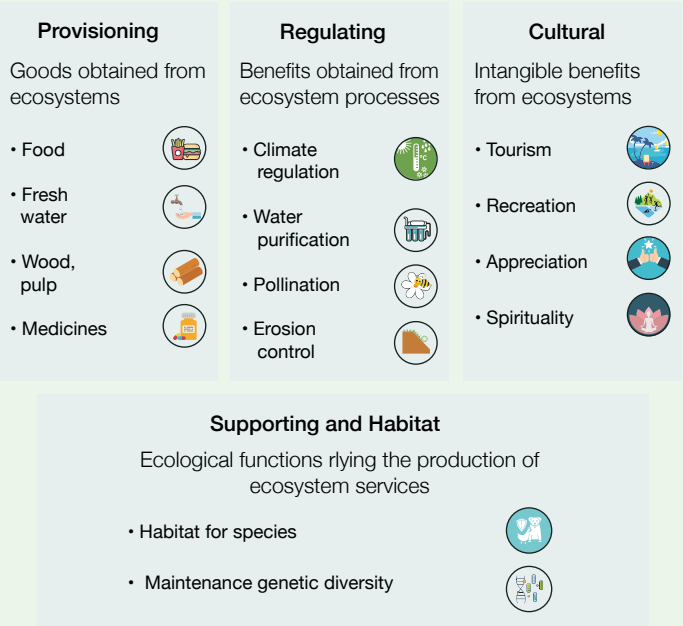

Figure 3: Classification and economics of ecosystem

The ESS can be classified as provisioning, regulating, cultural, supporting and habitat as per the provisioning is basically goods obtained from ecosystems and benefits obtained from the ecosystem process can be categorised as regulating part of ESS. Then again, tourism, recreation, appreciation and spirituality come from the cultural component. Additionally, a habitation for species, maintenance of genetic diversity are the supporting or habitat function of ESS. The leading organisation in wildlife conservation and endangered species 'The World Wildlife Fund' reflects that the total contribution of ecosystem services to human well-being is USD125 trillion per year. This is way more than the global Gross Domestic Product (GDP), which was about USD 84.54 trillion in 2020. However, the Economics of Ecosystems and Biodiversity (TEEB) is a global initiative focused on "making nature's values visible" concluded that the relationship between natural capital and economic development is usually misunderstood in traditional indicators of economic growth, such as GDP. In reality, GDP growth has a tendency to reflect on the reduction of natural capital or its replacement with other forms of capital.

Valuation of ESS

Until recently, nature's services have been taken as free public goods. Whereas the value of ecosystem services has not been considered in the economic and financial decisions of the governments. Now, there is growing recognition of the economic value of the natural-capital assets in both public and private sectors. At the same time, ecosystem service assessment and valuation (ESAV) is receiving prominence across the world as a useful tool with which to generate the data, evidence and arguments to ensure the 'best' uses of land, resources and funds for development and investment options. When values of biodiversity and ecosystem services are taken into consideration, it has helped in improving decision-making for effective, inclusive and sustainable socio-economic growth. In this regard, the World Bank has pioneered a new approach to assess countries' capital wealth calculating all sorts of assets involving economic development and measure indicators of the sustainability of growth. A study carried out in Albania, Bosnia & Herzegovina, Macedonia,

Montenegro and Serbia revealed that natural capital contributes up to a quarter of their total wealth as shown below:

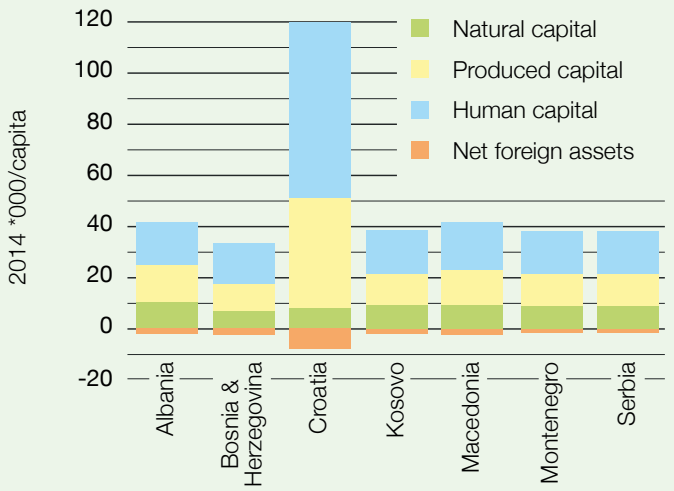

Figure 4: Contribution of various Natural Capitals

It is safe to say that better management of biodiversity, ecosystems and natural resources will be key for sustainable development. We would be in an illusion if we continue converting, depleting or degrading the environment to get economic development and it would be short-lived. In this regard, European Union (EU) has undertaken Mapping and Assessment on Ecosystems and their Services (MAES) as part of Action 5 of their Biodiversity Strategy, which can be followed by a country like Bangladesh. This has helped to map and assess the state of ecosystems and including the economic value of such services for the integration of these values into countries' wealth accounting. This assessment is giving inputs in preparing the development and implementation of related policies, on water, climate, agriculture, forest, and regional planning as shown below.

Figure 5: Illustration of MAES inputs into other policies

The Bangladesh Case

Bangladesh is defined as one of the most vulnerable countries to climate change impacts. At the same time, most rural households in Bangladesh depend on access to land, water, and forests for farming, fishing, bioenergy production, and the collection of non-timber forest products as shown below:

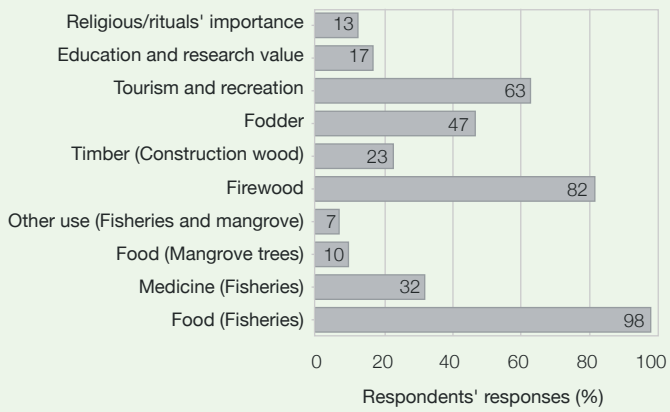

Figure-6 Coastal and Mangrove Ecosystems Services of Bangladesh (Source: J. Mar. Sci. Eng. 2020, 8, 815; doi:10.3390/jmse8100815)

For Bangladesh, increasing population, urbanisation and development pressures are putting an extreme burden on its limited stock of natural capitals and fragile ecosystems leading to unsustainable use of the ecosystem and its resources. It is a dilemma for Bangladesh as on one hand she must adapt to climatic disasters, continue economic development while maintaining and enhancing ecological sustainability using its limited financial, technological and environmental resources.

As ecosystem and ecosystem services are fundamental for sustaining and building resilience to climate change impacts. Hence, ESS based adaptation approaches have been accepted by international and national policymakers to provide reliable adaptation measures for climate change and sustainable development. UNEP's research shows that deforestation and land and habitat encroachment and urbanisation greatly multiply chances of infection like the coronavirus.

Though, the Bangladesh government has emphasised the development and sustainable use of marine and coastal resources for achieving blue growth and the UN SDG 14 (Life Below Water), previous research works suggest that faulty policies are the major cause of deforestation in Bangladesh and coastal small-scale fishing communities are already facing pressures from coastal development interventions under blue growth initiatives.

Thus, efforts need to be made to research policies made by governments, donor agencies, and other influential actors concerning ESS. Hopefully, it would minimise mismanagement of provision and exploitations of natural capital, which have direct links to human well-being. In the aftermath of the coronavirus crisis, the government may design packages that can boost the economy and at the same time carry out an assessment of ESS following the EU model that would help to formulate policies to reduce carbon emissions, conserve biodiversity, and protect the ecosystem services that support the country's affluence and absorb the shock generated by the COVID-19 pandemic.

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Dubai Police, Arab Academy sign MoU for maritime education and training

The Dubai Police General Command has recently signed a Memorandum of Understanding (MoU) with the Arab Academy for Science, Technology and Maritime Transport (AASTMT), to strengthen cooperation in the fields of education, training and qualifying human cadres, as well as exchanging studies related to maritime security and sharing best practices between the two bodies.

Professor Dr Ismail Abdel Ghafar Ismail Farag, President of AASTMT, said: "Our partnership with the Dubai Police represents an important stage in our journey in the academy to support and enhance maritime vocational training and qualification in safety and security institutions."

The agreement includes cooperation between both parties in maritime education and training, and training courses for maritime security, in addition to benefiting from the academy's capabilities in artificial intelligence and Internet of Things technologies. The agreement also paves the way for setting up an awareness media programme within the UAE to promote joint activities between both entities, attract more candidates for marine studies, coordinate public participation in events, and hold conferences and workshops in the field of maritime security.

Norwegians are developing cloud-based maritime training

Kongsberg Digital (KDI) and the University of South-Eastern Norway (USN) are partnering to develop cloud-based simulation exercises for the international maritime education market.

As a developer of cloud-based simulation software, KDI is aiming to drive the evolution of cloud simulation technology as a sustainable and immersive supplementary tool for building competencies within the maritime industry, the company said, adding its partnership agreement with USN will seek to scale up the scope of maritime training. The commercial agreement will enable USN to develop its cloud-based training products and distribute them globally via KDI's digital platform K-Sim Connect.

The aims of the partnership complement both the cloud-based maritime simulation initiative supported by Innovation Norway – which has the aim of addressing the global need for easily accessible, high quality, simulation-based training solutions for teaching and practicing navigation – and the COAST (Center of Excellence in Maritime Simulator Training and Assessment) project, for which USN is the host institution.

Cloud simulator solutions will also be adapted for post-qualification training and will contribute to simplifying the process of regular certificate renewals, increasing opportunities and flexibility within the sphere of maritime education.

Batumi State Maritime Academy and the University of Gibraltar have signed an agreement to establish educational links

A new USD 8 million marine education and research center in Stamford is one step closer to reality, after a multi-million-dollar gift from a local charitable foundation. The Steven & Alexandra Cohen Foundation recently awarded USD 3 million to Stamford-based SoundWaters, to build a new 12,000-square-foot harbour centre at Boccuzzi Park. Construction on the project, which also includes beach restoration and public access to the water, is under way and slated to be completed in mid-2022.

The Cohen SoundWaters Harbour Centre will be the home base for three programmes: Young Mariners, which teaches young students sailing; Harbour Corps, which offers maritime job skills training for young adults; and Research Intensive, a college-level marine research programme for high school students. The centre will also include launch access for SoundWaters' fleet of sailboats, and publicly available kayaks and paddleboards.

The future of ship systems to be smarter with ship bridge simulators

The maritime industry is not new to the simulation technique and has, in reality, been using this technique in automation as well as numerous other applications. The rising implementation of advanced technologies & automation in the maritime sector has surged the need for ship bridge simulators. The Asia-pacific region has rising passenger traffic and massive import & export businesses; as a result, the region is likely to be in major need of marine systems equipped with ship bridge simulators.

For years, simulators are extensively used in training and certification mainly in the Maritime Education and Training (MET). They are used in numerous areas of the marine sector including cargo handling, crane operations, system control, offshore operation training on ships, bridge operations, and towing & anchor handling. Such a wide range of applications of simulators has propelled their demand in recent years. A report by Research Dive reveals that the global ship bridge simulator market growth is expected to skyrocket and the market is anticipated to garner significant revenue in the upcoming years.

The COVID-19 pandemic has struck the maritime industry with various unprecedented challenges that hampered its supply chain and compelled quicker implementation of digital technologies in numerous areas of maritime operations, including the area of MET. As the virus was capable to multiply at a rapid pace with person-to-person interaction, several processes that need the physical presence of working personnel have been either postponed or limited for averting human mobility, as a protection measures against the COVID-19 virus. The termination of physical training programmes, lockdown, and travel restrictions have triggered several difficulties for seafarers to obtain or uphold their certificates of proficiency. As the MET industry is also experiencing various challenges in ensuring the endurance of the MET activities, and in coping and adapting to the restrictions imposed during the COVID-19 pandemic, the ship bridge simulator market growth is expected to decline to a certain extent until the pandemic relaxes.

UK's Maritime Skills Commission releases Seafarer Cadet Review Report

Government must overhaul funding for seafarer training and courses must be modernised for UK talent to remain competitive in the global shipping sector, according to a new report by the Maritime Skills Commission (MSC), UK.

The report recommends that seafarer officer training should be fully funded by government and cadets given access to modern technology, such as simulators and blended learning tools, for the UK to maintain its leadership in maritime expertise and attract global investment.

The MSC also recommends that the industry should encourage more applicants to have university degree or equivalent levels of education, and ensure 'Standards of Training, Certification, and Watchkeeping' (STCW) qualifications are the minimum standard for all recruits.

Set up by Maritime UK and the Department for Transport in 2020, the MSC aims to ensure the UK's maritime industry has the talent to serve the sector and compete with the rest of the world.

Maritime cyber research wins 2021 Lloyd's Science of Risk prize

An academic from the University of Plymouthhas won a prestigious international accolade for its research underpinning a suite of software tools designed to enhance maritime cyber security.

Dr Kimberly Tam, Lecturer in Cyber Security, won the overall prize – and the dedicated cyber category – in the 2021 Lloyd's Science of Risk prize.

The prize is awarded to academics and PhD students who, through their scientific work, further the understanding of risk and insurance.

Dr Tam's award was in recognition of her work on the Maritime Cyber Risk Assessment (MaCRA) framework, which she developed in conjunction with the University's Maritime Cyber Threats Research Group.

The principles behind the MaCRA framework were first set out in a study published in the WMU Journal of Maritime Affairs in 2019, and co-authored by Dr Tam and Executive Dean of Science and Engineering, Professor Kevin Jones.

The paper proposed a dynamic risk assessment model that uniquely takes into account both information technology and operational technology, both of which are prevalent in sectors like transportation and critical national infrastructure.

The University was then awarded a grant from the Maritime Research and Innovation UK (MarRI-UK) initiative to develop it as an industry-ready solution that ensures crucial cargo keeps reaching the UK's shores.

It is the second award the software has won in just over a week after it triumphed in a Cyber Den competition run as part of the UK government's flagship cyber security event, CYBERUK.

The first phase of a virtual reality maritime training initiative has begun

Greece-based e-learning specialist SQLearn is developing the Brave Dolphin project, aiming to create the ultimate VR training tool for maritime.

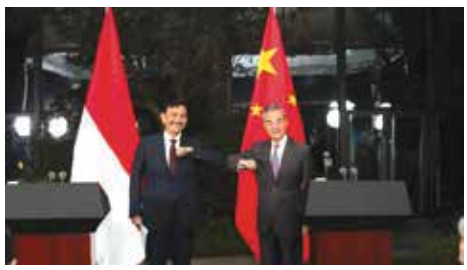
SQLearn is particularly active within the shipping industry as a provider of e-learning solutions and services. The company has placed a special emphasis on the shipping industry, recognising the importance of appropriate staff training as a means to reduce risks in a sector known to be exposed to multiple hazards. Aiming to expand its training services, SQLearn is implementing a Virtual Reality Application as a training tool for crew members, regarding emergencies that may occur on board.

Maritime safety risk cases are difficult to be simulated in a real environment. The Brave Dolphin VR application will include interactive scenarios and provide the chance to dive into a simulated world in which the user will be encouraged to interact with and perform the necessary actions, offering an exciting and safe learning experience.

The Brave Dolphin VR training solution will mainly include simulations of real-case scenarios of crucial incidents. The scenarios selected to be simulated in a VR environment were identified by expert maritime consultants, who have conducted a Risk Analysis on crucial incidents that occur on board.

The Brave Dolphin project is supported by a grant from Iceland, Liechtenstein and Norway through the EEA Financial Mechanism 2014-2021, in the frame of the Programme “Business Innovation Greece”.

China and Indonesia have pledged to expand their marine cooperation



China and Indonesia vowed to upgrade their cooperation into the maritime sector and also for political security, economy, cultural and people-to-people exchanges.

The consensus, along with agreement in the other four sectors, was reached during the inaugural meeting of the China-Indonesia high-level dialogue cooperation mechanism.

The two countries signed a new memorandum of understanding (MoU) on maritime cooperation, which will help “enrich, expand and upgrade” the cooperation mechanism.

The two sides agreed to take Indonesia’s construction of a “national fish storage center” as an opportunity to launch fishery cooperation in an all-around way and bring tangible benefits to the fishermen of both countries.

They also agreed to carry out ecological marine pastures and demonstration projects for seawater desalination and support several new high-quality projects.

Carrying forward the traditional friendship between the two sides, they also agreed to innovate interactive models, such as the “cloud tour” project to make full preparations for the full resumption of tourism cooperation after the epidemic.

They also agreed to strengthen cooperation in vocational education, conduct exchanges on athletes’ training and expand interaction between think tanks and the media.

Climate change goals may have a maritime shipping problem

The international cargo and container shipping industry plays a central role in global supply chains, but until recently has made few inroads toward decarbonisation. That needs to change if the world is going to achieve net zero emissions by 2050.

Maritime shipping is one of the few sectors left out of the language of the Paris Agreement on climate change. The industry currently accounts for a relatively small share of global CO2 emissions — between 2% and 3% according to S&P Global Platts Analytics — but some scientists have projected that maritime shipping could account for 17% of total annual CO2 emissions by 2050.

Shipping already plays a massive role in the global economy. The public got a stark reminder of that fact when the coronavirus pandemic upended supply chains, and again in March 2021 when a massive container ship blocked the Suez Canal for nearly a week. Seaborne ships on average carry more than 80% of global trade by volume.

Unless the industry changes course quickly, many supplies that other industries need to support their low-carbon transition — everything from wind turbine blades to lithium-ion batteries for electric vehicles — will be transported on cargo and container ships fueled by fossil fuels, known in the industry as marine bunker fuels.

As companies start pursuing their net zero targets, we expect shipping of materials needed for the low-carbon transition to climb. Some, such as lithium-ion batteries for electric vehicles, have already begun to show an uptick in demand.

UNWTO and Greece will collaborate on a Maritime Tourism Research Centre

UNWTO is to collaborate with the Greek Ministry of Tourism in establishing a first research station dedicated to measuring the sustainable development of coastal and maritime tourism across the Mediterranean.

The new monitoring centre will be based at the University of the Aegean in Greece. From here, experts will capture and collate measurement data and analysis relating to the environmental, economic, and social impact of tourism.

The United Nations specialised agency and the Ministry of Tourism confirmed their collaboration on the initiative during the UNWTO High-Level Conference on Coastal and Maritime Tourism, held in Athens and co-hosted by Cruise Lines International Association (CLIA) and Celebrity Cruises.

The World Tourism Organisation (UNWTO) is the United Nations specialised agency fostering tourism as a vehicle for equal, inclusive and sustainable development. Working with its Member States, international organisations and the private sector, UNWTO promotes safe and seamless travel for all. UNWTO also works to make tourism the foundation of trust and international cooperation and a central pillar of recovery. As part of the wider UN system, UNWTO is at the forefront of global efforts to achieve the 2030 Agenda for Sustainable Development, including through its ability to create decent jobs, promote equality and preserve natural and cultural heritage.

India and Vietnam meet to discuss maritime security

India and Vietnam held their second maritime security dialogue in a virtual format on 06 April 2021. The consultations involved exchanges on developments in the domain of maritime security, regional cooperation activities and opportunities for cooperation between the two countries.

The defence and security ties between the two countries have witnessed steady expansion.

In December last, Indian Prime Minister Narendra Modi held a virtual summit with his Vietnamese counterpart Nguyen Xuan Phuc during which both sides vowed to boost overall defence and security cooperation, including in the maritime sphere.

The two leaders had specifically reaffirmed the importance of maintaining freedom of navigation and overflight in the South China Sea.

Vietnam, an important country of the ASEAN (Association of Southeast Asian Nations), has territorial disputes with China in the South China Sea region.

The ILO calls for full respect of seafarers' rights

The ILO is calling on governments to treat seafarers as key workers and to cooperate to make vaccines available to them at the earliest opportunity, to allow them to pass through international borders and keep global supply chains moving.

These appeals are reflected in two resolutions adopted during the Special Tripartite Committee (STC) of the Maritime Labour Convention, 2006 (MLC, 2006), which brought together more than 100 governments, seafarers and shipowners, who met virtually from 19 to 23 April 2021 to review the impact of COVID-19 on the maritime sector.

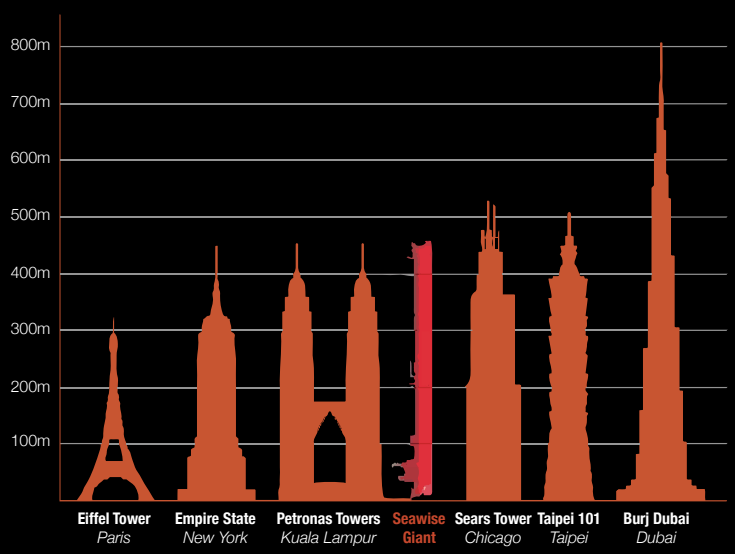
The Resolution concerning the implementation and practical application of the MLC, 2006 during the COVID-19 pandemic renews calls for States to designate and treat seafarers as key workers and take all necessary steps to ensure that they can travel to and from their country or place of residence and their place of work, and obtain medical care ashore as well as shore leave.

States are called upon to take all necessary steps to ensure that seafarers are not required to stay on board a vessel longer than the period specified in their seafarer's employment agreement, without their consent, and under no circumstances for longer than the maximum period of service stipulated by the MLC, 2006.

The Resolution concerning COVID-19 vaccination for seafarers calls on governments, in accordance with their national vaccination programmes, to make supplies of World Health Organisation Emergency Use List (WHO-EUL) vaccines available for seafarers on ships visiting ports in their territories, and for governments to consider establishing vaccination hubs for seafarers in ports.

Speaking on behalf of the Seafarers, Mark Dickinson noted that the meeting had, "started the process of learning the lessons, with a determination to make a difference and learn from the mistakes of this pandemic." "The meeting", he said, "had adopted two resolutions that were important not only in terms of progress and process, but as a visible recognition of the importance of seafarers to the industry."

A glimpse at Shipbuilding worldwide



The biggest shipyards are too small for some ships

The largest ship ever built was the Seawise Giant, by Sumitomo Heavy Industries at its shipyards in Yokosuka, Kanagawa, Japan. Completed in 1979, it took five years to finish, serving initially as a crude oil carrier and finally to carry containers. It had a draft of 81 feet, which unbelievably was too big to navigate the English Channel or the Panama and Suez Canals.

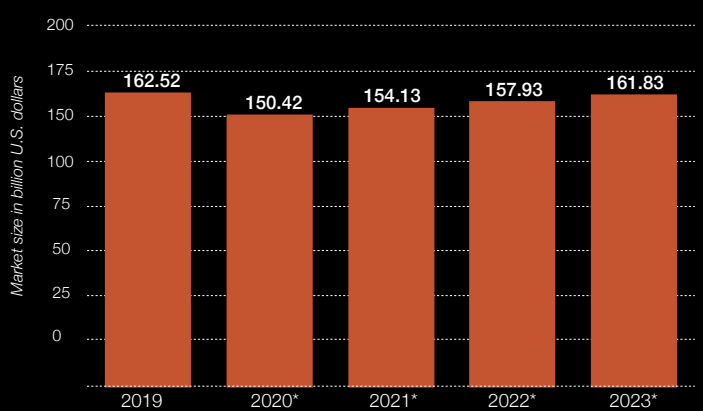
Fully loaded, it displaced over 650,000 tons in its 1,500-foot length. It sank during the Iran/Iraq war, but being so big, it was salvaged and ultimately sold for scrap metal in 2009.

The Seawise Giant might be the largest ship to ever be built in a shipyard. The Freedom Ship, in its planning stages, is too large to be made in any existing shipyard and so will be built out at sea. This colossal giant is 4,320 feet in length with 25 stories that will house over 50,000 people. It is more than three times the size of the Seawise Giant and will circumnavigate the globe once every two years. If everything goes according to plan, construction on the ship should start in the next few years.

The Impact of COVID-19

According to statista.com, the global shipbuilding market is expected to decline by over 7% between 2019 and 2020 due to COVID-19 pandemic, dropping to the size of around USD 150 billion in 2020. However, the market is forecast to grow from 2021 on, surpassing USD 160 billion in value in 2023.

Size of the global shipbuilding market in 2019 with a forecast for 2020 through 2023 *(in billion U.S. dollars)*

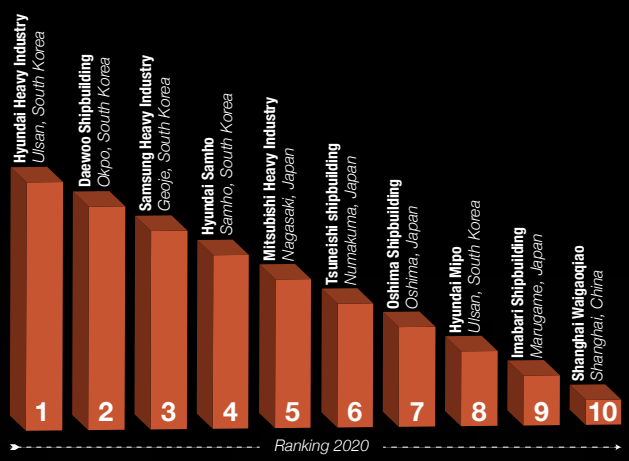


Shipbuilding market share

Between January and October 2020, China was the leading shipbuilding market based on orders in CGT (Compensated Gross Tonnage) with a market share of almost 50%. Japan reached a market share of 10% during that time period.

The biggest shipyards are in Asia

The ten most significant shipbuilding companies in the world are all from Asia, with four in the top five from South Korea, and the rest in China and Japan. The most significant yard, run by Hyundai Heavy Industries, is at Ulsan in South Korea. The yard runs for over 2.5 miles, employs over 60,000 people, and produces ships of significant size every 4 to 5 days.



A shipyard holds the world's most massive crane

The world's largest crane lives at Yantai Raffles shipyard in Shandong Province, China. The crane is called Taisun and holds a Guinness world record for the heaviest lift at just over 20,000 metric tons. It's a massive double gantry crane, with a height of 133 metres, and a span of 120 metres. It employs 50,000 metres of wire rope to do its job, the building of offshore oil rigs and semi-submersibles. Completed in 2009, it was unveiled at a ceremony hosting more than 600 people.

26th Finance Committee meeting

26th Finance Committee Meeting of Bangabandhu Sheikh Mujibur Rahman Maritime University (BSMRMU) took place on 14 June 2021. Important finance and accounts related matters of BSMRMU were discussed and decisions were taken.

8th Planning Committee meeting

BSMRMU's 8th Planning Meeting was conducted on 10 June 2021. Members of the Planning Committee were present both physically and virtually, keeping proper social distancing. Important matters on future prospects of BSMRMU including the establishment of permanent campus were discussed and decisions were taken. Vice-Chancellor of the university Rear Admiral M Khaled Iqbal (retd) presided over the meeting.

31st Academic Council

The 31st Academic Council of BSMRMU was convened on 6 June, 2021. Members of the Academic Council attended both physically and virtually, maintaining adequate social distancing. Diverse academic issues were discussed, and decisions were made. Vice-Chancellor of the university Rear Admiral M Khaled Iqbal (retd) presided over the meeting.

Webinar on Bangladesh Delta Plan 2100

On 22 April 2021, BSMRMU in association with Nuffic, Netherlands organised a webinar on "Trajectories towards Resilient Cities in Bangladesh Delta Plan 2100- The Urban Challenge". The welcome address was delivered by the Vice-Chancellor of the BSMRMU Rear Admiral M Khaled Iqbal (retd). Mr Chris Zevenbergen and Dr William Veerbeek from IHE Delft, Netherland and Dr M. Shah Alam Khan and Dr Shayer Ghafur from BUET presented their valuable papers during the webinar. BSMRMU faculty and students along with delegates from other universities and organisations attended the webinar online.

MoU signed among BSMRMU and DEW

On 2 June 2021, BSMRMU signed a Memorandum of Understanding (MoU) with Dockyard and Engineering Works (DEW) Ltd, Narayanganj. The signing ceremony was arranged at the conference room of BSMRMU. Registrar of the university, Commodore M Anisur Rahman Mollah on behalf of BSMRMU and Commodore S M Moniruzzaman, Managing Director of DEW signed the MoU. The Vice-Chancellor of the university, Rear Admiral M Khaled Iqbal (retd) graced the ceremony as well. The Deans, Faculty Members and Officers of the university attended the programme as well.

Ocean Odyssey

A brief story of the Bay of Bengal

The Bay of Bengal was formed approximately 10 million years ago by the northward movement of the techtonic plate carrying the Indian subcontinent towards Asia.

It forms the North-Eastern part of the Indian Ocean.

It is the largest bay in the world occupying an area of 1,72,000 square kilometres.

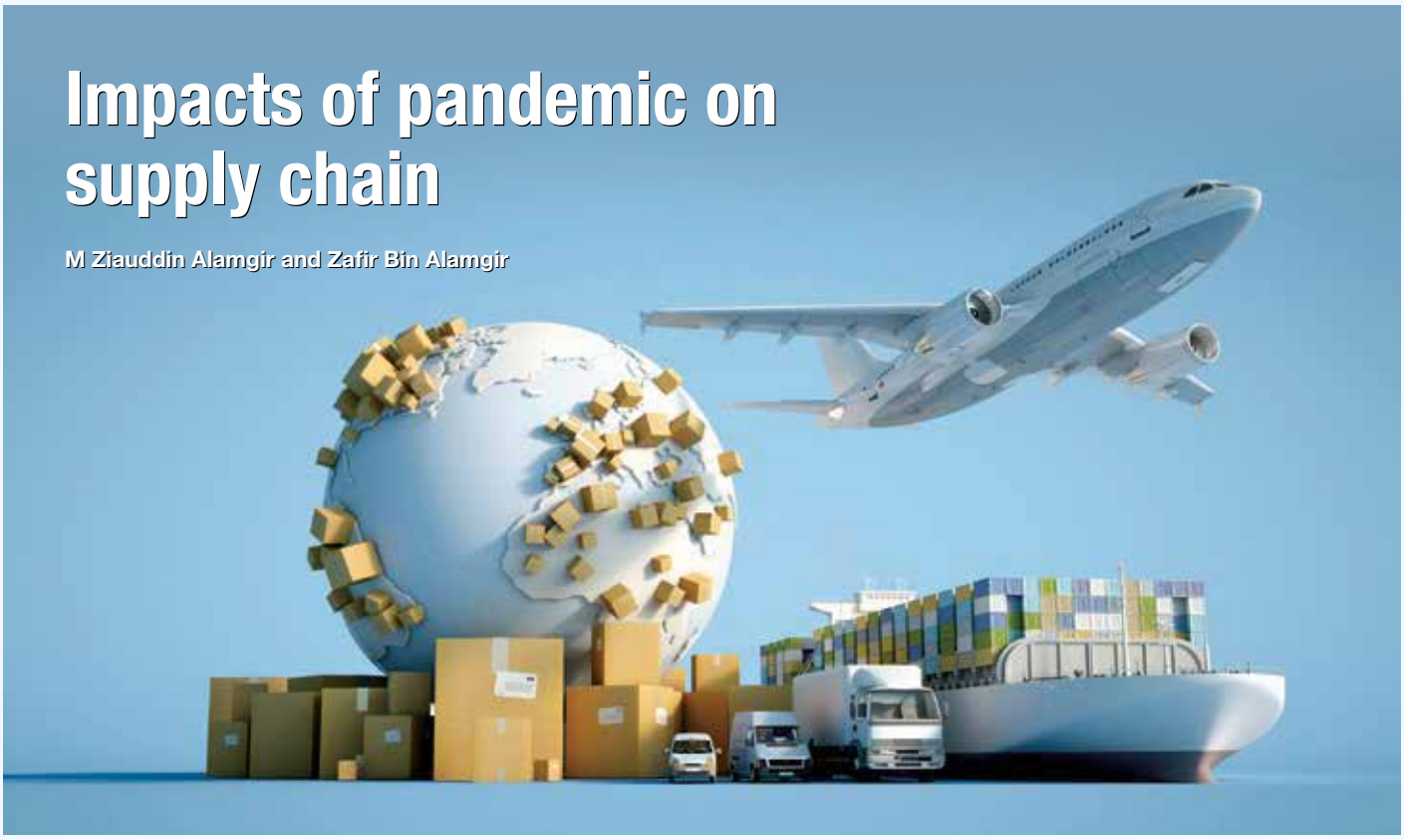
The Bay of Bengal is about 1,000 miles (1,600 km) wide. It has an average depth of more than 8,500 feet (2,600 metres. The maximum depth is 15, 400 feet (4, 694 metres).

The Bay has various names; 'Mahodadhi' which means Great water receptacle, 'Bangapsagar' which means Bengal's bay, 'Bangasagar' which means Bengal's see and 'Purbapayoda' which means Eastern Ocean. It was also called as 'Kalinga sagar' in the pre-British era.

The Bay of Bengal consists of some of the largest ports in the world and due to high Total Organic Carbon (TOC) in the depths of the Bay of Bengal, the area is rich in oil and natural gas and other resources. It has rich biological diversity and one of the world's 64 largest marine ecosystem.

Impacts of pandemic on supply chain

M Ziauddin Alamgir and Zafir Bin Alamgir



Background of the study

The world is going through a tough time. Almost every country is affected by COVID-19. The economy of those countries is also going down. The whole world is fighting together to overcome the damage. Bangladesh has been affected by COVID-19 as well and it is affecting people's day to day life and our economy as well. Many businesses are forced to shut down their operation and many organisations had to let their people go without notice. RMG sector faced a huge blow back due to the pandemic.

Local hospitals and government are fighting hard against this pandemic. However, the limited resources could have been managed efficiently to fight against this pandemic. In the early days of the pandemic, we saw the sudden increase in the price of hand sanitisers and masks. Hospitals were not equipped with PPE.

Import-export became sluggish as many countries have stopped shipping their products. As a result, many businesses which were solely dependent on the supply from abroad had to stop their operations. The price of the day to day life necessary items increased as there was lack of supply and the market was empty.

When a crisis hits, one needs to proactively reinforce the supply chain so as to continue meeting client/customers' demands. It is important to take a structured approach to logistics planning and organisation so no business activity finds itself in a tough situation. During black swan (an unexpected event that shocks the world by its impact and magnitude. a clear understanding of risk and relevant alternative supply chain strategies can help organisations establish the right plan in the face of the unexpected without incurring big losses. With this background, the objective of the study is to assess the impacts of the pandemic on the supply chain.

The study adopted field methods of data collection. This method involved conducting unstructured interviews and administration of questionnaires to a sample of respondents who are involved in the policy making of different NGOs.

Issues involved in the supply chain during the pandemic

Products stock: Our Study revealed that almost in 90% cases desired products were out of stock during the pandemic. It seems that companies went online without accessing the market and inventory. They should have had a strong inventory management system which can keep track of their products and can calculate at which point they needed to reorder their products so that customers do not find it being stocked out.

How often you find products being stocked out?

30 responses

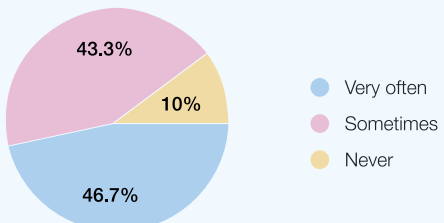


Fig 1: Respondents' responses on stock product delivery

How many days did it took to get deliveries?

30 responses

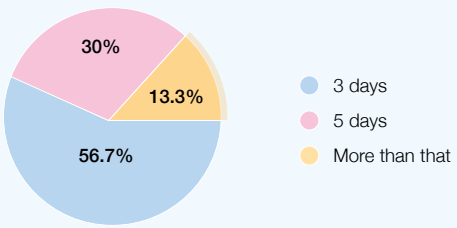


Figure 2: Respondents' responses on product delivery

In many cases customers did not find their desired products available in the shop they get their delivery in a quick time possible. Companies tried to deliver the products quickly and in a hygiene way. Average delivery time was found to be 5 days.

Government's resources

Do you think government have enough resources to fight against COVID-19?

30 responses

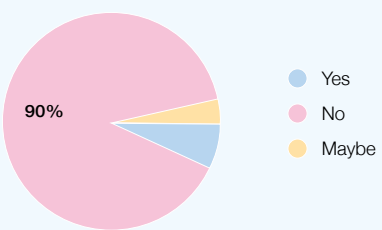


Figure 3: Respondents' responses on government's resources

Most of the people think that our government was not ready and equipped to fight against COVID-19. The lack of quick crisis response team is to blame here. There were shortage of PPE and hand sanitisers, price of day to day life increased due to lack of monitoring. Due to lack of planning during crisis, we failed to keep it under control. Government could not control the market and they were unsure about the lock down and quarantine process.

A proper crisis management team and policy could help minimising the damage and could have been more effective in this fight against COVID-19.

Impact of pandemic on supply chain

The impact of pandemic on supply chain is twofold. Companies must closely monitor short-term and long-term demand and inventory to accommodate production loss in the wake of factory closures and economic slowdown. On the other hand, retailers are faced with inventory depletion as consumers stock up in preparation for extended stays at Home Delivery options have also found new normal.

The pandemic has a disastrous effect on every sectors of economy of Bangladesh. Though, Government has come with so many strategies to fight with this uncertainty, but due to not having proper crisis management plan, businesses are going through tough time. Every important sector, like RMGs, Hospitality Industries, Transporters, the Self-employed like the small shop owners on footpaths and rickshaw-pullers everyone got a hard hit. It is apprehended that about 1 crore to 1.5 crore people may become jobless if the pandemic is not addressed properly.

The business is facing loss because most of the companies do not have any structured supply chain system backed with emergency plans. Besides, as most of the businesses are depended on outsourcing and foreign sellers for their regular raw materials, in such unexpected lockdown, they left with no options than waiting.

The Organisation for Economic Co-operation and Development (OECD), in a study stated that the coronavirus could cut global economic growth in half. Within few months after the outbreak of COVID-19, lots of business has been closed down in Bangladesh and many are on its way.

New Zealand has set a perfect example of going for zero COVID cases without any vaccination only because of strong crisis management policies which include sustainable supply chain management as well. In New Zealand, 4.8 million people are slowly emerging from life under lockdown, the government claims the virus has stopped spreading: seemingly showcasing the success of its "go hard, go early" lockdown strategy.

The impact on business in Bangladesh is tremendous. It warrants corporate changes to cope with the current supply chain challenges. Many companies are in a process of establishing approaches to respond to the current crisis in the different time horizons. Some companies are focusing on crisis management (short-term), balancing demand and supply, others are looking at a recovery plan (mid-term) to plan for demand and supply after the pandemic has subsided and the new norms are established. Nevertheless, all companies will need to work on risk mitigation (long-term) to minimise supply chain disruptions in near future. No matter the response or timeline, most companies recognise the need to replace the slow, soloed approaches of the past with a concurrent planning approach that enables the entire supply chain to respond with agility to unpredictable challenges.

To mitigate the risk in such pandemic every business needs to have emergency supply and demand strategies especially within a local network. Considering COVID, in case of uncertain lockdown, less dependency on global supply network will help to survive in more sustainable way. Optimising the entire supply chain management system across organisational boundaries with cross-functional collaboration, end-to-end visibility, and continuous real-time planning are key requirements to fight with any kind of emergency crisis situation. Companies need to make decisions based on their industry, their channels, and their product portfolios to prepare and adapt to the new normal during and after the pandemic, leveraging this model as a start.

Challenges militating against supply chain due to COVID-19.

Limited resources management

All though we lack necessary equipment and team most of the people think that our limited resources could have been used more effectively. If we had a structured supply chain team and a proper crisis management team, then we could have avoided the mismanagement

and sudden price hike of the market.

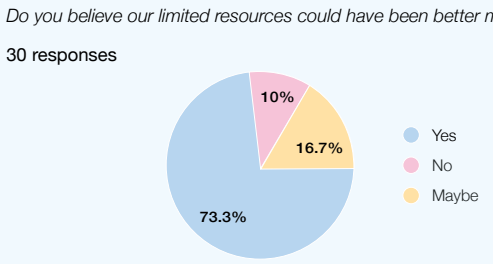


Figure 4: respondents' responses on limited resources management

Termination of shipping from abroad

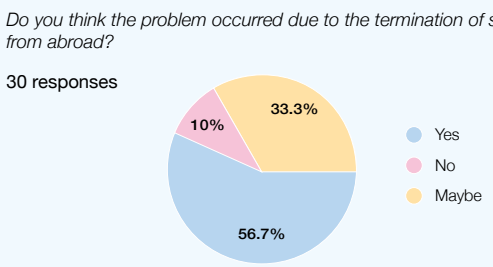


Figure 5: Respondents' responses on termination of shipping from abroad

Most of the local companies highly rely on their shipment from abroad. Either they bring their products from abroad or their raw materials. So after all the international flights being grounded and many companies were running out of their products they had to face a situation where they had to decide whether to stay in market or not.

Our RMG sector took the biggest hit due to this problem. Most of our RMG companies are export oriented. They were facing cancellation of orders in the middle of production and their payment was due, many organisations have to let their employees go or had to close down their operations.

Lack of crisis management team and proper supply chain network

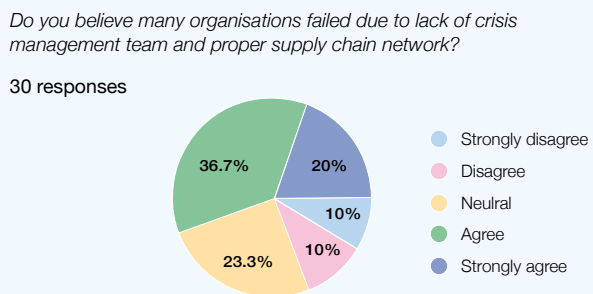


Figure 6: Respondents' responses on lack of crisis management team and proper supply chain network

We have seen many organisations going out of operations during this pandemic. The reasons might be different but the root problem was same and that is lack of visionary decision making skill, lack of crisis management policy and above all a proper supply chain structure.

A strong supply chain could have been the solutions of the problem. This pandemic proved the impact of a sustainable supply chain strategy in any business no matter how big or small they are.

Conclusion

A sustainable supply chain structure ensures the sustainability of an organisation. Although the concept of supply chain is new in our country, many multinational companies are practising an effective supply chain structure. It not only ensures the sustainability but also reduces cost of business and ensures the minimum time required to send the end product to the customer.

During this pandemic, many organisations took a hit and lost market share to their competitor who had advantage of a sustainable supply chain strategy and crisis management policy. Many organisations all over the world could not save their business only because of a proper supply chain management.

Regardless of the size of the organisation every organisation must have a crisis management policy, a sustainable supply chain strategy to back up the crisis management policy and a damage control team. Unexpected events like corona virus pandemic can happen without any notice. Every organisation should always be ready to face such disasters with proper plan and strategy.

Recommendations

It is recommended that every organisation should have:

- A proper crisis and damage control policy backed by a sustainable supply chain structure to fight against unwanted situations.
- A proper supply chain policy for day to day operations and for crisis period as well. They should also have sound technological base for automation and innovation.

M Ziauddin Alamgir
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Faculty of Engineering and Technology
BSMRMU

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Graduate Student,
Brac Business School

65-day ban on fishing in Bay of Bengal

All types of fishing vessels will be under the restriction from 20 May 2021 to 23 July 2021 in the sea.

The government has imposed a 65-day ban on fishing off the Bay of Bengal to try and preserve the fish stock and boost their breeding.

The ban – lasting from 20 May until 23 July – is timed to occur with the breeding season. All types of fishing vessels will be covered by the restriction.

The Ministry of Fisheries and Livestock issued a notification in this connection on 13 April 2021 considering the breeding of sea fishes and their conservation.

Fishing in all coastal countries across the remain prohibited for two to three months during the breeding season as it is essential to ensure a safe environment for mother fishes during this time.

Rear Admiral Md. Khurshed Alam (retd) elected as the head of an international maritime organisation

Rear Admiral Md. Khurshed Alam (retd), Secretary of Maritime Affairs Unit, Ministry of Foreign Affairs, has been elected as the Chairman of the Regional Committee of the IOC Central Indian Ocean. He was elected on 19 May at the company's virtual meeting.

A statement from the foreign ministry said Admiral Alam has been elected for two years. This is possible because the international community has confidence on him and can rely on him.

Founded in 1982, the organisation has a total of 19 members. The member countries are Australia, France, India, Indonesia, Iran, Iraq, Kuwait, Malaysia, Maldives, Myanmar, Oman, Pakistan, Qatar, Saudi Arabia, Sri Lanka, Thailand, United Arab Emirates and United Kingdom.

Per capita income is now USD 2,227

The per capita income in the country has increased to USD 2,227. In Bangladeshi currency, it is BDT 1 lac 88 thousand 873 per year.

On 16 May, in an unofficial speech at the cabinet meeting, Planning Minister MA Mannan disclosed this information. Cabinet Secretary Khandaker Anwarul Islam said this in a briefing after the meeting. Hon'ble Prime Minister Sheikh Hasina took part in the meeting virtually from Ganabhaban.

According to data provided by the Bangladesh Bureau of Statistics (BBS) last year, the per capita income for so many days was 2 thousand 64 US dollars. Compared to that, per capita income has risen by 163 dollars, up 9% from last time.

The International Monetary Fund (IMF) estimated that Bangladesh's GDP growth could fall to 3.8% in 2019-20. According to the organisation's calculations, this will have an impact in the current 2020-21 fiscal year as well.

Bangladesh is one of the top three countries in achieving SDGs

Bangladesh is one of the top three countries in achieving the United Nations Sustainable Development Goals (SDGs). This information has come up in the report of the Sustainable Development Solutions Network of the United Nations. The other two countries leading the SDGs are Afghanistan and Ivory Coast.

The United Nations enacted the SDGs in 2015, with a 15-year implementation period. Its main goal is to ensure peace and prosperity by 2030. It has set 17 targets. And there are 169 specific targets. Some of the goals of the SDGs is to eradicate poverty, ensure food security, improve health, improve education and prevent gender inequality.

Bangladesh's overall score in this year's SDG index is 63.5%. Last year this score was 63.26%. When SDG was adopted in 2015, Bangladesh's score was 59.01%. Bangladesh ranks 109 out of 165 countries in the world. Bangladesh is ahead of India and Pakistan in this regard.

Finland is at the top of the list this time. The country's score is 85.9%. The next four countries are Sweden, Denmark, Germany and Belgium. The countries at the bottom of the list are the Central African Republic, followed by Sudan and Chad. The three countries that have dropped in the list are Venezuela, Tuvalu and Brazil. Bhutan is the most advanced in South Asia. The country ranks 70th. It is followed by Maldives, Sri Lanka and Nepal. Their positions are 79th, 87th and 96th respectively.

The government has approved the acquisition of khas land in the Bay Terminal project area

The land acquisition complexity of the much-coveted Chattogram Port Bay Terminal construction project has been resolved. The land ministry has approved the acquisition of 803 acres of khas land (government owned fallow land) proposed for the project. On 22 June, in a letter signed by Md. Asaduzzaman, the Deputy Secretary of the Ministry of Land Acquisition-2, he directed the Chattogram deputy commissioner to hand over the 803-acre land to the secretary of the shipping ministry under the Land Acquisition and Occupancy Act. This put an end to the complexity of the Bay Terminal construction project.

Chattogram Port had bought 68 acres of land for the Bay Terminal using its own funds. The Central Land Allocation Committee was stuck with the acquisition of 803 acres of khas land proposed for the Bay Terminal. The port authority has taken another step towards the implementation of the project by approving a total of 803.17 acres of land, including .79 acres of privately owned land.

According to the plan, one of the three terminals will be built by Chattgram Port Authority alone and the other two on Build-Operate and Transfer (BOT) basis, which will be launched by 2026.

Port Secretary Mr. Mohammad Omar Faruk said, “The work of the Bay Terminal project has been taken up by the port authorities long ago. The port had bought 68 acres of land with its own funds. Now the letter from the land ministry shows new hope for the Bay Terminal project.”

UN delegation lauds Bangladesh’s Rohingya rehabilitation move to Bhasan Char

A high-level UN delegation, which had recently visited Bangladesh, appreciated the government of Bangladesh over the Bhasan Char rehabilitation project of the Rohingyas and sought the international community’s support to ensure the refugees live there with dignity.

‘’The government of Bangladesh has made an important investment in Bhasan Char by developing the housing facility. If you compare with Cox’s Bazar refugee camps, the housing facilities are much better in Bhasan Char,” UN Assistant High Commissioner for Refugees (protection) Rouf Mazou, who visited the island in Noakhali on 31 May 2021.

“What needs to be done now for us and the rest of the international community is to support the government and make sure those who are in Bhasan char and those who will be coming there can live in dignity,” he said.

Gillian Triggs, assistant high commissioner for the refugees (operations), was with Mazou when he visited Bhasan Char where the Bangladesh Navy built a housing project for 100,000 Rohingyas.

A large number of Rohingya people had escaped Myanmar during a military crackdown and started residing in Cox’s Bazar in 2017. Subsequently, considering the pressure on locals in terms of livelihood, environmental threat, security threat etc, Bangladesh Government decided to decongest these camps by relocating some of the Rohingyas to other locations.

Export of saplings for the first time by sea

For the first time, Bangladesh started exporting saplings by sea. On 9 June, a consignment of 3 thousand and 747 saplings of 8 species was brought to Chattogram port for exporting to Qatar. On 14 June, the ship of Maersk Shipping Line left Chattogram port with the consignment of Maersk Xiamen saplings. The consignment of saplings loaded in containers for export includes 795 saplings of oranges, 152 saplings of java apple, 950 saplings of lemon, 1 thousand 280 saplings of neem, 40 saplings of banyan tree, 320 saplings of Sapodilla, 170 saplings of almonds and 40 saplings of thorny acacia. Al Naimi Landscaping, a Bangladeshi-owned company based in Doha, Qatar, imported the saplings from Bangladesh to Qatar.

Messrs. Bijra Enterprise of Bijra Bazar, Laksam, Comilla exported the saplings. Prior to export, the saplings from Chattogram were loaded onto a 40-foot air-conditioned container at the Eastern Logistics Depot in Patenga.

Shamsul Islam, CEO of Bijra Enterprise, said, “During the inauguration of the country’s first World Trade Centre in Agrabad, Chattogram on 30 January, 2016, Prime Minister Sheikh Hasina asked traders to find new markets. Emphasising on agricultural products, the Prime Minister said, ‘This market will never shrink.’ Inspired by that, I have been trying to export saplings since 2018. Despite exporting saplings a few times by air while facing various difficulties, this is the first time I am exporting saplings from Bangladesh by sea. Exporting saplings by air is very expensive. So, I have started to export saplings by ship. Through this, I hope to be able to export about 1 crore dollar worth of saplings a year.”

Abu Sufian Maruf, owner of Al Naimi Landscaping, a Qatari importer, and Messrs. Bijra Enterprise in Comilla, said: “We have been trading saplings in Qatar for 20 years. We import and sell saplings from more than 20 countries to Qatar. But this is the first time I am taking saplings from my own country by ship.”

“Vietnam exports trees to many countries in the Middle East, including our neighbouring country India,” he said. “Despite the huge potential, Bangladesh is lagging behind in this sector.”

Bangladesh seeks joint efforts to IORA's new action plan

Around 50 senior officials from the 22 member states of IORA participated on 20 May for a daylong workshop. Bangladesh has sought cooperation from Indian Ocean Rim Association (IORA) member states for implementing the new action plan through concerted efforts as Bangladesh is set to become chair of the IORA in the last quarter of this year.

Secretary (Maritime Affairs Unit), Ministry of Foreign Affairs Rear Admiral Md Khurshed Alam (retd) made the request on 20 May while attending a workshop.

Bangladesh, current vice chair of the IORA, hosted the workshop virtually to discuss the IORA's second action plan.

Secretary Alam highlighted the evolution of IORA into a forum that has started to address regional and global issues of both human security and human development across several continents.

He stressed that the Second IORA Action Plan should be result-oriented, action-oriented, inclusive, comprehensive, and aligned to the objectives of the IORA.

Alam hoped that the workshop would be able to lead us to a well-structured, farsighted and pragmatic action plan that will minutely address all the opportunities and challenges of this region.

Bangladesh played a pivotal role in discussions during the workshop and conveyed thought-provoking suggestions and fruitful inputs for the Second IORA Action Plan including the format and structure of the new Action Plan, said the Ministry of Foreign Affairs.

Discussions on the IORA Strategic Vision were held, and member states were also requested to agree on the proposed format and structure of the new IORA Action Plan.

40% of power will come from renewable sources in 2041

As part of the government campaign for the expansion and installation of renewable energy sources in the country, the ratio of renewable energy source will be 40% in power generation in the future.

According to Nasrul Hamid, the State Minister for Power, Energy and Mineral Resources, Bangladesh is generating electricity from renewable energy sources at 730.62MW with the installation of 5.8 million solar home systems across the country as part of the global green and clean energy campaign.

He said that being encouraged by the government's steps and incentives for the expansion of renewable energy in the country, entrepreneurs in the private sector had been setting up solar home systems and rooftop solar panels.

"We will bring 100% of people under electricity coverage within the Mujib Borsho and around 99% of people already have access to electricity, as power generation capacity reached 25,227MW," Nasrul Hamid said.

According to the minister, solar energy is the most potential source of renewable energy in Bangladesh due to its geographical location.

Entrepreneurs will get benefits if their ships sailing in the sea

This year's budget has given relief to the entrepreneurs of sea-going vessels. The government has agreed with some of the demands of the entrepreneurs to increase investment in this sector. For a long time, entrepreneurs in this sector could import ships which were at a maximum of 22-years-old from abroad. And after they made the purchase, there was no opportunity to sell the ship before 5 years. They had to pay in advance. Therefore, the entrepreneurs demanded to lift the various restrictions imposed on the business in this sector including reducing taxation.

In his budget speech, Finance Minister A.H.M Mustafa Kamal recommended that the lifespan of old ships be changed from 22 years to 25 years and the period of sale after imports be fixed at 3 years instead of 5 years. Sea-going vessels have also been included in the circular of withdrawal of advance tax. In the circular, the finance minister also announced the withdrawal of advance tax on the import of sea-going vessels with a carrying capacity of more than 5,000 tons.

According to the data of the Shipping Office last April, the number of sea-going ships carrying the flag of Bangladesh is now 66. KSRM (SR Shipping), Meghna Group, Akij Group, Bashundhara Group, Karnaphuli Limited, MJL Bangladesh, Orion Group and 11 other industrial groups have sea-going vessels. The number of ships has increased in the last few years as compared to the past due to increasing the facilities for the entrepreneurs in this sector. This year, industrial groups like Meghna Group and Karnaphuli Limited have made new investments in the sector.

According to the data of the three seaports, more than 10 and a half crore tons of imported and exported goods are transported by sea in Bangladesh every year. Very little of this product is transported on domestic flagships. According to Bangladesh Bank, in the fiscal year 2019-20, USD 2.87 billion or BDT 24 thousand and 359 crore has been spent on importing goods by sea. However, according to the Bangladesh Ocean Going Ship Owners Association, the cost of transporting goods by sea will not actually be less than USD 8 billion. From this, only USD 300 million, or 4.5% share held by Bangladeshi flagships.

Marine food production in Bangladesh under the Blue Economy initiative

Maritime Campus desk

More than half of the total fish products come from the freshwater of Bangladesh, while marine fishing is limited to coastal and brackish water farming, which is mainly used for shrimp farming. The overall contribution of marine aquaculture to the fisheries sector of Bangladesh is significantly low. Although the country is witnessing a marginal rising trend in marine fisheries production led by Hilsa catching, there are signs of some fishery stocks getting depleted at the same time. Amidst a rising protein demand with a rising population in the face of depleting land-based resources, the rise of marine food production by expanding mariculture and management of marine fisheries cannot be thwarted. The newly demarcated sea boundary of Bangladesh has opened the doors for sustainable use of maritime resources, which is also termed as the Blue Economy.

The future food security and export earnings of Bangladesh will begin depending on coastal and marine resources. To broaden the scope of existing marine food production sustainably, the issues of distance fishing, modern fishing technology, mariculture and innovative farming must be considered. The scope of product diversification and value addition, fish stock assessment, ecosystem-based fisheries management, live feed culture and production, also hold enormous prospects for sustainable use of marine fish resources. Bangladesh is ranked 3rd largest in aquatic biodiversity in Asia, with almost 300 species of fresh and brackish water fish species.

The shallow continental reef of Bangladesh is much bigger than the global average of 65 km, which extends over 185 km. This bigger reef is offering an attractive opportunity to fishing boats having limited capacity. As a result, small scale fishing has grown over the past decade, which has contributed to the country's marine fish production. On the other hand, due to the absence of updated fishing technologies and high capacity fishing vessels for deep-sea fishing, trawler fishing, which commonly referred as industrial fishing is still largely untapped. At present, more than 67,000 mechanised and non-mechanised boats are involved in fishing, which lacks appropriate fishing technologies. Using the long-line method, hook fishing and other suitable gears and high tonnage vessels, there remains scope for harvesting the unexploited pelagic fishery, which includes high ended fish varieties like tuna, swordfish, salmon, etc. The exploitation of marine fishery resources on an industrial scale started in 1972 with 11 trawlers introduced by Bangladesh Fisheries Development Corporation. Shrimp trawling started after some encouraging findings of penaeid shrimp stocks by the Mitsui Tayo survey in 1976-1977. Near about 40 shrimp trawlers and over 200 fish trawlers are engaged in fishing in the Bangladeshi waters of the Bay of Bengal.

Traditionally different types of marine fish and only some specific varieties of crustaceans like shrimp, crab and lobsters are consumed in Bangladesh. Nonconventional species such as sole, ray, squid, cuttlefish, small pelagic species remain largely untapped due to their unattractive features. Although some species are harvested for fishmeal manufacturing, utilisation of other species for consumption as a source of nutrition for human beings is essential to prevent post-harvest fishery losses. Preparations of fish cutlets, fish fingers, canning of fish and fish products, dried and salted fish/shrimp, breaded prawns and fish sticks, fish cakes, shrimp skewer, coated squid rings, coated fish balls, fish oils, liver oils, fish sauces, surimi and surimi-based products, sausages, fermented products, protein concentrates, etc. can be made from such species for preventing post-harvest fishery losses. Besides, seafood processing discards is a rich source of proteins and xanthophylls, which is yet to be explored. It can be used to produce fishmeal, silage and composts, including various enzymes and amino acids.

The declining trends of the catch-per-unit effort by the commercial trawlers found in the surveys indicate diminishing stocks, which is alarming, despite the overall total catch seems to be rising in the short term. The rise might be correlated to the rising number of vessels in operation and the use of underwater fish finder technology. Stock assessment reports however provide detailed insights on histories, biology and fishery information for a particular species as well as additional fisheries statistical information. With these insights it is easy to estimate the optimal harvesting strategy, monitor the status of fish populations and provide important scientific information for the conservation and management of stocks.

Black tiger shrimp, or Bagda in the local language, is the principal species farmed in the coastal districts of Bangladesh, which has an area of 272,717 ha suitable for coastal aquaculture. Shrimp culture in Bangladesh witnessed a rapid expansion between 1970 and 1990, mostly in lands enclosed by polders from the sea, also known as ghers in the local tongue. Production of sea bass, mullet, crab and seaweeds are done on a limited scale. Globally, seaweed is a billion-dollar industry. They are an important part of marine ecology, where they use photosynthesis and use sunlight to produce food and oxygen from carbon dioxide and water, thus making them important sources of food, fodder and a host of industrially important chemical compounds. Nevertheless, mariculture has a significant imprint on the Bangladeshi economy, which earned a significant amount of foreign currencies (BDT 42,876 million in 2017) by exporting frozen shrimps and fisheries products. Amongst the 50 export destinations of Bangladeshi shrimp and fish items, Belgium UK, Netherlands, Germany, USA, China, France, Russian Federation, Japan and Saudi Arabia are the principal markets. Despite the massive potentials of this sector, the coastal aquaculture of Bangladesh is hindered by disease outbreaks, technological barriers, unscientific use of inputs, poor compliance with quality standards, sourcing of seed, etc. The production of coastal and marine aquaculture can be improved significantly by selectively overcoming these challenges.

The domestication process of marine species in Bangladesh which is limited to a few fish species and crustaceans are moving slowly. Until now, Bangladesh is practising third level domestication through tiger shrimp culture under captive conditions. Second level domestication or captive rearing of wild fry/seed can be achieved by rearing mud crab, sea bass, mullet and seaweeds. First level domestication starts with the initial trials of acclimatisation of about fifteen species of fishes, including threadfin, sea bream, terapon, spotted scat, goby, croaker, mugil, and silver biddy in tide-fed coastal ponds and Hilsa under captivity. Future growth of mariculture will largely depend on the ability to successfully domesticate new species and the species that are

Shrimp production system needs to be upgraded to a semi-intensive system

A joint effort between Bangladesh, India, and Myanmar is needed to protect hilsa from overfishing.

currently farmed. If hatchery technology for artificial propagation and fry production can be guaranteed, mud crab fattening (i.e. rearing of wild small crabs up to marketable size) in pens or cages, coming to attention only recently, will hold huge promise for the future. It is also applicable for commercial farming of sea bass, mullet and seaweeds. Domestication of new aquaculture species like bringing in alternative species to tiger shrimp farming, plagued with disease problems can play a vital role in diversified farming. Domestication in long term can help boost productivity and enhance the sustainability of the Bangladeshi aquaculture industry.

Marine cage farming, which is still not in practice in Bangladesh, can be done at an artisanal level with a simple design and small size. Fish farming cages can be fabricated using easily available materials like bamboo, wooden boards, steel/PVC pipe, and nylon nets. Successful artificial breeding, hatchery-produced fry and manufacturing of pelleted feed can make sea bass, mullet, grouper and sea bream farming possible. These species can be cultured through cage farming in inshore coastal, open sea or offshore types, installed either individually or connected to form a floating raft. Bangladesh can study the knowledge and techniques employed by Thailand, Malaysia, the Philippines, Indonesia and Viet Nam for cage culture for its successful introduction in the country.

Shrimp farming in Bangladesh mostly practices extensive cultivation methods featuring low-stocking density and zero to minimum inputs resulting in low yields, which is an outdated mode of production. This production system needs to be upgraded to a semi-intensive system by introducing healthy and quality seed, nutritious feed, good husbandry practices, and improved health management techniques. A semi-intensive system can help boost production up to 2,000–3,000 kg/ha from the present paltry figure of 60–230 kg/ha. However, measures and techniques must be learnt to reduce and avert the risks and mitigate the challenges associated with such intensification.

It is imperative to promote environmental sustainability and social acceptability of aquaculture practices since aquaculture generates pollution of the aquatic ecosystem by degrading water quality. Aqua-silviculture or integrated mangrove aquaculture and integrated multi-trophic aquaculture system have emerged as promising eco-friendly options. Aqua-silviculture is designated as a low-input farming system that can maintain harmonious co-existence between aquaculture and mangrove forests and at the same time can support

income, food security, coastal defence, community resilience, and restoration and/or conservation of the mangroves. Suitable locations for the 'integrated' mangrove-shrimp, 'separate' mangrove-shrimp mangrove-crab, and nipa-shrimp systems in Bangladesh are the Chakaria Sundarbans and the adjacent Cox's Bazar coastal belt. An area of at least 4 ha can provide sufficient livelihood to farmers associated with aquasilviculture.

Wastes generated by target species like fish in an integrated multi-trophic aquaculture system could be used as food for other species having different feeding habits in different trophic levels. Organic wastes for suspension feeders like oysters and mussels and dissolved inorganic nutrients such as nitrogen and phosphorus for seaweeds are notable examples of feeding cycles in an integrated multi-trophic aquaculture system. Although Cox's Bazar-Teknaf coast and the Islands of St. Martin's, Moheshkhali and Sonadia can be considered suitable places for building integrated multi-trophic aquaculture systems, there has not been any initiatives to develop and test such systems in Bangladesh.

During the early live stages, commercial aquaculture feeding still depends on live feeds. There are commonly three groups of live diets used in larviculture, which are: species of microalgae ranging 5–50 µm in size for bivalves, penaeid shrimps, rotifers, copepods and fish, rotifers (50–200 µm in size) for crustaceans and marine fish, and nauplii of brine shrimp (400–800 µm in size) for crustaceans and fish. The cultivation of live feeds is a bottleneck in Bangladesh because there is no local laboratory and institutions for obtaining pure strains of rotifers and algae. It is necessary to acquire relevant technologies for producing live feeds for the sustainability of the marine aquaculture industry.

In Bangladesh diseases caused by the white spot syndrome virus and luminous bacteria are major barriers to achieving economic and production sustainability of shrimp farming. Traditionally chemical disinfectants and antibiotics are used to control diseases, which creates serious compliance issues with quality standards due to their adverse effects on product quality and human health. By developing specific pathogen-free and specific pathogen resistant stocks, improving husbandry and hygiene practices, applying bio-security and eco-friendly health management techniques such as probiotics, immune-stimulants, avoiding the irrational use of antibiotics, and embracing the traceability requirements, the disease problems can be mitigated.

There are several hurdles to be faced while venturing into the Blue Economy-related to marine fisheries and mariculture. Implementations of some of the recommended steps are both time-consuming and investment intensive. It can take 5–12 years of research for domesticating a new species and bring it to market, genetic improvement and selective breeding programmes, such as developing specific pathogen-free and specific pathogen resistant stocks can take 5–10 years. A comprehensive stock assessment of marine fishery resources is a costly process, which may take up to 10 years and requires a reassessment every 2-3 years depending on the level of depletion of stocks.

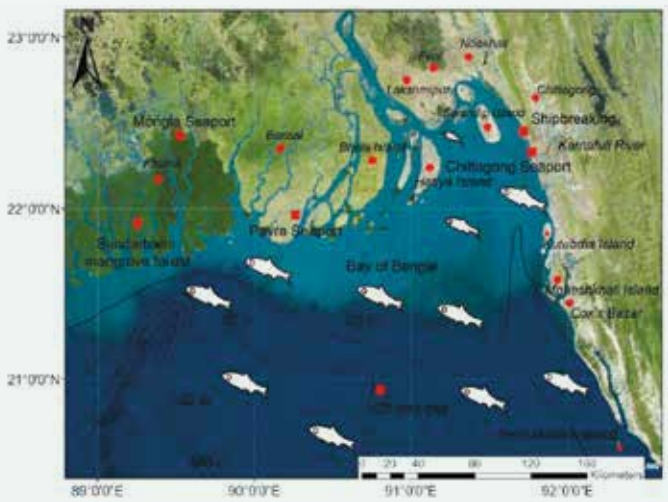
The peaceful resolution of maritime disputes has opened the gate for the country to explore and extract the vast resources in the coastal and marine waters of Bangladesh. With scientific and technical knowledge, innovation and investment, it is possible to lift marine food production under the Blue Economy initiative. Implementation of sustainable fishing, fish breeding technologies, developments in the research pipeline and new results, and translating those results into viable commercial use will take the initiative towards ultimate success. The relevant authorities can look to introduce regional institutional management councils, where all important stakeholder groups will be well represented and the best available tool is used in the decision-making process for marine fisheries management. Under such a framework, effective engagement of the farming sector, industry, academia and research, extension service and other stakeholders with regional and international cooperation can take place, which is all equally important for the sustainability of the Blue Economy of Bangladesh.

The future prospect of maritime activities in Bangladesh

Maritime Campus desk

The Government of Bangladesh has decided to implement the concept of the Blue Economy across various policies. The Blue Economy concept presents an idea of economic growth which is achieved by utilising marine resources and thereby providing more jobs for people, all the while ensuring that those marine ecosystems aren't damaged. Some of the activities which are a part of implementing this concept are exploring marine resources and utilising them properly, providing people with the tools needed to facilitate activities in the ocean, and also protecting the oceanic environment.

Geographical location of the coastal area of Bangladesh



Some of the current maritime activities which are ongoing are outlined below:

- Marine living resources are extracted through fisheries (bony fishes, shrimps), from mangrove forests (honey, fuelwood), coral ecosystems, etc.
- Non-living resources in Bangladesh include gas, crude oil, and many important mineral deposits (Zircon, Garnet) etc. and these have the potential to have a huge positive impact on the economy
- Land-based activities include urbanisation, tourism, shipbuilding and ship recycling.
- There are many ongoing types of research concerning marine areas and these include hydrographic data collection and assessment of biodiversity and fish stock

By taking into account the current ongoing activities and their contributions to the economy, some trends can be noticed. In the last decade, export income from fisheries has been growing. On the other hand, revenue from the mangrove forests has been decreasing in comparison to the 1980s and 1990s. The tourism industry is providing jobs for many people and contributes USD 8.4 million to the economy. The sea salt production sector provides USD 35.5 million to 41.2 million and employs more than 5 million people, and the ship recycling industry contributes USD 1.5 billion every year.

Below are the activities that will be undertaken once the Blue Economy concept begins to be utilised:

- Fisheries need to adopt more advanced fishing practices, making use of longline and hook fishing, and other supporting crafts, to

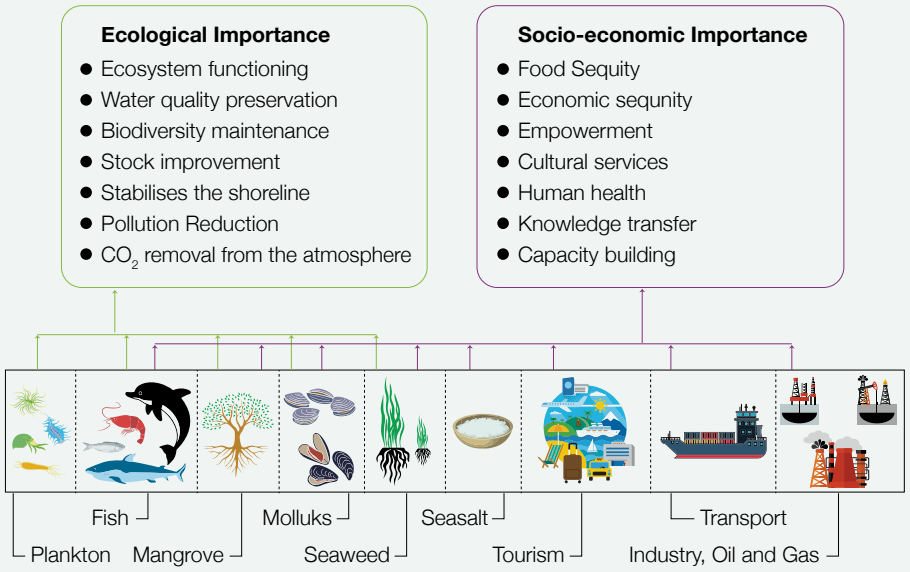
harvest large pelagic fish from deep-sea areas. There must also be a joint effort between Bangladesh, India, and Myanmar to stop the fishing of Hilsa juveniles as this is a transboundary species

• Fisheries also need to focus on the culture of sea bass, mullets, pomfrets, etc. as these species are highly profitable.

• Aquaculture of non-traditional species such as sea-weed, mussels, oysters, etc, will also be commercially beneficial for the country

• Available marine resources should be utilised for producing medicines (antibiotics, nutritional supplements) and also nutritionally balanced foods (shrimps, crabs, etc.)

• Sands along the coast of Patenga to Teknaf have the potential to contain valuable heavy minerals. If these can be extracted, they can contribute to various industries such as paper, ceramics, welding electrodes, etc.



Socio-economical and ecological importance of marine resources and activities

• Renewable energy can be produced by harnessing the power of natural energy sources such as wind, solar radiation, water currents, etc.

• Shipping companies should have the goal of increasing the size and capacity of national fleets as this can be hugely beneficial to the economy

• Bangladesh should attempt to place itself on the global ocean cruise map, and through this, bring in even more revenue through tourism, and provide more jobs

• For Blue Economy to be truly effective, the first step that needs to be taken is Marine Spatial Planning (MSP). If MSP is implemented, there will be better planning of how to best protect marine ecosystems, which will further help to maintain a better balance between economic growth and conservation of marine environments

It is important to focus on marine activities because these resources are greatly benefitting the economy. Resources from fisheries provide individuals with food, economic security, etc. and to the society, it can provide recreational services and transfer of knowledge. The wood from mangrove trees is rot-resistant, making it more valuable. The tourism sector and also the oil and gas sectors are contributing to economic growth by providing jobs. The available natural resources are also important for maintaining the ecosystem. The various species of fish help to maintain biodiversity, while the mangrove forests provide a habitat for many birds and animals. Similarly, seaweed beds are home to many marine species. Coral reefs are themselves extremely diverse ecosystems.

The basic conceptual framework of Blue Economy is meant to provide the Government with a framework that encourages both economic development and environmental management. In other words, it makes the government better equipped to recognise any economic activity which takes place in the oceans as a separate part of the larger economy, but also acknowledging that the two are interconnected and there are shared risks and opportunities and utilise natural capital to support policies made for the ocean economy.

The country's 8th Five Year Plan addresses about the important connection between marine ecosystems and the growth of the economy. This plan outlines three main aims:

a) implementation of 'Bangladesh Delta Plan-2100' which will not be affected by natural disasters and climate change

b) to make use of natural resources in a sustainable fashion

c) handling the change into urbanisation and integrating the plan with the new context.

Some of the activities which will need to be undertaken, including increasing the size and capacity of the domestic fleet to increase revenue, building a well-equipped research and education centre, prioritising potential changes brought on by climate change and making necessary changes. The Government of Bangladesh already has plans underway to apply the Blue Economy concept to the country's ocean economy.

A few obstacles are standing in the way of effectively implementing the Blue Economy policy. There is a lack of proper management and no means of enforcing them, and no regulation measures have yet been taken to address these issues. MSP has also not been implemented. If MSP is properly implemented, it should have multiple objectives, it should have a strong strategy and be future-oriented, and have a plan to use ocean resources to sustainably grow the Blue Economy. Alongside this, there are also no plans to identify Marine Protected Areas (MPA) in the country or to implement an Ecosystem Approach to Fisheries Management (EAFM). Overall, there is a lack of proper planning. There is also an insufficient partnership between the private and public sectors, making development in other sectors such as trade, tourism, fishing, etc. difficult.

In conclusion, stakeholders need to cooperate to calculate how many of these obstacles can be turned into opportunities, and to guarantee that implementing the Blue Economy concept doesn't result in unsustainable practices for short term economic gains instead of long term sustainable ones. The government can observe how MSP has been implemented in the EU so that the development objectives of the country which are already in place will fall in line with the development plans regarding the Blue Economy.

Application of GIS and remote sensing in maritime region: Research technique

M. R. Ashikur

Background

The world coastal zone and maritime region are under rising stress for the development of industries, tourism, trade and commerce, and population growth and migration that descend water quality. Now Bangladesh is called a maritime nation having about 712 km coastline with an exclusive economic zone (EEZ). It encloses about 32 percent of the total area and about 38,520,000 people in the 19 coastal districts called Barguna, Bagerhat, Bhola, Barishal, Chattogram, Chandpur, Feni, Cox's Bazar, Jashore, Gopalganj, Khulna, Jhalkati, Narail, Lakshmipur, Patuakhali, Noakhali, Satkhira, Pirojpur, and Shariatpur (Figure 1). The maritime region has covered 47,150 sqr km and off-shore islands called the Bay of Bengal (BoB) of Bangladesh. It interprets the preservation, property, and utilisation of coastal and marine resources for escalating economic benefits.

The maritime region is treated as one of the most complex areas to be managed and analysed through a traditional planning system. Geographical Information System (GIS) and Remote Sensing (RS) techniques are the most common tools for managing and analysing the coastal areas as well as the maritime region. GIS and RS techniques are in use for various analytical purposes since the 1970s and continue to be widely used in water quality assessment as well as coastal management in the contemporary world. In Bangladesh, the application of GIS has been spread out since 1991 by 'Irrigation Support Project for Asia and the Near East (ISPAN)' for the project called 'Flood Action Plan-19 (FAP-19)'. Recently, GIS and RS techniques are more frequently used to collect and analyse the water quality and physical features in the coastal area and maritime region. The seawater quality parameter (SWQP) and physical features can be estimated by satellite remote sensed data that have been limited to their optical properties based on visible, near-infrared and infrared signals.

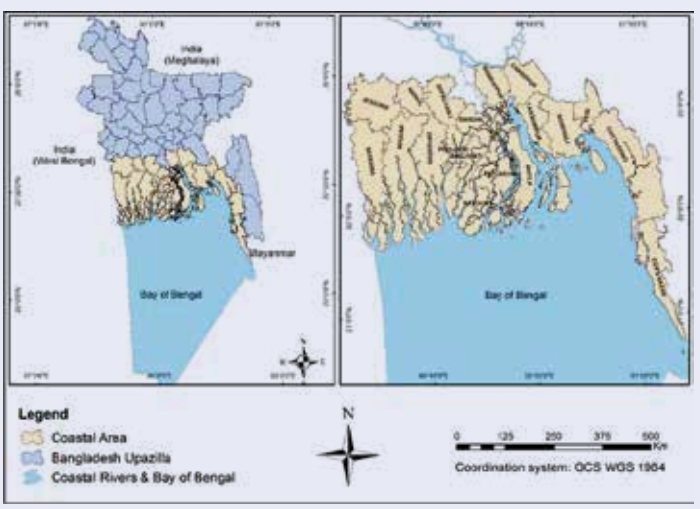


Figure 1: Maritime region of Bangladesh. The figure shows the 19 coastal districts, administrative boundaries and the BoB of Bangladesh.

Concept of GIS and remote sensing

A GIS is a set of computer-based techniques to process, capture, manipulate, organise, analyse, and display spatial or geo-referenced data related to positions on Earth's surface. By GIS technique it means the integration of all the systems that can be useful to introduce a Decision Support System (DSS) for spatially and temporally related problems. The system requires some components (Figure 2) for data analysis and image processing, modeling, simulating, and optimising the data. By organising data spatially along with tabular data or attribute data, GIS can increase the understanding of the Ocean and represents a virtual Ocean inside of a computer.

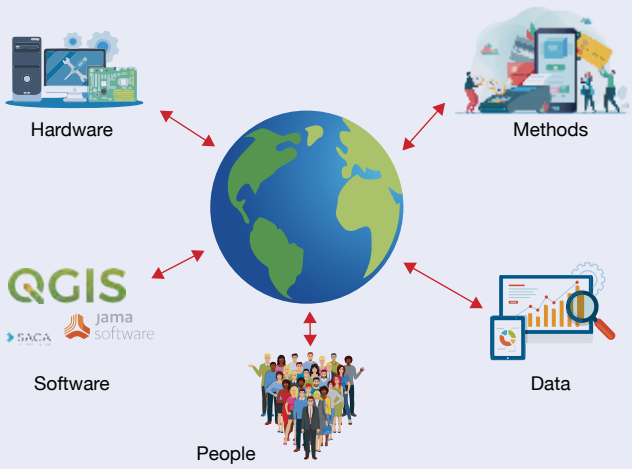


Figure 2: Components of GIS. The figure shows five elements for performing any GIS-related activities. (Mierzejowska & Pomykoł, 2019)

Remote sensing is the method of detecting and monitoring the physical features of an area by measuring the reflected and emitted radiation at a distance that is typically from a satellite or aircraft (Figure 3). Special cameras gather remotely sensed images, which assist researchers in "sense" things about the Earth and Ocean. Cameras on satellites can be utilised to make images of SWQP and physical features in the maritime region.

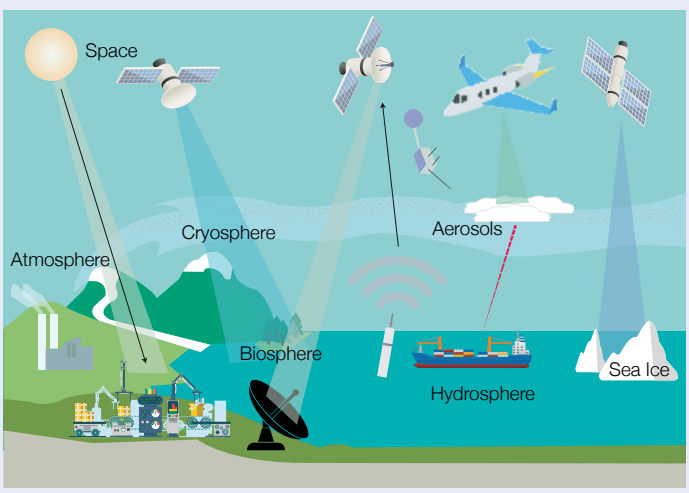


Figure 3: Functions of satellite remote sensing. The figure shows the role of satellite remote sensing in climate change studies in the maritime region. (Yang et al., 2013).

Why GIS and remote sensing for coastal area/ maritime region?

The SWQP of the BoB and physical features of the coastal area including physical, chemical, and biological properties have been experimented within the laboratory and these data are collected and gathered from the in-situ/field. The laboratory-based experiment ensures more accuracy but it takes more time and labours. GIS and RS have been applied to offshore and onshore planning, monitoring, and management to keep track of a broad range of natural and human-induced changes. As GIS and RS count and work with the spatial components, these can contribute significantly to coastal analysis, monitoring, and management in several ways (Paiman & Asmawi, 2017). GIS and RS consider database and layers which is given in Figure 4. The benefit of GIS and RS application for handling data in the maritime region and coastal management is given below:

(i) It can manage big databases of the coastal area and consolidate and synthesise data from the different relevant conditions.

(ii) It encourages the advancement and application of standards for coastal data definition, collection, and storage.

(iii) The efficiency to develop a model, test, simulation and compare alternative scenarios- past to present.

(iv) The ability to handle much larger databases and their integration leads to more holistic and coordinated management strategies.

(v) It promotes and enhances the capacity for data exchange in the coastal area.

(vi) It enables the compression of spatial and temporal scales to more manageable dimensions.

(vii) It helps to share the database for the uniform provision of datasets to all departments who are working with the GIS and RS in the coastal area.

Figure 4: Database and layers in the GIS and RS techniques (Vectorstock, 2021).

Data used in GIS and remote sensing technique

GIS and RS data can be categorised into data on a global, a regional, and a local scale. The global scale satellites deliver a variety of meteorological and non-meteorological services. The regional scale data are gathered from moderate resolution remote sensing images like MODIS sensors and Landsat satellites etc. The local scale satellites are generally used for monitoring in a limited area with high resolutions. Availability of multi-spectral and spatial data from various satellite platforms like Landsat, SPOT, etc. has assisted to provide information on different fields of the coastal and marine environment. Various ocean color data from SeaWiFS, MODIS, etc. deliver information on biological aspects and all data are categorised into vector and raster (Figure 5). Table 1 shows the Landsat band for different map purposes.

Table 1: Landsat 4-5 (TM), Landsat 7 (ETM+), and Landsat 8 (OLI), Bands for mapping

Landsat-4-5	Landsat-7	Landsat-8	Band Description	Wavelength (µm)	Resolution (m)	Mapping
-	-	Band-1	Coastal aerosol	0.43-0.45	30	Coastal and aerosol studies
Band-1	Band-1	Band-2	Visible blue	0.45-0.51	30	Bathymetric and vegetation.
Band-2	Band-2	Band-3	Visible green	0.53-0.59	30	Vegetation for assessing plant vigor
Band-3	Band-3	Band-4	Visible red	0.64-0.67	30	Vegetation slopes.
Band-4	Band-4	Band-5	Near-infrared	0.85-0.88	30	Biomass content and shorelines
Band-5	Band-5	Band-6	Short wavelength infrared-1	1.57-1.65	30	Moisture content of soil and vegetation.
Band-6	Band-6	-	Thermal Infrared	10.40-12.50	60 (30)	Thermal mapping and soil moisture.
Band-7	Band-7	Band-7	Short wavelength infrared-2	2.11-2.29	60 (30)	Hydrothermal and mineral deposits.
-	Band-8	Band-8	Panchromatic	0.50-0.68	15	Sharper image definition.
-	-	Band-9	Cirrus	1.36-1.38	30	Cirrus cloud contamination
-	-	Band-10	Thermal Infrared-1	10.6-11.19	100	Thermal mapping and soil moisture
-	-	Band-11	Thermal Infrared-2	11.50-12.51	100	Thermal mapping and soil moisture

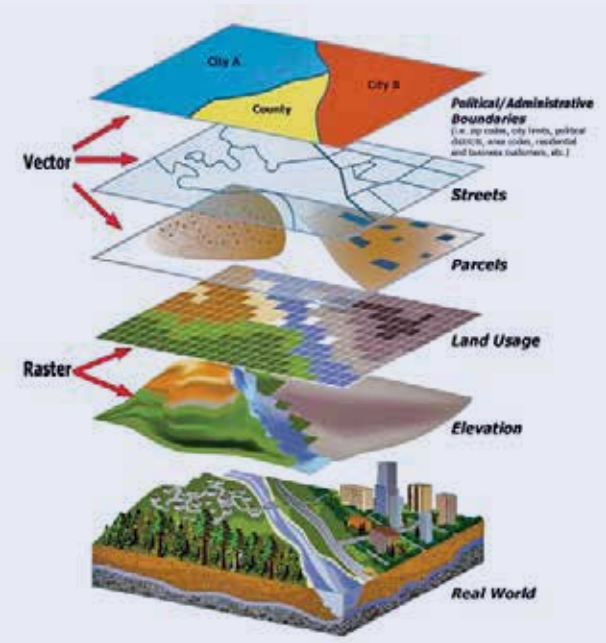


Figure 5: Raster and vector data for the analysis of GIS and RS

GIS and remote sensing application in maritime region

The current scientific tools and techniques of GIS and RS are extremely valuable in the development of databases and to analyse them in an integrated manner and derive management action plans. There are different types of applications of GIS and RS in the maritime region, especially in the coastal areas.

I. Coastal resources and marine ecosystem

Coastal habitats are highly productive, serve important ecological functions, deliver coastal protection, and are critical resources for energy, food, tourism, and economic development. Satellite imagery has immensely helped the mapping of coastal ecosystems and provided estimates of the extent and alteration in land cover in the coastal ecosystem (Figure 6). The image interpretation key is developed to identify various components of the ecosystem.

Figure 6: Marine environment and Satellite observation (Kate 2010)

Dense, degraded, mangrove plantation areas and reclaimed areas can be distinguished using Landsat data. The Potential Fishing Zone (PFZ) maps are generated based on oceanographic features. Toxic chemicals, nutrients, sediments and solid waste discharged into coastal waters affect coastal ecosystems and they can be mapped through GIS and RS.

II. Seawater quality parameters

The abundance or scarcity of SWQP experiences changes according to seasons and periods. The proper and meaningful monitoring should include identifying spatial and temporal patterns of SWQP, identification of different species related to different indicators (Ashikur et al., 2021). Chlorophyll introduces nutrient load, trophic status, and the possibility of pollutants in sea waters. Suspended sediments influence the fisheries and aquatic life, and the recreation potential of sea resorts. Oil spills from vessels and platforms are infrequent and the oil rises to the surface and spread across the water body, and thus is amenable to remote detection. Systematic observation with high-resolution satellite data will be helpful to explore their effect on coastal habitats (Nayak, 2004). Figure 7 indicates the satellite observation to detect SWQP.

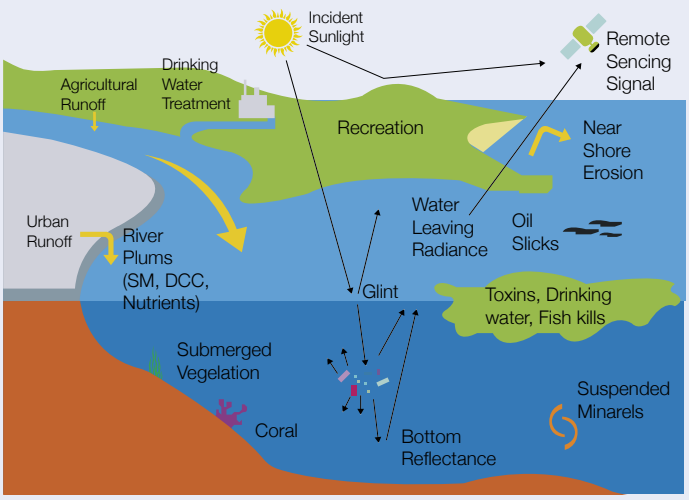


Figure 7: Water quality parameters and RS technique (Greb et al., 2018).

III. Site selection for aquaculture

Figure 8: Suitable location identification through GIS technique (WB, 2017).

The land use land cover (LULC) and wetland information have been used for exploring and examining the quality of the surrounding coastal areas and waters. The spatial distribution of coastal areas is dependent on the availability of specific resources and the scope of potential use. These maps along with other biological, meteorological, engineering, socio-economic, and infrastructure-related parameters are gathered using GIS for evaluating site suitability (Figure 8).

IV. Coastal Zone management

Coastal Zone Management (CZM) is spatial management that means the allocation and distribution of space, alternative uses, or the control of processes. The environmental (both physical and ecological) modeling can be represented by a spatially distributed model and it describes environmental phenomena. GIS combines different data sets and it facilitates the spatial and temporal analysis and the relationship between various coastal environments that allowi an easier interpretation of coastal environmental features. GIS applications use under a mixed approach have not only been identified as a decision support tool in CZM but serves a vital purpose for policymakers in tracking the emerging liabilities from coastal hazards. Besides, it is used GIS to monitor the risks from various stressors like carcinogenic toxins, toxic releases, and stream pollutants, and hazardous air triggered by industrial activities and urbanisation in different countries (Twumasi et al., 2016).

V. Sea level rise, climate change and disaster management

The integration of GIS and RS data can play an important role in minimising the danger posed by the flooding and sea-level rise. The sea-level rise is highly variable both in terms of time and space. GIS and RS data represent a powerful tool to understand the coastal processes where the images allow a synoptic view of an area and provide a relation between coastal environment, vegetation, and multi-temporal information (Figure 9). The marine environment is sensitive and vulnerable to climate change. It is necessary to determine the present status of the various systems and to predict future conditions which are the fundamental analysis of GIS and RS.

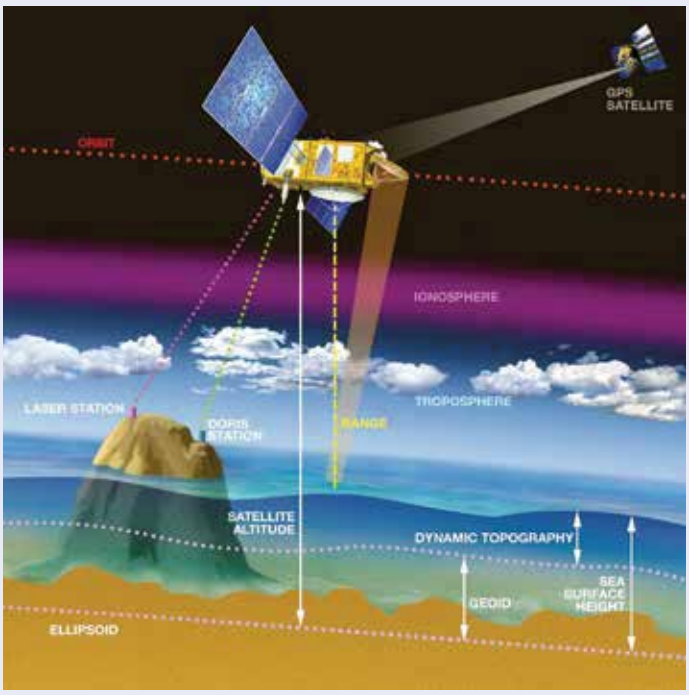


Figure 9: Sea Level Anomalies and Mean Sea Surface Modelling by Ocean Remote Sensing (Vergos & Natsiopoulos)

VI. Bathymetry, shoreline change, and boundary delineation

Multi-date satellite images have been used to analyse and simulate bathymetry and shoreline change and coastal landforms, which deliver insight into large area sediment transport studies and find out a long-term change in the entire coastline. Shoreline-change and boundary delineation mapping for the entire coastal area has been demarcated using Landsat data. Besides, the boundary of BoB is identified and demarcated with the help of the GIS and RS systems.

VII. Marine Spatial Planning (MSP)

Multi-Criteria Evaluation (MCE) also known as multi-criterion decision analysis (MCDA) is used to create areas based on multiple criteria along with a plan. When utilising MCE with spatial data, there can be better integration of social, political, environmental, and economic factors in the output than the traditional suitability analysis. RS can be used in marine spatial planning (MSP) by adding collected habitat data to management information and human impact information. Many ecologically fragile areas are designated as 'Marine Protected Areas (MPA)' to preserve and conserve such ecosystems. All the MPA should be taken under observation through GIS and RS techniques. Table 2 shows some important parameters of BoB and coastal areas along with its mathematical algorithms for the GIS and RS analysis.

Table 2: Mathematical Algorithm Applied in GIS and Remote Sensing System

SL	Parameter	Algorithm
01	Sea Surface Chlorophy	Log Chl = [2.41*(Red/Green)] + 0.187
02	Total Suspended Solid	TSS= 7.9038 * Exp(23.942 * Red)
03	Sea Surface Salinity	SSS= 29.983 + 165.047 (Blue) - 260.227 (Green) + 2.609 (Red)
04	Chemical Oxygen Demand	COD= 2.76 - 17.27 * (Blue) + 72.15 * (Green) - 12.11 * (Red)
05	Biological Oxygen Demand	BOD= 1.79 - 0.789 * Blue + 52.36 * Green + 3.28 * Red
06	Total Dissolved Solid	TDS= 171.139-88.528*(NIR)
07	Total Phosphorus	Ln(CTP)= 4.334 - 4.594 * (Blue / Green) + 1.103 * (NIR / SWIR)
08	Dissolved Oxygen	DO= -0.131xSST – 0.132xSSTm-1 + 0.066xChl-am-1 + 12.343
09	Potential of Hydrogen	PH= 11.987 + 422850000 * (G)10 - 1263600000 * (R)10 - 0.62664* (1/NIR) + 0.052596 * (1/SWIR-1) + 0.016603 * (1/NIR)2
10	Normalised Difference Turbidity Index	NDTI = (Red-Green)/(Red+Green)
11	Land Surface Temperature	Lλ={(LMAX-LMIN)/(QCALMAX-QCALMIN)}*DN-1*LMIN BT={(K2)/(ln(1+K2/K1))} LST0c=BT-273
12	Normalised Difference Water Index	NDWI=(NIR-SWIR1)/(NIR+SWIR1)
13	Normalised Difference Vegetation Index	NDVI=(NIR-Red)/(NIR+Red)
14	Soil Adjustment Vegetation Index	SAVI=(NIR-Red)/(NIR+Red+L)
15	Normalised Difference Salinity Index	NDSI = (Red – NIR)/ (Red + NIR)
16	Salinity Index-1	SI-1 = (Red * NIR) / Green
17	Salinity Index-2	SI-2 = Sqrt (Green2 + Red2)
18	Vegetation Soil Salinity I ndex	VSSI = 2 * Green – NIR * (Red + NIR)
19	Modified Normalised Difference Water Index	MNDWI = (Green - MIR)/ (Green + MIR)
20	Normalised Difference Buildup Index	NDBI=(SWIR1-NIR)/(SWIR1+NIR)
21	Enhance Bareness And Buildup Index	EBBI=(SWIR1-NIR)/(10√(SWIR1+TIRS1)
22	Bathymetry Calculation	Lyzenga model = Ln (Blue) / Ln (Green)

Conclusion

The maritime region is considered as a comparatively small but highly productive and extremely diversified system with a variety of ecosystems. As it has complex and diversified characteristics, GIS and RS have become more important for the coastal environment. The maritime region research can certainly be perfectioned and updated by the use of GIS and RS. These techniques will prove useful in drawing attention to shoreline geomorphological features, SWQP, and man-made structures. Specific coastal issues like habitat protection and coastal hazards, can thus better be addressed. GIS and RS represent the latest weapon in the arsenal of tools to solve the spatial data-handling problem.

It is gainsaid that a GIS and RS approach would foster an intensive collaboration between scientists, planners, engineers, policy experts, oceanographers, and coastal zone managers. And GIS and RS are educational and research tools with serious potential to enhance better land-use decision-taking at the national and local levels in the maritime region.

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