PAAL

Vol 07, Issue 01, April 2024

Maritime Science
A Journey from Waves to Wisdom

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A publication of
PATRONISED BY BANGLADESH NAVY
BIMRAD
Bangladesh Institute of Maritime Research and Development

Volume 07, Issue 01, April 2024

PAAL

A Publication of Bangladesh Institute of Maritime Research and Development (BIMRAD)

Patronised by Bangladesh Navy

Registered Under the Societies Registration Act XXI of 1860, No. S 12926/2018

ISSN 2959-5444

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Price: BDT 250.00 / USD 8.00

Editorial

Maritime Science: A Journey from Waves to Wisdom

Nestled amidst the intricate waterways of South Asia, Bangladesh has long been intimately connected to the rhythms of the ocean. With its extensive river networks, sprawling coastlines, and abundant marine life, the nation's destiny has been woven with the threads of blue. As we navigate through the pages of this edition, our focus naturally turns to the maritime domain, where Bangladesh's dynamic blue economy shines as a beacon of sustainable progress on the global stage.

At the heart of this endeavor lies the crucial role of marine science. In a world where economic advancement must walk hand in hand with ecological stewardship, marine science emerges as the compass guiding us towards a balanced and thriving future. Bangladesh's rich maritime resources present both opportunities and challenges that require a deep understanding of the marine ecosystem.

Marine science serves as the foundation upon which Bangladesh can build a resilient blue economy. Through meticulous research and exploration, scientists can uncover the untapped potential of the ocean while also deciphering the delicate balance necessary to ensure its long-term health. From studying marine biodiversity to assessing the impacts of climate change on coastal communities, marine scientists play a crucial role in shaping policies and practices that safeguard our marine environment.

The concept of the blue economy extends far beyond traditional sectors, encompassing a wide array of disciplines within marine science. From oceanography to marine biology, from marine geology to maritime engineering, each branch of marine science contributes valuable insights and expertise to the sustainable management of our oceans. Through interdisciplinary collaboration and innovative research, marine scientists can unlock new avenues for economic growth while also preserving the integrity of marine ecosystems.

As we navigate the challenges posed by climate change, marine science becomes even more essential. Rising sea levels, ocean acidification, and extreme weather events threaten not only coastal communities but also the very foundation of our blue economy. Through cutting-edge research and predictive modelling, marine scientists can help us anticipate and mitigate the impacts of climate change, ensuring that Bangladesh's maritime resources remain resilient and productive for generations to come.

In this edition of PAAL, we delve deep into the role of marine science in shaping Bangladesh's blue economy. From exploring the potential of maritime fisheries, shipping and trade, offshore wind and tidal energy to examining the impacts of marine pollution and environmental degradation, our contributors offer valuable insights and perspectives on the challenges and opportunities that lie ahead. Through their expertise and dedication, we gain a deeper understanding of the intricate web of life that sustains our oceans and drives our economy.

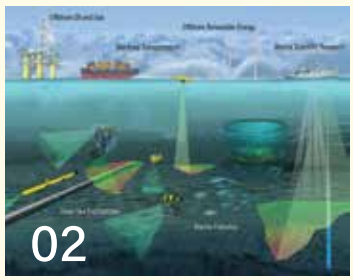
As we set sail on this journey towards a sustainable blue economy, let us heed the wisdom of marine science. Let us chart a course that honors the delicate balance between human prosperity and ecological integrity. And let us, together, navigate towards a future where our oceans thrive, our communities prosper, and our planet flourishes.

Thanking you
Editorial Board

“There is No Doubt That Sea-Related Subjects Like Expansion of International Trade, Use of Marine Mineral Resources for Long-Term Energy Security, Proper Management of Marine Fish Resources and Protecting Marine Environment and Marine Biodiversity Would Determine Bangladesh’s Future Development and Economic Growth”

- Hon’ble Prime Minister Sheikh Hasina

In this issue...



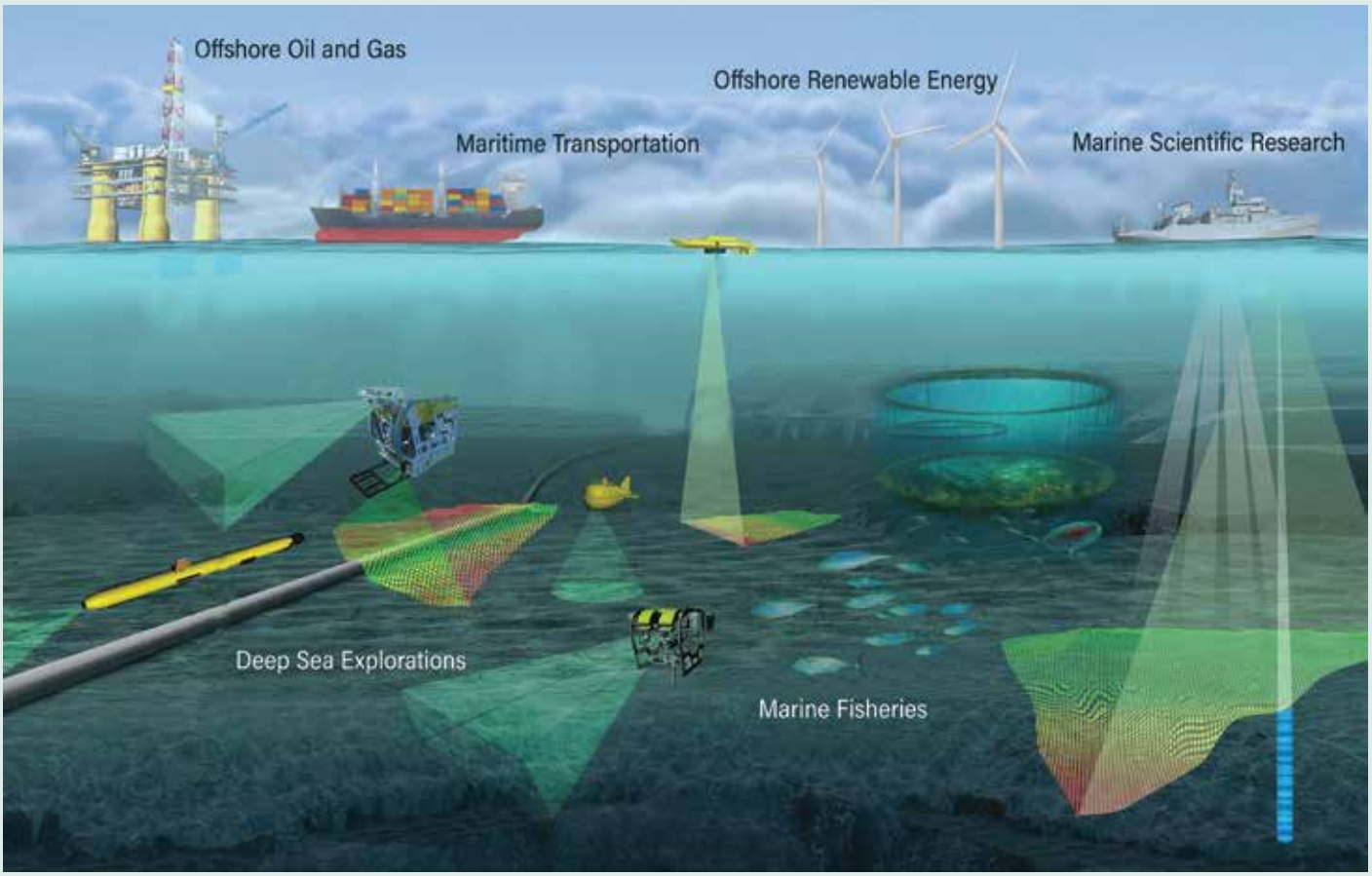
Cover Story

BIMRAD Feats

Articles

From Waves to Wisdom: How Marine Science is Fueling Bangladesh's Blue Economy

Captain M Minhaz Uddin, (H), NPP, psc, BN



Our planet is often called "Earth," but that's a bit misleading because about two-thirds is covered in blue water. That's why it's more accurate to call it the "blue planet." Life exists only on Earth, but for centuries, humans have been benefiting from the resources found in the oceans. The idea of using the oceans for economic purposes is not new, but what's gaining recognition is the crucial role oceans play in sustainable economic growth.

The term "blue economy" refers to a sustainable development approach that sees the oceans as valuable spaces for development. This involves careful planning integrating conservation, sustainable use of living resources, extracting oil and minerals, bio-prospecting, sustainable energy production, and developing the marine transport sector. The key idea behind the Blue Economy is to separate socio-economic development from environmental harm, moving away from the traditional 'brown' model of high energy, low employment, and industrialized development.

The vast expanse of the ocean, with its mesmerizing waves and profound mysteries, holds unparalleled significance for Bangladesh, a country bounded by the Bay of Bengal to the south. In the context of Bangladesh, the ocean is not merely a source of natural beauty but a gateway to immense economic opportunities, encapsulated by the concept of the blue economy. The Bay of Bengal, with its rich biodiversity, not only supports a diverse marine ecosystem but also offers vast fisheries potential. The country's traditional reliance on fisheries has evolved into a strategic approach towards sustainable management, fostering economic growth while preserving the marine environment.

On the other hand, marine science became the conductor, coordinating this complex symphony. Researchers, like ocean detectives, donned their metaphorical magnifying glasses, unraveling the Bay's hidden secrets. They meticulously mapped its swirling currents, charted the vibrant tapestry of its life forms, and diagnosed its silent wounds. They became the voice of the voiceless, speaking for the coral reefs whispering with secrets of millennia, the mangroves standing guard against coastal erosion, and the turtles weaving through underwater forests.

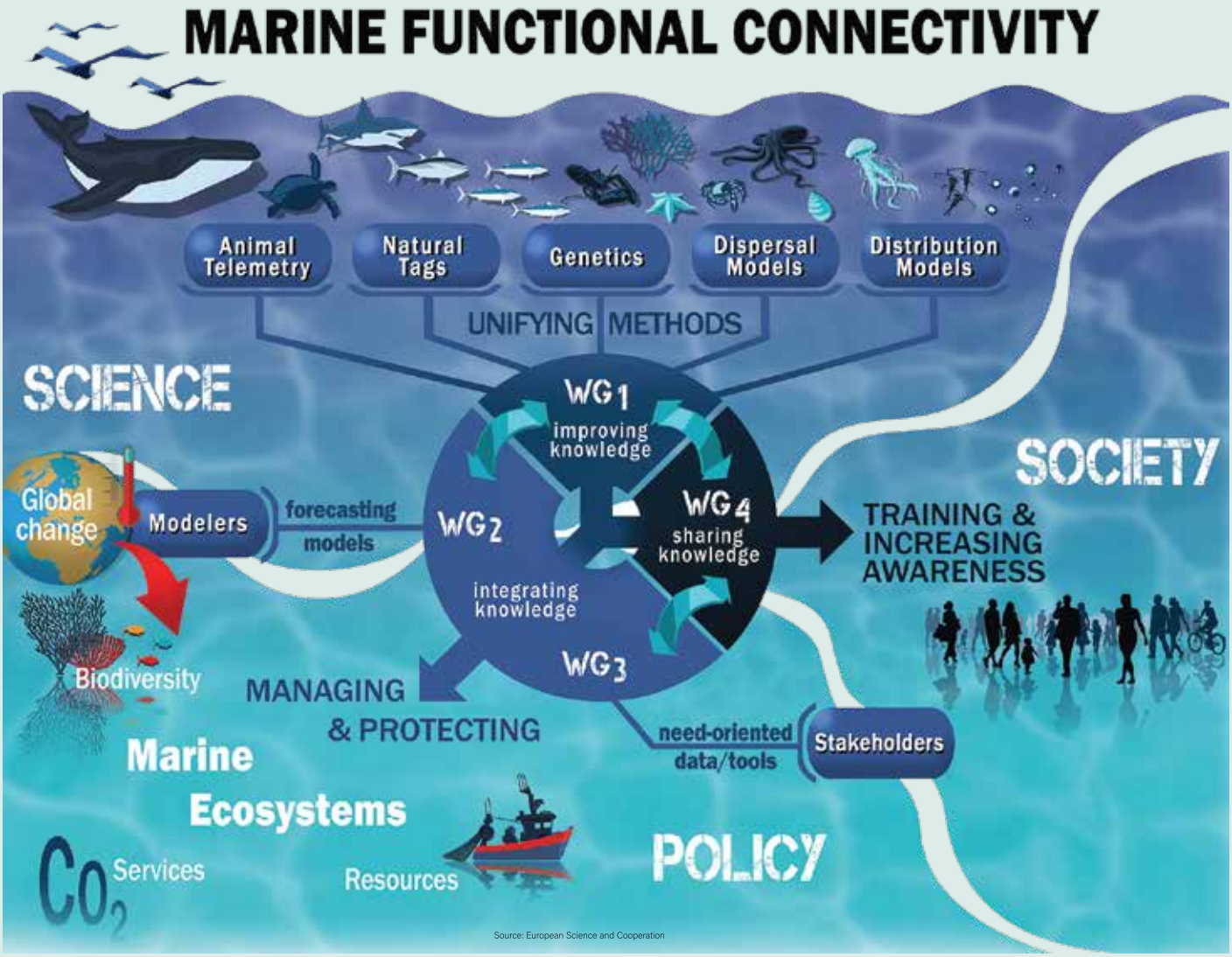
In the coastal expanse of Bangladesh, the fusion of scientific knowledge with human ingenuity has sparked a renaissance across 26 diverse industries, collectively breathing life into the blue economy. Take aquaculture, for instance, where scientific precision has transformed traditional fish farming into a sophisticated endeavor. Through careful monitoring of water quality, selective breeding programs, and innovative feeding techniques, aquaculture not only meets the nutritional needs of millions but also safeguards the delicate balance of marine ecosystems by alleviating pressure on wild fish stocks.

The spectacle of seaweed farms, swaying gently in the ocean currents like emerald tapestries, is another testament to the transformative power of scientific understanding. These farms serve as a sustainable source of food and income and act as powerful agents in the fight against climate change. Through photosynthesis, seaweeds sequester carbon dioxide from the atmosphere, playing a crucial role in mitigating greenhouse gas emissions while yielding valuable bio-treasures such as alginate, agar, and carrageenan.

Offshore windmills stand tall as majestic sentinels, their whispering blades harnessing the relentless power of the ocean winds to generate clean, renewable energy. Powered by scientific insights into aerodynamics and engineering, these wind farms reduce dependence on fossil fuels and contribute to the nation's energy security while minimizing environmental impact.

Meanwhile, the art of shipbuilding has been elevated to new heights by applying hydrodynamic wisdom. Vessels crafted with precision engineering and advanced materials glide through the waves with the grace of dolphins, demonstrating the symbiotic relationship between scientific knowledge and maritime craftsmanship.

In the realm of maritime transport, optimization through data-driven insights has revolutionized the efficiency of global trade. From route planning to cargo management, every aspect of the supply chain is fine-tuned with scientific precision, ensuring smooth and seamless operations while minimizing environmental footprint.



Tourism, too, has undergone a metamorphosis, evolving into a responsible and immersive experience that celebrates the beauty of the Bay of Bengal while respecting its delicate ecosystems. Guided by marine science, visitors embark on journeys that enrich their lives and contribute to conserving coastal biodiversity and empowering local communities.

At the heart of this transformative journey lies the empowerment of coastal communities, once vulnerable and marginalized, now equipped with scientific knowledge and sustainable practices to safeguard their livelihoods and the future of the ocean. Through collaboration between researchers, policymakers, and industry stakeholders, data flows like whispered secrets, informing evidence-based decision-making that ensures environmental regulations are not barriers but catalysts for sustainable development.

Even if we look into the diagram, it appropriately shows the relationship between marine science, society, and training and increasing awareness, titled "Marine Functional Connectivity." The diagram shows how these three groups are interconnected and work together to improve our understanding of the marine environment.

The animal telemetry, natural tags, genetics, dispersal models, and distribution models boxes in the top left of the diagram represent the different aspects of the marine environment that scientists study. The unifying methods box in the center of the diagram shows how scientists use a variety of approaches to collect data and learn about the marine environment.

The science box on the left side of the diagram represents the role of scientists in improving our understanding of the marine environment. The global change, modelers, forecasting, and (Working Group 2) WG2 boxes show how scientists use models to forecast how the marine environment will change in the future. The (Working Group 4) WG4 box shows how scientists share their knowledge with other groups.

The society box on the right side of the diagram represents the role of society in managing and protecting the marine environment. The biodiversity, managing, protecting marine ecosystems, and CO_2 boxes show how society can take action to protect the marine environment. The services box shows how the marine environment provides various benefits, such as food and recreation. The resources box shows how we can use the resources of the marine environment sustainably.

The policy box at the bottom of the diagram shows how policy can be used to protect the marine environment. The stakeholders box shows how different groups, such as governments, businesses, and NGOs, can work together to protect the marine environment.

The training and increasing awareness box at the top of the diagram shows how we can all learn more about the marine environment and take action to protect it. The need-oriented data/tools box shows how we can develop tools and data that meet the needs of stakeholders.

Overall, the diagram shows how marine science, society, training, and awareness are interconnected and work together to improve our understanding of the marine environment and protect it for future generations.

The diagram shows the symphony of a future where the blessings of science are not merely felt but celebrated as essential pillars of a prosperous and harmonious coexistence between humanity and the ocean.

But the symphony isn't without its discordant notes. Climate change, a menacing storm cloud, loomed on the horizon. Even the study of marine science kept a close watch, creating systems to warn early about potential issues, mapping at-risk areas, and helping with plans to adjust and adapt. In this unfolding saga, the blue economy is more than a development model. It's a cultural revolution, a rekindled respect for the ocean, recognition that our fate is intertwined with its health. It's a story woven with the threads of science, innovation, and community, a tapestry shimmering with the promise of a sustainable future.

The ongoing narrative of the blue economy extends an invitation for our participation. Join the collective effort, let our voice harmonize with the chorus, and let our actions contribute as strokes on the canvas of a sustainable future.

The next time you experience the sea breeze, pay attention. Within the sound of the waves, you'll discern the resonance of a transformative era – a narrative where scientific advancements guide the way, communities act as stewards of the oceans, and a nation collaborates with the Bay, hand in hand, toward a prosperous future. The ongoing narrative of the blue economy extends an invitation for our participation. Join the collective effort, let our voice harmonize with the chorus, and let our actions contribute as strokes on the canvas of a sustainable future. Together, let's compose a narrative that will be scraped in the memory of oceans for generations to come.

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Article

Exploring the Marine Conservation Potentials and Challenges of the Swatch of No Ground Marine Protected Area

Commodore M Nazmul Hassan, (N), NPP, BCGM, PCGMS, afwc, psc, BN

Introductory Background

Marine conservation concerns the science and art of conserving physical and biological marine resources and ecosystems. It functions through planned management and governance while encountering over-exploitation of living and non-living marine resources, destructive fishing, habitat degradation, species loss, and marine pollution to protect the marine environment. Marine Protected Areas (MPAs) are fundamental marine conservation tools that provide legal protection and management measures to conserve biodiversity, maintain ecological processes, and promote sustainable resource use. It reduces anthropogenic damage to marine ecosystem and restores damaged ecosystems, including habitats, biodiversity, and threatened species. On the contrary, overfishing and poaching, illegal equipment usage, including small mesh nets, and destructive fishing by the Illegal Unreported and Unregulated (IUU) fishers pose offshore challenges to the marine conservation of Bangladesh. The former Ministry of Environment and Forest of Bangladesh declared part of the Swatch of the No Ground (SoNG) area of the Bay of Bengal (BoB) as Bangladesh's first MPA on 27 October 2014 under the Wildlife Conservation and Security Act, 2012. It is instrumental and holds immense potential in conserving marine ecosystems, including threatened species.

Swatch of No Ground MPA

Swatch of No Ground (SoNG), a deep sea canyon, is located south of Sundarban and the Dublar Char Island in the BoB. With an average depth of 900 meters covering approximately

1,836 sq km of marine area, it is known as a hotspot and a critical habitat for endangered cetaceans. It is also a significant marine biodiversity hotspot that offers unique conservation opportunities in the BoB. The SoNG MPA is the first significant marine conservation initiative of the Government of Bangladesh aimed at conserving and protecting unique marine ecosystems, including rich biodiversity and fragile habitats off Dublar Char Island. It also holds immense potential for blue economic activities like marine fisheries, renewable energy, and ecotourism amidst sustainable marine conservation of the BoB. According to the International Union for Conservation of Nature (IUCN), the SoNG MPA falls into category IV (habitats and species management area), which is managed mainly for conservation to maintain, conserve and restore species and habitats of endangered marine ecosystems. It offers a sanctuary and has been an essential breeding and spawning ground for endangered marine species like cetaceans, whales, dolphins, turtles, sharks, rays, birds, and other globally endangered marine species. However, the SoNG MPA contributes to climate resilience through carbon sequestration services that mitigate climate change effects.

Conservation Potentials of SoNG MPA

The SoNG MPA presents a myriad of opportunities for marine conservation through the ecosystem, biodiversity, endangered species, and habitat protection. Despite threats such as overfishing and habitat destruction, the SoNG MPA remains a critical area for marine species, illustrating its transboundary conservation potential, including marine conservation research. However, the marine conservation potential of SoNG MPA is depicted below:

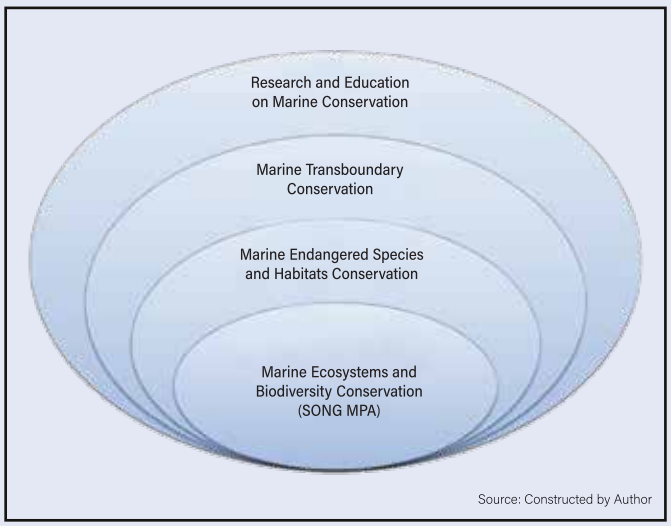

Figure 2: Conservation Potential of SoNG MPA

Preservation and Restoration of Marine Ecosystems and Biodiversity. The SoNG MPA is acknowledged for its rich biodiversity and unique ecological characteristics. It plays a significant role in maintaining the overall health and balance of the marine ecosystems of BoB. Overfishing and destructive fishing practices, including bycatch, pose significant risks to the populations of various species, including sharks, turtles, and cetaceans. The escalating anthropogenic activities and environmental changes have endangered many marine species, which warrants preservation and restoration efforts. Implementing protective measures like marine pollution control, sustainable fishing practices, and effective governance of SoNG MPA is critical for the conservation of endangered species, ecosystems, biodiversity, and the resilience of the marine environment of the BoB.

Protection of Endangered Marine Species and Habitats. The SoNG MPA is a critical marine ecosystem supporting habitat for several endangered and threatened species. Unsustainable human activities, such as overfishing, habitat destruction, and pollution, pose significant risks to the survival of these species. As such, many of these species are endangered and about to be extinct due to various human activities. Implementing sustainable fishing practices, such as size and catch limits, gear restrictions, and seasonal closures, can prevent overfishing and ensure the long-term viability of fish populations. It is imperative to prioritize the protection and conservation of these species by implementing various strategies, including sustainable fishing practices, pollution control measures, public awareness campaigns, and effective governance of SoNG MPA.

Marine Transboundary Conservation Potential. The SoNG MPA is characterized by rich marine biodiversity, valuable ecosystems, and globally endangered and threatened species that transcend national maritime borders. It shares a border with Indian territorial waters. The SoNG MPA holds significant potential for establishing transboundary MPA with India amidst common global challenges like marine pollution, over-exploitation of fish, and climate change. By harnessing the potential of transboundary MPA, Bangladesh can enhance the protection and sustainable management of the marine resources in the SoNG area of BoB and foster regional cooperation with India.

Education and Research on Marine Conservation. Education and research on marine conservation are critical components in understanding the ecological processes, identifying threats, and addressing the challenges faced by the ecosystems for their sustainability. Marine conservation education is crucial for fostering a sense of stewardship and understanding the ecological importance, biodiversity, and vulnerability of the SoNG area. Research, a cornerstone of effective marine conservation, helps identify and comprehend the ecological processes, biodiversity patterns, and sustainable ecosystem services in the BoB. It raises awareness and provides scientific knowledge for evidence-based decision-making. Education and research are the fundamental pillars of marine conservation in the SoNG area of the BoB. By prioritizing education and research, the SoNG ecosystem's conservation efforts will be sustainably enhanced.

Marine Conservation Challenges of SoNG MPA

The marine environment of the BoB is susceptible to threats like global warming and ocean acidification induced by climate change. Anthropogenic interferences like marine pollution, destructive and IUU fishing due to rampant commercial exploitation of marine resources, including an inadequate understanding of marine conservation, rising in the BoB. The significant anthropogenic damages arising from the extensive exploitation of living and non-living marine resources, destructive fishing practices, habitat degradation, species loss, and the prevalence of marine pollution pose substantial challenges to the conservation of marine ecosystems of SoNG MPA. Bridging knowledge gaps, promoting mass communication, and increasing public awareness through research and education are essential for the conservation and management of the SoNG MPA. Moreover, electronic and print media are also essential in fostering stewardship and promoting responsible behavior towards marine ecosystems. However, the critical challenges of marine conservation of SoNG MPA are summarized below:

- Global warming, ocean acidification, and marine Pollution
- Illegal, unreported, and unregulated fishing and unsustainable fisheries
- Unsustainable or destructive fishing practices
- Preserving ecological integrity and protecting marine ecosystems
- Protecting vulnerable marine habitats
- Promoting a healthy and resilient marine environment
- Engaging local communities and stakeholders
- Implementing education initiatives, including marine research
- Bridging knowledge gaps and public awareness
- Sustainable legal and policy frameworks
- Effective management and governance

Concluding Remarks

The SoNG MPA is a unique and ecologically significant marine ecosystem that warrants sustainable conservation through effective management and governance. The conservation efforts of SoNG MPA must be supported by scientific data, appropriate policy promulgation, and active community participation in achieving adequate protection of the marine environment of the BoB and its invaluable marine biodiversity. Significant threats to the marine environment of the BoB include destructive fishing, marine pollution, climate change, and other unsustainable economic activities at sea. Besides, most blue economic activities like fisheries, transportation, tourism, and exploration of living and non-leaving resources often conflict with marine conservation. SoNG MPA has the potential to facilitate the protection and preservation of endangered species, including their habitats and the biodiversity of marine ecosystems in the BoB. Effective marine spatial planning, MPA governance, monitoring, and stakeholder engagement are essential for maximizing its potential for sustainable marine conservation. SoNG MPA needs specific policy guidelines on protection, management, and governance. It requires effective management plans and governance frameworks to safeguard its biodiversity, ecological integrity, and conservation goals. Ensuring a healthy marine environment in the declared MPAs through effective conservation measures, management, and governance will thus contribute directly towards the sustainable blue growth of Bangladesh. Hence, it is imperative to facilitate a healthy marine environment through effective conservation of SoNG MPA to foster sustainable blue growth and the socio-economic development of Bangladesh.

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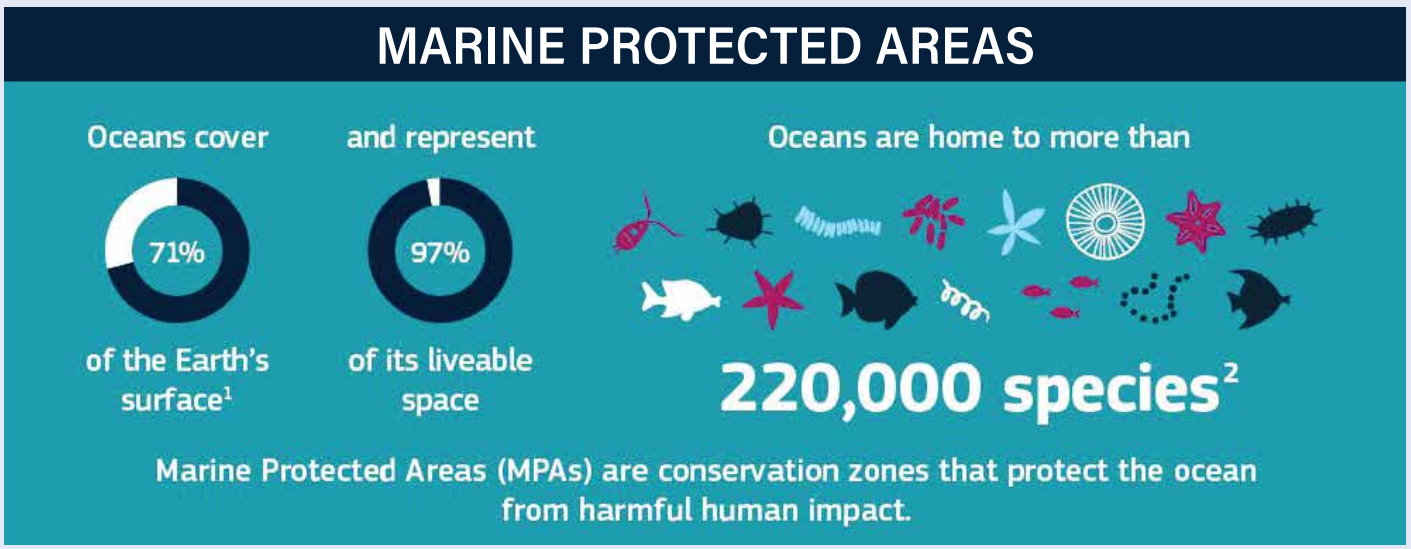


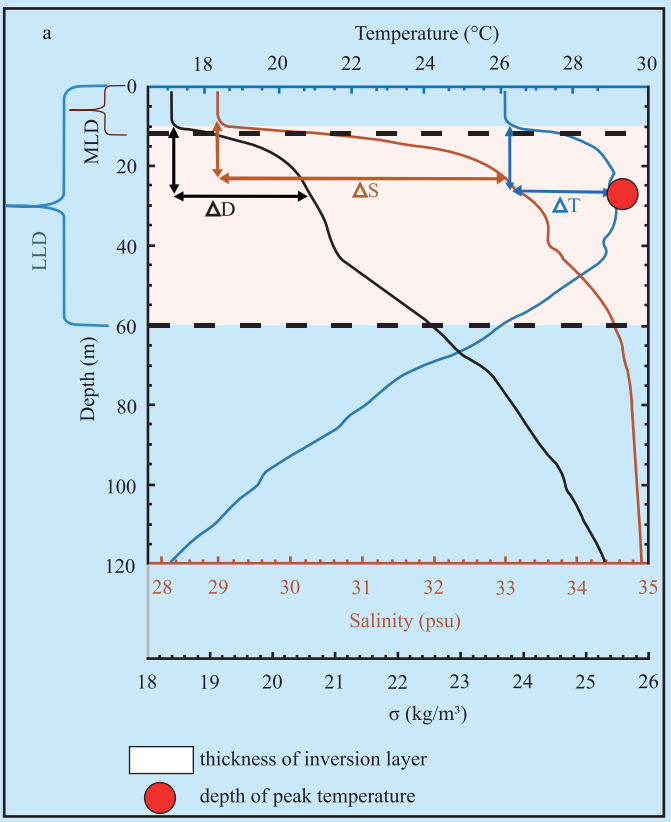
Article

Temperature Inversion in the Bay of Bengal

Dr. K M Azam Chowdhury

A layer between the warmer subsurface layer below and the colder surface water above is known as the temperature inversion layer. In contrast to the gradual decrease of temperature in a typical profile, temperature inversion creates a zone of positive gradient in the subsurface in a temperature profile. Temperature inversion was first introduced by Makarov (1894) in the North Pacific Ocean and later explored in detail by Uda (1935) in this ocean. Subsequently, this anomalous temperature profile has been observed in different parts of the world and considered a common occurrence in the subarctic of the North Pacific Ocean. This phenomenon has also been observed in several other tropical and subtropical oceans, including the Bay of Bengal (BoB).

Temperature inversion generally occurs at the strong temperature front and in an area with a robust temperature structure where warm and cold water meets, such as the mixing zone of the Kuroshio and Oyashio currents (Nagata, 1968, 1979). Nevertheless, the temperature structure of the North Pacific subarctic ocean (North of 45°N) and subtropical/tropical regions are not similar. In the subtropical/tropical regions, there might be only a temperature maximum in the subsurface layer, whereas in the subarctic region, the vertical temperature profile has both the minimum and the maximum. This temperature minimum and maximum in the subarctic region are known to be the dichothermal and mesothermal structures, respectively.



A barrier layer is a layer with sharp halocline below the MLD, usually observed in the southeastern Arabian Sea, eastern equatorial Indian Ocean, and BoB. Barrier layer thickness is the term used to describe the thickness of the layer. Temperature inversion has been detected within the barrier layer in the Indian Ocean. East India Coastal Current and Winter Monsoon Current drifts the cool, low-saline water from the BoB to the adjacent Arabian. When this cool, low-saline water advected over the warm, salty water of the Arabian Sea haline stratification formed and aids to form temperature inversion. Net surface heat loss and penetrative heat below the mixed layer are also dominant precursors for the initiation temperature inversion in this sea. Thus, upper ocean thermohaline structure is essential to know the processes driving the temperature inversion in an ocean.

A strong haline stratified layer inhibits the mixing and causes a thin mixed layer, which is suitable for the formation of temperature inversion. Still, such inversions continue to exist in tandem with the barrier layer. The barrier layer prevents nutrients to exchange from surface to subsurface, which affects the productivity and, eventually, the ocean's ecosystem. It also significantly affects the climate system by changing the sea surface temperature (SST) and mixed layer heat budget. Several studies also have reported the non-negligible effect of temperature inversion on SST in the BoB. There is an obstruction to transferring of heat and biogeochemical components between the surface and deeper water in an area with temperature inversion. Furthermore, the upper layer thermal structure influences the ocean heat content, the tropical cyclone heat potential, and the regional weather system. Because of this, a realistic understanding of temperature inversions, including their vertical structures and processes, is necessary to elucidate the dynamics of the surface layer and thermodynamics in the oceanic regions where they occur.

Most of the research considering the BoB suggested that temperature inversion only occurs in the winter, while a few studies also proposed that it happens in the spring, summer, and autumn. For example, Girishkumar et al. (2013) noted temperature inversion in the central bay from autumn to winter; Vinayachandran et al. (2002) identified summertime temperature inversion in the northern bay; and Li et al. (2012) revealed temperature inversion in late spring along the Sri Lankan dome. In addition, Thompson et al. (2006) and De Boyer Montégut et al. (2007) hypothesized that temperature inversion occurs in the BoB practically year-round considering some Argo data (Array for Real-time Geostrophic Oceanography).

The available observational data sources in the central and southern parts of the BoB are the RAMA mooring buoys (Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction). Using in-situ data, Thadathil et al. (2016) revealed much weaker inversions at the RAMA buoy stations (12°N, 8°N, and 4°N) along 90°E, providing evidence of the presence of the temperature inversion outside the northern BoB. Li et al. (2016) averaged the temperature inversion temporally and spatially (averaged over 5 days within a 2°×2° bin) considering basin-wide Argo data and identified the primary elements of the wintertime temperature inversion in the northern BoB. However, Chowdhury et al. 2022 provide a comprehensive picture of temperature inversion throughout the basin extending beyond winter. They use long-term Argo (2004 to 2020) and RAMA (2007 to 2020) profile data in the BoB and eastern equatorial Indian Ocean to focus on the region's finer-scale temporal and spatial distribution of temperature.

In the northern BoB, net surface heat loss and freshwater advection are recommended as the main factors causing the temperature inversion during winter, considering research concentrating on a single RAMA buoy or a portion of the bay. For example, Shee et al. (2019) took into account a single Argo float, while Thadathil et al. (2016) and Li et al. (2016) utilized the RAMA buoy (15°N, 90°E) to explore the mechanisms of temperature inversion using heat budget analysis. Girishkumar et al. (2013) examined the temperature inversion at RAMA (8°N, 90°E) and reported that penetrated heat beneath the mixed layer is advantageous for the temperature inversion formation in the central bay. It has been proposed that during winter, the downwelling eddy plays a significant role in the production of inversion along the northern bay. Chowdhury et al. (2022) disclosed the driving mechanisms behind temperature inversion for several sub-regions in the BoB. The combined effect of the cooling tendency of the mixed layer and the significantly warmer subsurface layer below the stratified shallow mixed layer (mean 25 W/m^2) causes higher temperature inversions throughout the year in the northern BoB. The southern portion of the bay is less favorable than the northern part to the formation of a temperature inversion due to a lower cooling tendency by net surface heat loss and a higher salinity of the mixed layer. Comparatively, deeper ILD, and the thicker BLT promote to form an intense temperature inversion in both the BoB. The tropical cyclone heat potential is higher in temperature inversion events than that of noninversion profiles during spring to autumn in this area.

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1

Carbon dioxide (CO_2) levels in the atmosphere rise due to human activities that burn fossil fuels. Driving, creating electricity, and deforestation are all activities that emit carbon dioxide.

Did you know: The ocean's pH has changed from 8.2 to 8.1 since the industrial revolution. This may sound small, but it is actually a ***30% increase in acidity***.

2

Excess carbon dioxide dissolves into the ocean, where it reacts with water (H_2O) to create carbonic acid. This chemical reaction increases the acidity of the ocean. Ocean acidity is measured by pH (a lower pH = higher acidity).

$CO_2 + H_2O$ = Increased Acidity

22 million tonnes of CO_2 is absorbed by the ocean per day.

Humans who are dependent on marine resources are negatively affected. Many humans depend on the ocean for food or livelihoods. Acidification impacts the marine ecosystem, and makes it difficult for humans to get resources from the ocean.

3

Increased acidity harms marine life. Even small changes in pH can have a big impact.

Organisms with shells can't get enough carbonate ions to build their shells, and can't maintain their shells or skeletons.

Some fish can't function well in higher acidity environments and may have trouble detecting predators, growing and developing, or finding suitable habitats.

Acidity threatens plankton and other organisms that form the base of the food chain. This disruption of the food chain makes it harder for larger organisms to get enough food

Ocean Acidification

How Carbon Emissions Impact Marine Life

Article

Ocean's Secrets: How Marine Science Safeguards Life Below the Waves

Afifat Khanam Ritika

Bangladesh heavily relies on its aquatic resources, particularly the Bay of Bengal, for sustenance. More than 60% of the country's animal protein intake, supporting a population of over 160 million, is sourced from inland and marine fisheries regions. The agricultural sector, engaging nearly half of the population in farming, fishing, fish handling, and processing, constitutes 14.2% of the nation's economic output. The Bay of Bengal specifically contributes about 20% to the overall fish production in the country.

But, in this present context, this exclusive support-providing ocean is under severe threat. Concerns about overfishing and habitat degradation have haunted the Bay for decades. Historically, believing in the ocean's unlimited bounty comforted societies into complacency. However, scientific evidence painted a bleaker picture by the turn of the 20th century. The 1884 pronouncement of Thomas Henry Huxley – "the fisheries will last indefinitely, if not interfered with by man" – proved tragically ill-founded. This tragically optimistic pronouncement failed to grasp the immense impact of technological advances and limitless appetites. Overfishing has pushed many species, like bluefin tuna, to the brink despite the vastness of the oceans, exposing Huxley's assumption as a fatal miscalculation.

So, this stark reality ushered in a new era of consideration. Many Research institutions like the Bangladesh Fisheries Research Institute (BFRI) and dedicated marine stations across the country emerged as guards of knowledge. Through particular data collection, stock assessments, and ecosystem studies, they shed light on the intricate life cycles of commercially important fish, mapped the delicate tapestry of the ecosystem, and quantified the dangerous dance between exploitation and sustainability. Population models, meticulously crafted using data on growth, recruitment, and mortality, whispered prophecies of future fish populations inform crucial decisions like the Total Allowable Catch (TAC). Marine protected areas, established based on scientific guidance, became sanctuaries for threatened species, offering safe havens for regeneration. All the above issues are intimately

connected to the knowledge of marine science. No doubt, dealing with fisheries requires an explicit knowledge of marine science. Along with food and livelihood, marine ecosystems, with their intricate web of interactions between species, also influence climate patterns and carbon cycling, playing a crucial role in the Earth's overall environmental stability. Sustainable practices informed by marine science are crucial for ensuring the resilience of these ecosystems, safeguarding biodiversity, and sustaining the economic benefits derived from the world's oceans.

As we explore deeper into understanding the complex relationships within marine ecosystems, we gain insights into the sustainability of fisheries and aquaculture and potential solutions for broader environmental issues. Thus, investing in marine science is an investment in the resilience of ecosystems, the protection of biodiversity, and the long-term stability of the global economy.

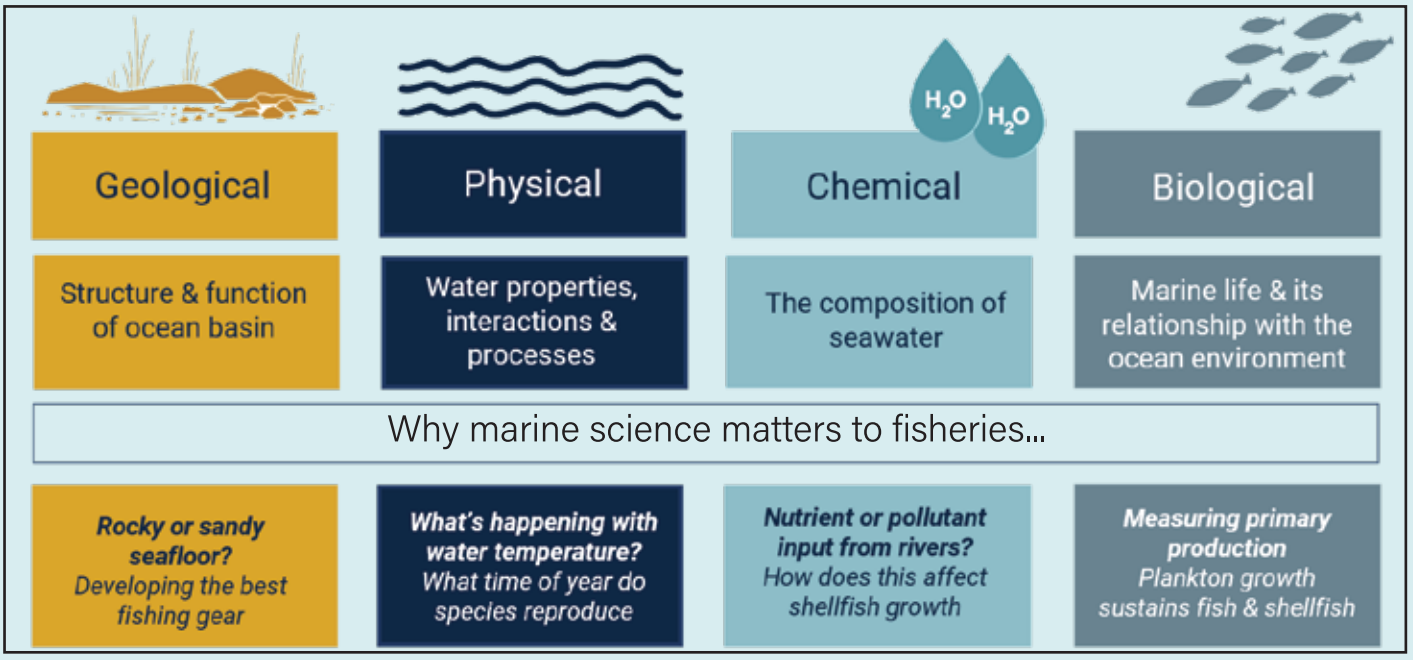
Additionally, marine science deployed a diverse array of tools in exploration. Oceanographers chart currents and unveil the hidden topography of the seafloor, while biologists delve into the intricacies of marine organisms, from microscopic plankton to majestic whales. Chemists analyze the complex soup of elements and compounds sustaining ocean life. Technological advancements, such as underwater drones and advanced sensors, provide real-time data, allowing for unprecedented observation and understanding of the ocean's complexities.

But when we talk about sustainable fisheries management, it relies on a comprehensive understanding of the interactions between various species, environmental changes' impacts, the ecosystem, ocean physics and chemistry, etc. So, fisheries are a package of different sciences, or as a whole, marine science. One prime example of the intertwined relationship between marine science and fisheries is using oceanographic models to predict tuna migration patterns. Marine scientists meticulously track ocean currents, water temperature, and food availability through these models, providing crucial insights to fisheries managers. This information allows them to implement catch quotas in specific areas at specific times, minimizing bycatch and protecting vulnerable tuna populations while ensuring a sustainable and profitable fishery. This intricate dance between scientific data and fishery management demonstrates marine science's vital role in maintaining healthy tuna populations and a thriving fishing industry.

In a true sense, the sustainable fisheries practice is now critical. Advancements in marine science are essential for maintaining fish stocks, preserving biodiversity, and ensuring the long-term viability of the fishing industry. Integrating scientific insights into fisheries management can enhance resilience, mitigate climate change impacts, and secure marine resources' economic and ecological sustainability for current and future generations.

Marine science's benefits extend beyond the immediate waves, encompassing various ecosystem services. Healthy marine ecosystems are invaluable, from food and energy production to climate regulation and coastal protection. Marine science equips us with the knowledge to make informed decisions, mitigating our impact and maximizing the benefits derived from these ecosystems.

In essence, marine science is not just a passive observer; it is an active participant in interpreting the language of the ocean. Through this understanding, marine science kindles a love for the marine environment, fostering the actions necessary to safeguard the lifeblood of our planet. As Jacques Cousteau wisely noted, "We only protect what we love; we only love what we understand" In marine research, we invest in our planet's future and its ecosystems' well-being.



The future of Bangladesh's fisheries hinges on this delicate equilibrium between science, policy, and community engagement. Empowering local communities, fostering collaborative research initiatives, and investing in cutting-edge scientific tools are vital to navigating marine resource management.

Bangladesh must embrace marine science as the key to understanding and sustainably managing its vibrant ocean life to thrive as a blue economy truly. As any life relies on internal processes, our marine future rests on scientific knowledge of the intricate web of ecosystems, resources, and threats within our waters. Bangladesh should expand research institutions, fund diverse marine science projects, and encourage local scientific talent. Ground fisheries management, conservation efforts, and coastal development in robust scientific data and principles are essential. Integrating marine science into school curriculums to cultivate a generation of ocean-aware citizens and future scientific leaders should be on priority. By investing in marine science, Bangladesh can unlock the vast potential of its ocean for generations to come, ensuring a thriving blue economy powered by knowledge and respect for the wonders of the deep.

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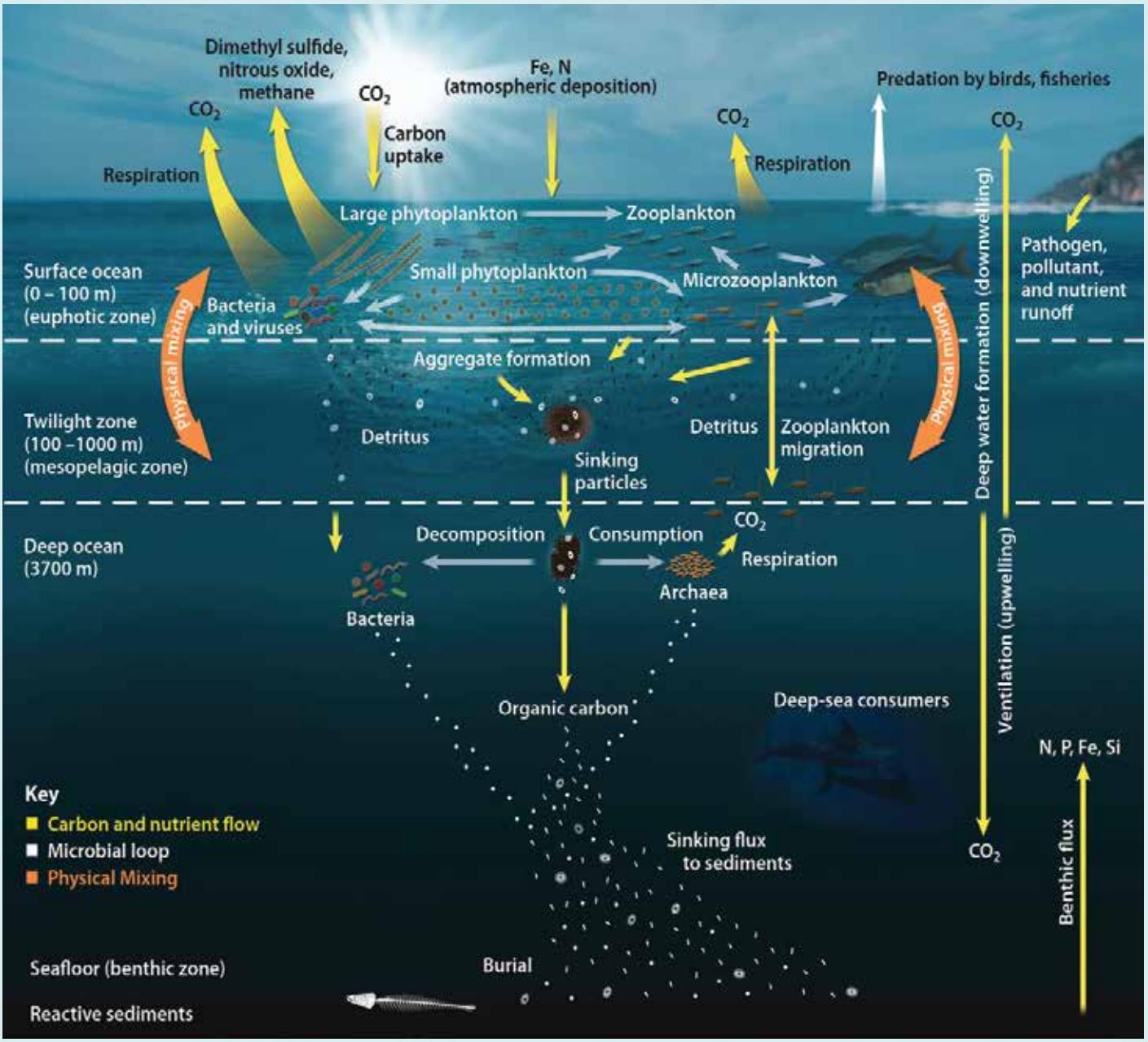

Article

Seafaring Resilience: Climate Challenges and Technological Solutions for Bangladesh's Fishers

Md. Salah Uddin

Introduction

In the coastal hamlets of Bangladesh, where life harmonizes with the ebb and flow of the Bay of Bengal (BoB), seagoing fishers struggle with a list of challenges exacerbated by the looming specter of climate change. As these mariners navigate the capricious waters, their struggles are magnified by a shortage of disaster preparedness infrastructure, rendering them acutely vulnerable to natural disasters. This in-depth analysis aims to dissect the scientific intricacies of climate change-induced vulnerabilities and explore technology's critical role in fortifying disaster risk reduction strategies among Bangladesh's seagoing fishers.

Climate Change and Complex Vulnerabilities

The low-lying coastal terrain of Bangladesh, intricately woven into its geographic fabric, renders the nation highly susceptible to the impacts of climate change. The rising sea levels, an escalating frequency of cyclones, and the erratic weather patterns collectively pose existential threats to seagoing fisher and their communities. Let's delve into the intricate scientific nuances of these climate-induced vulnerabilities, shedding light on the multifaceted challenges these maritime communities face.

Climate change has become an undeniable reality in recent

decades, with the global scientific community pointing to anthropogenic activities as the primary driver. The Intergovernmental Panel on Climate Change (IPCC) reports underscores the vulnerability of low-lying coastal regions to rising sea levels. Bangladesh stands at the forefront of nations grappling with the consequences.

The frequency and intensity of cyclones in the BoB have exhibited an upward trend, adding another layer of complexity to the lives of seagoing fishers. The scientific community attributes this increase to the warming of sea surface temperature and creative conditions conducive to the formation and intensification of cyclonic storms. The socio-economic ramifications of cyclones are profound, as they disrupt fishing activities, damage infrastructure, and displace communities.

Insufficiency in Disaster Risk Reduction Capacity

Amidst this environmental disorder, the inadequacy of disaster risk reduction capacity stands out as a stark reality for seagoing fishers in Bangladesh. While traditional ecological knowledge has been a valuable asset for these communities, it falls short of addressing the escalating challenges brought about by climate change. This analysis section employs scientific terminologies to scrutinize the limitations stemming from constrained access to timely and precise meteorological information, substandard infrastructure, and the absence of structured disaster preparedness protocols.

Despite its susceptibility to climatic hazards, Bangladesh has limitations in its capacity to mitigate and respond effectively to disasters. In collaboration with local authorities, the scientific community has identified key challenges contributing to this insufficiency. First and foremost is the issue of access to timely and accurate weather information. While advancements in satellite technology and meteorological models have improved the accuracy of weather forecasts, disseminating this information to remote coastal areas remains a challenge.

Furthermore, substandard infrastructure, including inadequate shelter facilities and evacuation routes, compounds the vulnerability of seagoing fishers during cyclonic events. The lack of robust disaster preparedness protocols further exacerbates the situation, as there is often a gap between early warning systems and the execution of timely and coordinated responses.

The Imperative of Disaster Preparedness

Scientific methodologies are employed to underscore the critical importance of disaster preparedness in safeguarding the lives and livelihoods of seagoing fishers. Early Warning Systems fortified with advanced meteorological insights, resilient infrastructural frameworks, and meticulously crafted evacuation strategies are dissected as indispensable components for mitigating natural disasters' immediate and long-term impacts. The need for resource allocation to address the insufficiencies hindering disaster preparedness should be emphasized. The imperative of disaster preparedness in the face of climate-induced vulnerabilities cannot be overstated. Scientifically informed early warning systems are a crucial defense against the intensifying impacts of cyclones and other natural disasters. Integrating advanced meteorological insights derived from cutting-edge technologies such as satellite imagery and climate modeling enables more accurate production of cyclonic events, providing communities with the lead time needed to initiate evacuation procedures.

Based on scientific risk assessments, evacuation strategies must be meticulously crafted to ensure communities' swift and organized relocation in the face of impending disasters. This involves identifying safe evacuation routes and accounting for the specific needs of vulnerable populations, such as older people, women, and children. The scientific community, working hand-in-hand with disaster management authorities, can contribute to formulating and implementing effective evacuation plans.

However, despite recognizing these imperatives, resource constraints and institutional challenges hinder the actualization of comprehensive disaster preparedness measures. The allocation of sufficient funds to implement scientifically sound disaster preparedness strategies is a critical step that requires commitment from both national and international stakeholders. The scientific community can play proactive roles in advocating for the allocation of resources, emphasizing the cost-effectiveness of preventive measures compared to the exorbitant costs associated with post-disaster response and recovery.

Technological Paradigm for Resilience

Now, let's explore technology's pivotal role in enhancing the Resilience of seagoing fishers. Utilizing scientific language, we dissect satellite technology, precision weather forecasting applications, and state-of-the-art communication tools as transformative instruments for disaster preparedness.

In the digital transformation era, technology emerges as a game-changer in fortifying the Resilience of seagoing fishers against the onslaught of climate-induced vulnerabilities. The fusion of scientific advancements with cutting-edge technologies offers a multifaceted approach to disaster preparedness and response, fundamentally altering the landscape of risk reduction.

Satellite technology stands at the forefront of this technological paradigm for Resilience. Advanced Earth observation satellites equipped with remote sensing capabilities provide real-time data on meteorological phenomena, enabling scientists to monitor and predict the development of cyclones with unprecedented accuracy. Integrating satellite-derived information into weather forecasting models enhances the precision of early warnings, affording communities crucial lead time for evacuation and other preparatory measures.

Precision weather forecasting applications, powered by sophisticated algorithms and real-time data feeds, bring a

granular level of accuracy to weather predictions. These applications, accessible through mobile devices, can potentially empower seagoing fishers with timely and localized weather information. This not only aids in informed decision-making regarding fishing activities but also serves as an early warning system, allowing anglers to seek safe harbor well before the onset of adverse weather conditions.

Mobile technology is a lifeline for seagoing fishers, transforming communities' dynamics at sea. Mobile devices with weather applications and emergency notification systems enable real-time communication between fishers and relevant authorities, e.g., the Bangladesh Navy/Coast Guard/BMD/Department of Fisheries. In an impending disaster, authorities can send timely alerts to fishers, guiding them to safe locations and mitigating the risk of being at sea during a cyclonic event.

Precision weather forecasting applications, powered by sophisticated algorithms and real-time data feeds, bring a granular level of accuracy to weather predictions. These applications, if made accessible through mobile devices, can empower seagoing fishers with timely and localized weather information. This will aid in informed decision-making regarding fishing activities and serve as an early warning system, allowing fishers to seek safe harbor well before adverse weather conditions.

The synergy between scientific advancement and technology extends beyond disaster preparedness to encompass post-disaster recovery and resilience-building. Geographic Information System (GIS) technologies can facilitate the mapping of vulnerable areas, aiding the identification of high-risk zones and informing land-use planning. This spatial information can be invaluable for developing resilient infrastructure that can withstand the impacts of climate-induced disasters.

Capacity Augmentation and Community Empowerment

Training initiatives, infused with scientific methodologies, are essential components to empower seagoing fishers with technological insight. Establishing community-driven disaster management committees is analyzed as a critical measure to foster local Resilience and autonomy, aligning with the overarching goal of sustainable development.

Capacity building, rooted in scientific principles, is a prerequisite for empowering seagoing fishers to navigate the complex challenges climate change poses. Training initiatives, designed in collaboration with scientific and disaster management experts, can enhance the technological understanding of fishers, equipping them with the skills needed to leverage advanced tools and applications for disaster preparedness and response.

The training curriculum should encompass a spectrum of topics, including interpreting satellite imagery, understanding weather forecasts, and proficiency in using mobile applications for real-time communication and emergency alerts. Workshops and interactive sessions facilitated by experts serve as a knowledge transfer and skill development platform. Moreover, capacity-building programs extend to developing a cadre of local experts who can act as focal points for disseminating scientific information and coordinating disaster response efforts within their communities.

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Article

Marine Pollution Scenario in Bangladesh: An Obstacle to the Blue Economic Growth

Assistant Professor Mir Mohammad Ali

The existence of oceans is crucial for the survival of life on Earth. The marine environment is the richest ecosystem on Earth, making up about two-thirds of the globe. The Bay of Bengal (BoB) is one of the world's 64 bays between South and Southeast Asia. Bangladesh's coast may be roughly split in half, with the exposed coast taking up 23,935 square kilometers and the inner beach taking up 23,266 square kilometers (Biswas et al., 2021). Bangladesh's blue economy is based mainly on the country's coastlines and the Bay of Bengal. They hold a wealth of resources. It was during the 2012 (Rio+20) Rio Summit that the term "blue economy" was first used. The term refers to an economic model predicated on the seas, intending to foster economic expansion via the methodical exploration of marine resources without jeopardizing the health of the oceans. The blue economy bolsters the social, environmental, and economic development processes. "Blue economy" describes various marine economic activities, including 26 distinct sectors. These sectors include fishery, food production, mineral extraction, biotechnology, maritime trade, shipping, tourism, coastal protection, monitoring and surveillance, scientific research, etc. Bangladesh's government has recently announced Delta Plan 2100, which incorporates five initiatives to use the blue economy to achieve Sustainable Development Goals (SDGs). If Bangladesh makes good use of its oil, gas, fisheries production, port development, and tourist industries, it may generate annual revenues in the billions (Alam & Xiangmin, 2019; Sarker et al., 2018). However, marine pollution is one of several threats to the potential benefits of researching and using marine resources.

Human health and biodiversity are both threatened by pollution in the ocean and along the coast. When it comes to human health and well-being, food insecurity, and livelihoods, marine pollution's negative ecological repercussions are just as devastating as widespread (Kudrat-e-Khuda and Barsha, 2021). Article 1(4) of UNCLOS defines marine pollution as the release of energy or substances into the ocean that can harm the marine environment. This harm includes damage to marine resources, marine life, human health, water quality, and the use and enjoyment of coastal areas. Several reasons cause the contamination of Bangladesh's maritime environment. The two most significant contributors to global pollution are land and water, respectively, with 80% of marine pollution coming from land-based activities. As a bonus, marine pollution hastens the demise of cherished ecosystems like coral reefs and seagrass meadows (Alam et al., 2018). Pressure on marine and coastal ecosystems is rising due to changes in biochemical processes and physical factors brought on by climate change and ocean

acidification (Hossain et al., 2015). Humanity continues on a primarily unsustainable path despite growing awareness of the dangers of marine contamination.

Point Sources	Non-point Sources	Sea-based Sources of Marine Pollution
> Wastewater Treatment Plants > Untreated sewage- Outfalls > Partially treated/ Untreated Industrial Effluents Outfalls > Aquaculture Effluents	> Agricultural Runoff (pesticides, fertilizers, and animal wastes) > Oil, grease, and toxic chemicals from urban runoff and energy production Coliform Bacteria and pathogens > Sediments (from Construction), Hill cutting & deforestation. > River runoff	> Crude Petroleum- (PAHs) > Antifouling Agents- (TBT) > Volatile Organic Compound (VOC)- PCBs, DDTs, Dioxins, Furans > Oil Spill, Bilge from Ship, Boats > Dumping of Wastes > Introduction of Alien species through ballast water etc.

Table: Different Point, Non-Point, and Sea-Based Marine Pollution Sources

Approximately 230 rivers in Bangladesh deposit billions of tons of sediments in the Bay of Bengal. These sediments include unidentified plant nutrients and enormous quantities of toxic residues from agricultural pesticides, industrial residues, farm effluents, solid waste, sewage discharge, etc. Other pollution causes include rapid urbanization, deforestation, and uncontrolled coastal resource exploitation. Annually, 10 billion gallons of sewage, 3.25 million metric tons of crude oil, 10 billion tons of ballast water, and millions of tons of solid waste are dumped into the marine environment on a global scale (Kudrat-e-Khuda & Barsha, 2021; Biswas et al., 2021). Almost all trash ends up in the ocean or water near the shore. Even for a developing nation like Bangladesh, the situation is quite similar. The riverine and coastal areas are home to many industrial facilities, shipbreaking yards, sewage, tourism, and transboundary depositions, all of which contribute to the release of vast quantities of harmful solid and liquid waste.

Moreover, major industrial centers of Bangladesh, including Dhaka, Gazipur, Narsingdi, Narayanganj, Chittagong, Khulna, Mongla Port, and Sylhet City, are pollution hotspots. Interestingly, these industrial hubs are connected with the major rivers, including the Ganges, Padma, Jamuna, Brahmaputra, and Meghna, which carry wastes to the Bay of Bengal and ultimately deteriorate the marine environment. In addition, the Padma, Jamuna, and Brahmaputra rivers carry transboundary pollution from India, Nepal, and China to the Bay of Bengal, where they are eventually deposited in the coastal soils of Bangladesh (Chowdhury et al., 2017; Haque et al., 2017).

The coastal regions of Bangladesh are linked to more than 8,542 manufacturing facilities. The textile industry, in particular, is very harmful to marine life since it discharges about 40,000 m^3 of effluent daily. Twenty percent of the world's pure water is tainted by the 12.7-13.5 million m^3 of sewage that the textile and dyeing industries emit yearly. Ocean and the marine ecosystem are also harmed when ships discard trash and waste into the water. Every year, about 4,000 to 6,000 tons of crude and refined oil are spilled into the Bay of Bengal from Bangladesh's imports. About 22.5 tons of polychlorinated biphenyls are dumped annually at shipbreaking yards—more than half of the oil in the ocean results from human activity. Coastal contamination is caused partly by the 3000 trillion pieces of plastic garbage produced daily and by tourists. Heavy metals, micro and macroplastics, chemicals, POPs, and radioactive substances are among the most dangerous pollutants due to their genotoxic and carcinogenic effects (Biswas et al., 2021; UNEP, 2018). Higher quantities of toxic heavy metals (Pb, Hg, Cd, As), microplastics, POPs, and polycyclic aromatic hydrocarbons (PAHs) are observed in the water due to the lack of maintenance of effluent releasing criteria (Islam et al., 2016).

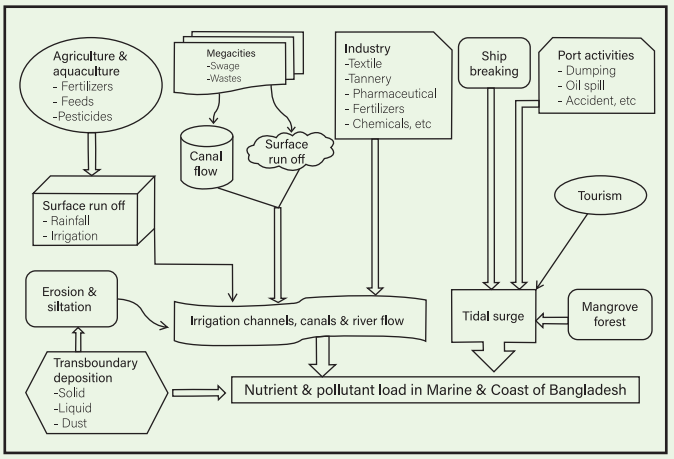

Figure: Pollution Sources and Mechanisms in the Coastal and Marine Ecosystem

If we can keep pollution out of our water and air, we will have clear blue skies and oceans. There has to be a shift toward more sustainable practices in managing our current marine resources and an increase in funding for initiatives to restore marine ecosystems and biodiversity. Since shipping is the principal means of delivering products, it must be subject to a worldwide regulatory framework. Introducing waste treatment facilities and enforcing stringent restrictions are viable options for decreasing land-based pollution. The government may start regulating land and water use by enterprises, keep an eye on pollution levels, and strictly enforce current laws. The only way to solve environmental problems on a global scale is via a coordinated legislative effort at the national and regional levels. The Bay of Bengal resources may aid Bangladesh's economic development. However, stopping marine pollution is necessary for this to occur. While laws are in place to address environmental concerns, their enforceability needs to be improved by a lack of institutionalized coordination and enough funding. The infrastructure must be upgraded to provide proper sanitation and the harmless discharge of industrial effluents. For the sake of aquatic life and human health, it is necessary to conduct a comprehensive assessment of the origins, destinations, and levels of present effluent dumping in rivers.

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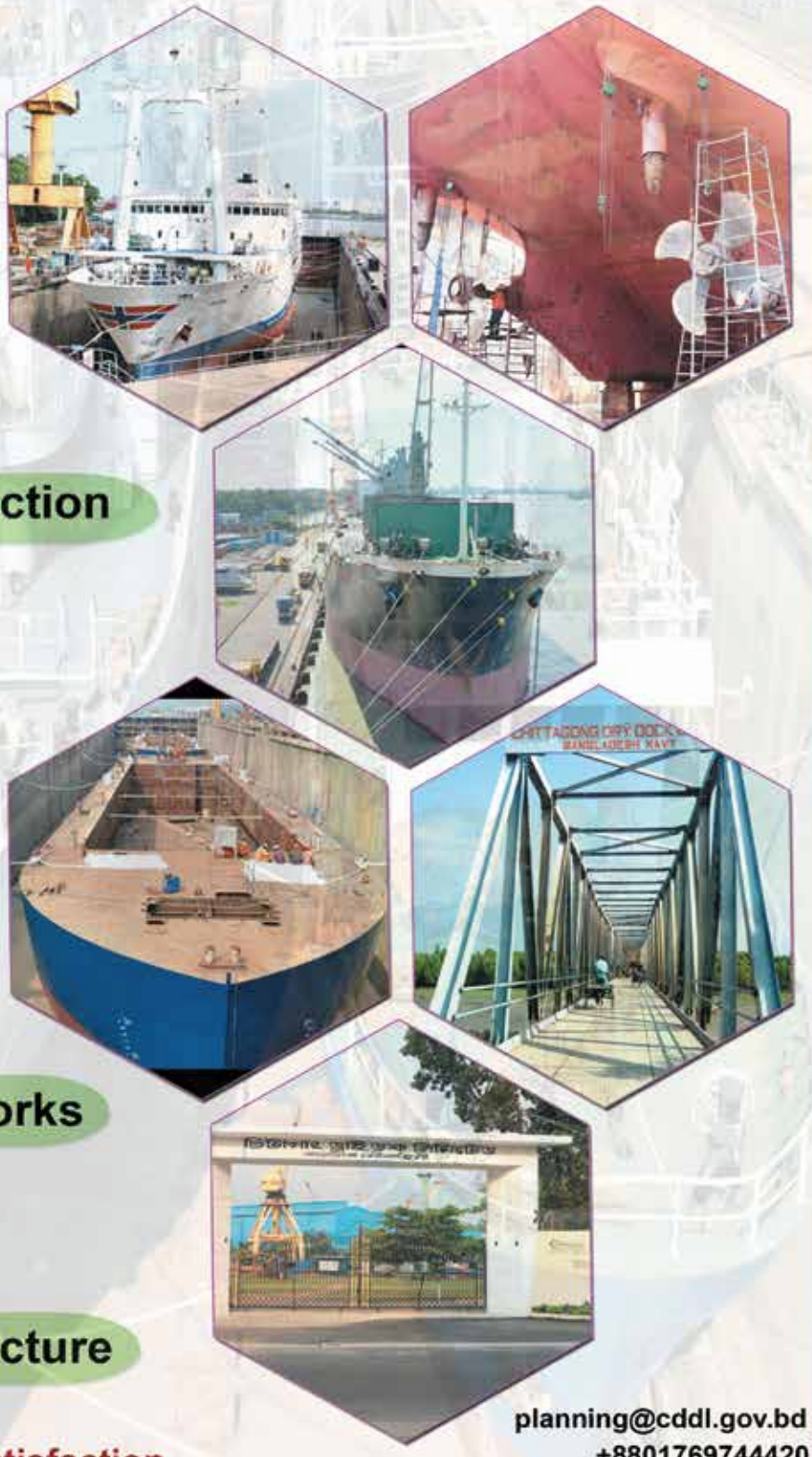

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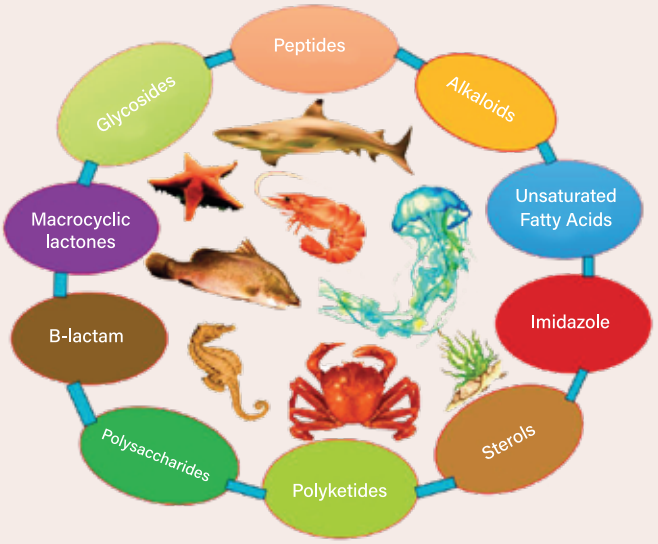
Article

Bioactive Natural Products Would be the Emerging Field of Blue Economy: A New Vision and Strategy for Sustainable Blue Growth

Assistant Professor Md. Masud Rana

The world's oceans hold a vast untapped resources, harboring countless species and ecosystems that have remained largely unexplored. Riding the wave of sustainability, the "blue economy" promises prosperity from our oceans while keeping them healthy and vibrant. Within this emerging field, bioactive natural products derived from marine organisms are emerging as a promising avenue for driving sustainable blue growth. Bioactive natural products are chemical compounds produced by living organisms that possess therapeutic properties or exhibit biological activity. Marine organisms, including microorganisms, algae, invertebrates, and fish, have evolved unique biochemical pathways and defense mechanisms to adapt and survive in the challenging marine environment. These adaptations have resulted in the production of a rich diversity of bioactive compounds with tremendous potential for various applications in sectors such as pharmaceuticals, nutraceuticals, cosmeceuticals, and agrochemicals. Harnessing of bioactive natural products from marine sources represent a paradigm shift in the utilization of marine resources. Unlike the traditional extraction of marine resources for food or energy, the focus has shifted towards discovering and developing novel bioactive compounds that address pressing societal challenges such as human health, food security, and environmental sustainability. This shift in perspective has led to the realization that the sustainable use of marine resources can support economic growth and contribute to conserving and preserving marine ecosystems. The potential of bioactive natural products from marine sources is vast. These compounds have exhibited diverse biological activities, including antimicrobial, antiviral, anticancer, anti-inflammatory, and antioxidant properties. Such properties have attracted attention from the pharmaceutical industry, where the need for novel drug candidates to combat drug-resistant infections and diseases remains high. Furthermore, the demand for natural and sustainable alternatives in the cosmetic and personal care industry has opened doors using marine bioactive in developing innovative and eco-friendly products.

Bangladesh exercises exclusive control over resources like oil and gas within its designated maritime zone. This commitment to ocean governance stems from 1974, when Bangabandhu Sheikh Mujibur Rahman initiated efforts to resolve maritime disputes with India and Myanmar. The current maritime boundaries with freshly occupied sea territory in the Bay of Bengal have created ample chance to expand Bangladesh's contribution to the GDP through the blue economy. Biotechnology technologies on marine resources are called marine (or blue) biotechnology. All endeavors that use marine resources as a source or a target for biotechnology applications fall under the umbrella of marine biotechnology. Biotechnology involves applying science and technology to living creatures and their components, products, and models to change living or non-living materials for the development of knowledge, goods, and services. The living organisms used in marine biotechnology come from aquatic sources. Marine biotechnology is a developing field centered on utilizing marine natural resources.



Marine biotechnology is a developing field centered on utilizing marine natural resources. Applications for marine biotechnology may include health, food, cosmetics, aquaculture & agriculture, fisheries, manufacturing, environmental remediation, biofilms and corrosion, biomaterials, research tools, etc. Marine biotechnology generally involves bioprocessing, bio harvesting, bioprospecting, bioremediation, bioreactors, etc. One of the most exciting and well-known results of marine biotechnology research is drug development. Because they differ significantly from those produced by closely similar terrestrial animals, the biochemicals produced by marine invertebrates, algae, and bacteria have enormous potential as new classes of drugs. A neurotoxin from a snail that possesses painkilling characteristics and is 10,000 times more potent than morphine without adverse effects is an example of a marine-derived medication. Other examples include an antibiotic from a fungus, two chemically similar substances from a sponge cure cancer and the herpes virus.

As more researchers turn to the sea for these biotechnological uses, there are now several marine-derived substances in clinical trials, and it is anticipated that many more will move to the clinic. Algae, crustaceans, and sea fan compounds are used in cosmetics, nutritional supplements, artificial bone (corals), and industrial applications. Marine-derived compounds are also used in fluorescent compounds from jellyfish, novel glues from mussels, and heat-resistant enzymes from deep-sea bacteria.

As a result, the horizontal breadth of marine biotechnology encompasses a wide range of uses, many of which rely on the marine environment for their raw materials. This includes creating a cutting-edge buoy system for monitoring ocean pollution to generate a novel cancer treatment from a deep-sea sponge. Bio-prospecting, enhancing the productivity of marine organisms, creating novel products, particularly food and feed items, and developing diagnostics and biosensors are a few examples of marine biotechnology's commercial applications. The entire drug/molecule development process, including screening, identification, efficacy testing, safety testing, and large-scale commercial production, is included in bioprospecting. Secondary metabolites produced by marine creatures are known as bioactive natural products. Over the past two decades, these products have drawn more chemists' and pharmacologists' attention. These products have been used for various things, such as food, pharmaceuticals, scents, pigments, and pesticides. Integrating bioactive natural products into the blue economy framework presents a new vision and strategy for sustainable blue growth.

Marine biotechnology can fuel economic growth by responsibly tapping ocean resources while preserving our precious underwater world. Moreover, the sustainable utilization of bioactive natural products can foster the establishment of blue biorefineries and create new opportunities for job creation, entrepreneurship, and technological advancements.

In conclusion, bioactive natural products derived from marine organisms can be the emerging field of the blue economy. With

unique chemical diversity and vast therapeutic potential, marine organisms offer exciting prospects for sustainable blue growth. By embracing this new vision and strategy, we can harness the power of the ocean's bioactive treasures while ensuring marine ecosystems' long-term health and resilience.

Unlocking the ocean's treasure chest of untapped potential: Interdisciplinary minds, bold innovation, and responsible stewardship can forge a future where prosperity and sustainability swim hand-in-hand.

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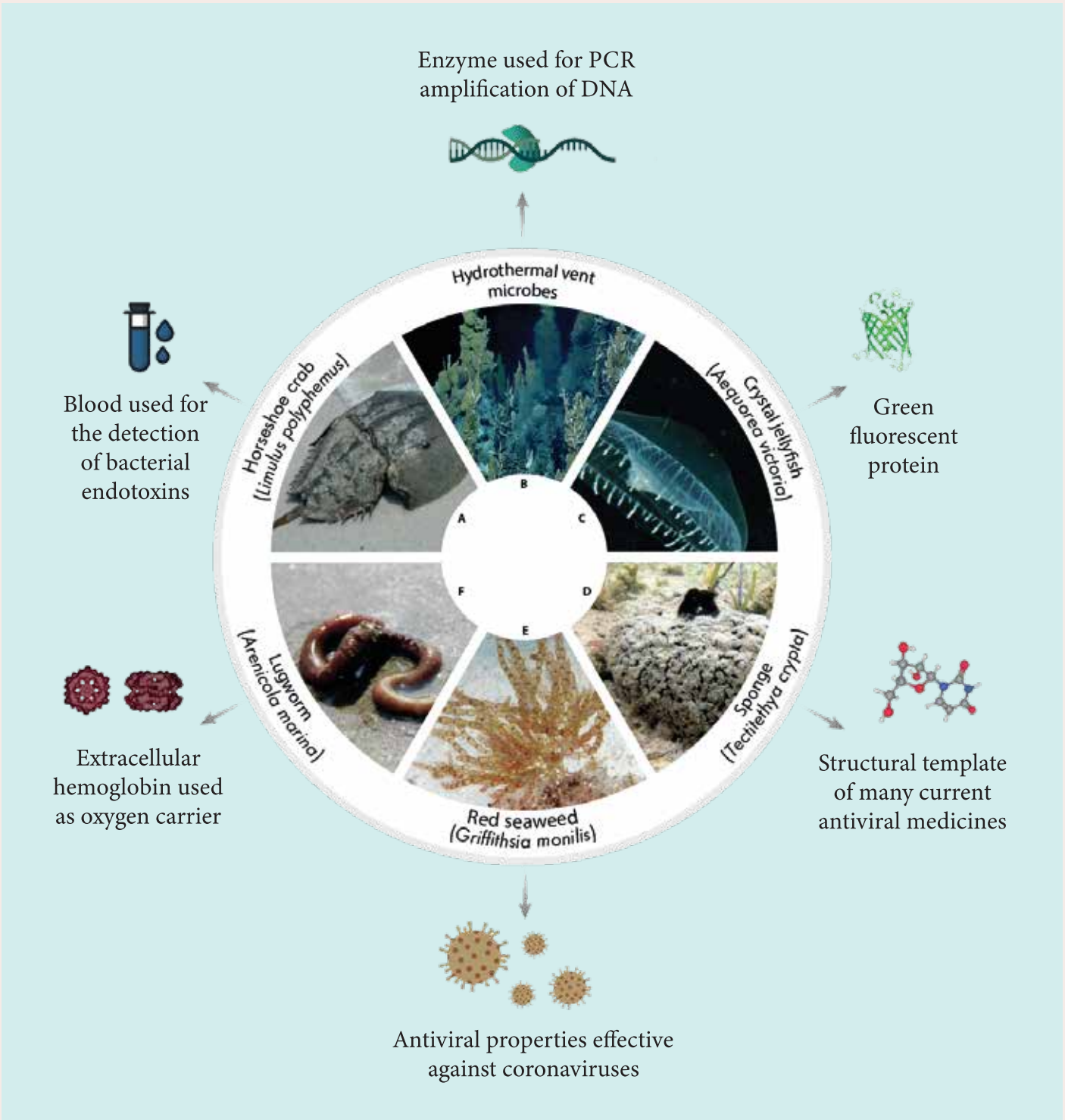

Article

Destructive Fishing: A Global Menace to Marine Life

Mishkat Farah

The oceans, covering over 70% of the Earth's surface, host an incredibly diverse marine life. However, the unchecked pursuit of fishing practices has led to severe consequences, endangering this vibrant ecosystem. Destructive fishing methods employed worldwide pose a significant threat to marine life, impacting not only the targeted species but also causing collateral damage to the broader ecosystem.

Destructive fishing refers to fishing practices that harm the marine environment, damaging or depleting fish stocks and their habitats. Some examples include blast fishing using explosives, using cyanide or other poisons to catch fish, bottom trawling that scrapes the ocean floor, and using illegal fishing gear like drift nets.

The implications of destructive fishing are severe. They can destroy coral reefs and other habitats, disrupt the marine ecosystem, lead to the extinction of species, and reduce biodiversity. Additionally, it can negatively impact local communities that rely on fishing for their livelihoods, disrupt food chains, and contribute to global food insecurity. Overall, destructive fishing practices have significant environmental, economic, and social consequences.

Fishing has been integral to human survival and development throughout history. Early humans relied on fishing as a primary food source, leading to the development of various fishing techniques using spears, hooks, nets, and traps. Over time, fishing evolved from small-scale subsistence practices to larger-scale operations driven by technological advancements, navigation, and industrialization.

Ancient civilizations like the Egyptians, Greeks, and Romans had sophisticated fishing methods and utilized various tools such as handlines, harpoons, and simple nets. As societies progressed, fishing became more organized by establishing fishing communities, regulations, and trade networks.

The Industrial Revolution brought significant changes to fishing practices. Innovations such as steam-powered vessels, improved gear, and refrigeration techniques enabled larger catches and more extended fishing expeditions, increasing efficiency and productivity. This period also saw the rise of

commercial fishing fleets, further expanding the reach and impact on marine ecosystems.

However, intensifying fishing activities also led to over exploitation and depletion of fish stocks in many regions, which has prompted concerns about sustainability and the need for conservation measures to prevent the collapse of fisheries. Modern fishing practices have faced scrutiny due to issues like overfishing, bycatch (unintended catch of non-target species), habitat destruction, and destructive fishing methods.

To address these concerns, there have been efforts to promote sustainable fishing practices, implement regulations, establish marine protected areas, and encourage responsible fishing techniques that minimize environmental impact while ensuring the long-term viability of marine ecosystems and fisheries.

Overfishing: Depleting Marine Populations

Driven by greedy demand and technology's relentless grip, we've devoured seafood at an unsustainable pace, sucking entire fish populations from the ocean faster than they can replenish. This overfishing is like a runaway train barrelling through the intricate marine food web, ripping apart the delicate relationships between predator and prey. The consequences ripple out, threatening not just the future of our favourite fish dishes, but the very health of the ocean that sustains them all.

Habitat Destruction and Bycatch

Destructive fishing practices often involve methods that harm marine habitats. Bottom trawling, for instance, involves dragging heavy nets along the ocean floor, destroying coral reefs, and disrupting the seabed. Such practices result in the loss of critical habitats for countless marine species, leading to their displacement or decline.

Moreover, bycatch – the unintentional capture of non-targeted species – is pervasive in destructive fishing. Trawling nets, longlines, and other indiscriminate methods trap and kill marine life beyond the intended catch, including dolphins, turtles, seabirds, and juvenile fish. This collateral damage further strains already vulnerable populations and disturbs the ecological balance.

Ecosystem Imbalance and Environmental Impact

The repercussions of destructive fishing reverberate throughout marine ecosystems. Overfishing disrupts the predator-prey relationships, leading to the proliferation of certain species while decimating others. This imbalance can cause cascading effects, altering the entire ecosystem's structure and function.

Additionally, the environmental impact extends beyond just the marine life. Fuel consumption, use of destructive gear, and habitat destruction contribute to environmental degradation, affecting water quality and exacerbating climate change.

Global Initiatives and Solutions

Several initiatives and regulations aim to mitigate the impact of destructive fishing. Implementation of marine protected areas, restrictions on fishing gear, and quotas to limit catches are some measures undertaken by various countries and international bodies to promote sustainable fishing practices.

Innovations in fishing technologies, such as developing selective gear that reduces bycatch and promoting sustainable fishing methods, like pole-and-line fishing or aquaculture, offer promising solutions to minimize the adverse effects on marine life.

> *Destructive fishing practices pose a severe threat to marine life globally, jeopardizing the health and sustainability of our oceans.*

Conclusion

Destructive fishing practices pose a severe threat to marine life globally, jeopardizing the health and sustainability of our oceans. It has Economic and Social Impacts, and over time, the depletion of fish stocks and degradation of habitats due to destructive fishing can affect the livelihoods of fishing communities, leading to economic hardships and social instability in areas heavily reliant on fisheries.

Addressing these threats requires concerted efforts toward adopting sustainable fishing practices, implementing stricter regulations, investing in technological innovations that minimize environmental impact, establishing marine protected areas, and promoting responsible fishing methods to safeguard marine ecosystems for future generations.

This issue requires a concerted effort from governments, fishing industries, conservation organizations, and individuals worldwide to adopt and enforce sustainable fishing practices. By prioritizing the preservation of marine ecosystems, we can protect diverse aquatic life forms for the well-being of current and future generations.

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Article

Exploring the Depths: Hydrography's Role in Achieving a Sustainable Blue Economy

Lieutenant Commander Md Saiful Islam, (H2), psc, BN

Introduction

The Earth's oceans hold immense potential for economic development and environmental stewardship. However, unlocking this potential requires a comprehensive understanding of marine environments and effective management strategies to ensure long-term sustainability. Hydrography, one of the critical branches of marine science, plays a pivotal role in this endeavor by providing essential data and information for informed decision-making, integrated planning, and ecosystem-based management of marine resources. This writing will explore the significance of hydrography in achieving a sustainable blue economy, emphasizing its contributions to navigational safety, resource management, coastal zone management, renewable energy development, maritime defence, international cooperation, and so on.

Understanding Hydrography

Hydrography is the science of measuring and mapping bodies of water, including oceans, seas, lakes, and rivers. It encompasses a wide range of techniques and methodologies for collecting and analyzing hydrographic data, such as sonar, satellite imagery, and bathymetric surveys. By mapping the seafloor, charting maritime routes, and assessing environmental conditions, hydrographers contribute to various aspects of marine resource management and sustainable development.

What is Sustainable Blue Economy?

The Sustainable Blue Economy refers to an approach to economic development that focuses on using ocean resources to benefit both people and the environment over the long term. It involves activities like fishing, tourism, renewable energy, and shipping, but done in a sustainable manner that preserves the health of marine ecosystems and supports the well-being of coastal communities. So, when we talk about the Sustainable Blue Economy, we're talking about intelligent, responsible ways of using the ocean to create jobs, generate income, and protect the environment simultaneously.

Hydrography's Contribution to Sustainable Blue Economy

Navigational Safety and Efficiency. One of the primary contributions of hydrography to achieving a sustainable blue economy is in the realm of navigational safety and efficiency. Accurate hydrographic data are essential for maritime transportation, enabling ships, boats, and other vessels to navigate

safely through oceans, seas, and waterways. By providing detailed information about water depth, underwater hazards, currents, and navigational routes, hydrography helps prevent maritime accidents and minimize the risk of collisions, groundings, and other incidents that could endanger human lives and disrupt maritime trade. Moreover, hydrography supports the development of navigational aids such as buoys, beacons, and lighthouses, which guide vessels along established shipping routes and through variable waters. Hydrography is indispensable for promoting navigational safety and preventing maritime accidents, which are prerequisites for a sustainable blue economy.

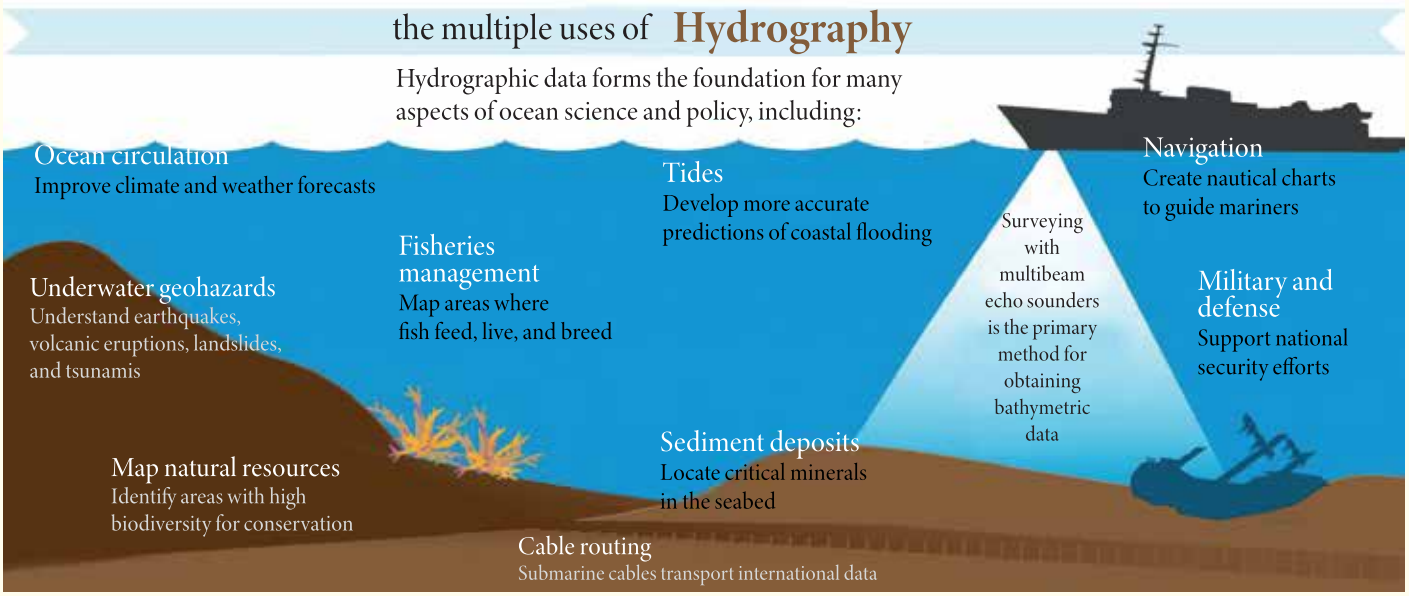
Resource Exploration and Management. Hydrography contributes significantly to exploring and managing marine resources, including fisheries, minerals, oil, and gas. By mapping the seafloor and identifying geological features, hydrographers provide critical data for locating and assessing the potential of offshore resources (UNEP, 2019). This information enables responsible resource development practices that minimize environmental impact and ensure long-term sustainability. Additionally, hydrographic data support managing marine protected areas and conservation measures to preserve biodiversity and ecosystem health. For instance, hydrography helps identify and map marine habitats, monitor environmental conditions, and assess the health of ecosystems. This information is crucial for developing management strategies that protect critical habitats, preserve biodiversity, and promote ecosystem health, ensuring the sustainable use of marine resources.

Integrated Coastal Zone Management (ICZM). Hydrography provides crucial information for coastal zone management plans, which aim to balance economic development with environmental conservation in coastal areas. By accurately mapping coastal features, including shorelines, estuaries, and wetlands, hydrography supports the identification of sensitive habitats and coastal vulnerabilities. This information is instrumental in developing strategies to mitigate coastal erosion, protect coastal communities from storm surges and sea-level rise, and preserve valuable ecosystems such as mangroves and coral reefs.

Marine Spatial Planning (MSP). MSP involves systematically analyzing and allocating marine space and resources to various uses, including shipping, fishing, aquaculture, tourism, conservation, and renewable energy development. Hydrographic data underpin MSP by providing detailed information about seabed topography, bathymetry, and hydrographic features, essential for identifying suitable areas for different activities and minimizing conflicts between competing uses. By integrating hydrographic information into MSP processes, policymakers can optimize marine resource allocation, enhance stakeholder engagement, and promote sustainable development practices that maximize economic benefits while minimizing environmental impacts.

Maritime Defense. Hydrography plays a critical role in supporting maritime defense operations by providing vital data and intelligence that enable naval forces to operate safely, effectively, and decisively in challenging and dynamic maritime environments. Almost all types of naval operations are highly dependent on accurate hydrographic information. The National Hydrographic Offices provide essential marine data and information to support various products used in naval operations. Surface, submarine, anti-submarine, mine-hunting, coastal defence, and air-sea naval operations need different nautical information products. Updated Hydrographic and Oceanographic data necessary for preparing such products must be readily available if national investment in defence is to be optimised.

Ecosystem-Based Management (EBM). EBM is an approach to natural resource management that seeks to maintain the health and resilience of marine ecosystems while supporting



sustainable human activities. Hydrography plays a critical role in EBM by providing data for assessing the status and trends of marine habitats, identifying ecosystem services, and evaluating the impacts of human activities on marine biodiversity. By integrating hydrographic information with ecological data, policymakers can develop management strategies that protect critical habitats, preserve biodiversity, and promote ecosystem health, ensuring the long-term sustainability of marine resources and supporting the well-being of coastal communities.

Climate Change Adaptation and Resilience. Hydrography contributes to climate change adaptation efforts by providing data for assessing coastal vulnerabilities, predicting sea-level rise, and identifying areas at risk of flooding and erosion. By accurately mapping coastal features and bathymetry, hydrography helps coastal communities understand their exposure to climate-related hazards and develop adaptation measures to enhance resilience. These include measures such as coastal defenses, habitat restoration, land-use planning, and ecosystem-based adaptation strategies that can reduce the impacts of climate change on coastal infrastructure, communities, and ecosystems.

International Cooperation and Capacity Building. Through initiatives such as the International Hydrographic Organization (IHO) and regional hydrographic commissions, countries work together to exchange hydrographic data, harmonize standards and practices, and build technical capacity in developing countries. International cooperation in hydrography is essential for addressing transboundary issues such as maritime safety, environmental protection, and resource management. Furthermore, capacity-building initiatives help developing countries build technical skills, acquire modern surveying equipment, and establish national hydrographic offices, enabling them to participate effectively in regional and international hydrographic activities. These cooperative engagements strengthen the foundation for sustainable marine resource management and support the implementation of global agreements such as the United Nations Sustainable Development Goals (SDGs) and the Convention on Biological Diversity (CBD).

Renewable Energy Development. Hydrography supports the development of renewable energy sources, such as offshore wind, wave, and tidal energy, which are critical components of a sustainable blue economy. By mapping the seabed and assessing oceanographic conditions, hydrographers help identify suitable sites for renewable energy projects and optimize the design and deployment of offshore infrastructure. This enables the efficient harnessing of clean energy resources while minimizing environmental impact and maximizing socioeconomic benefits for coastal communities.

Marine Science. Marine science depends largely on bathymetric information. Global tide and circulation models, local and regional models for a wide variety of scientific studies, marine geology/geophysics, the deployment/placement of scientific instrumentation, and many other aspects of marine science depend on bathymetry provided by Hydrographic Services.

Maritime Boundary Delimitation. Authentic hydrographic data is essential for proper delimitation of the maritime boundaries as detailed in the United Nations Convention on the Law of the Sea.

Technological Advancements. Hydrography has benefited significantly from technological advancements, which have enhanced the precision and efficiency of data collection and analysis. The development of remote sensing technologies, such as satellite imagery and aerial LiDAR (Light Detection and Ranging), has revolutionized the way hydrographic data is acquired over large marine areas (IHO, 2019). These technologies enable hydrographers to gather detailed information about water depth, seafloor morphology, and coastal features with unprecedented accuracy and coverage.

Furthermore, advancements in sonar technology, including multibeam and sidescan sonar systems, have greatly improved the resolution and quality of underwater mapping.

Environmental Conservation and Sustainable Development. Hydrography plays a vital role in environmental conservation and sustainable development by providing essential data for assessing the health and resilience of marine ecosystems. By mapping marine habitats, monitoring environmental conditions, and assessing the impact of human activities on marine biodiversity, hydrographers contribute to developing management strategies that protect critical habitats, preserve biodiversity, and promote ecosystem health. For example, hydrographic surveys help identify and map coral reefs, seagrass beds, and other sensitive habitats that provide essential ecosystem services and support a wide variety of marine species. This information is crucial for implementing conservation measures, such as marine protected areas (MPAs) and habitat restoration projects.

Conclusion

In conclusion, hydrography is an indispensable tool for achieving a sustainable blue economy by providing essential data and information for informed decision-making, integrated planning, and ecosystem-based management of marine resources. By leveraging hydrographic expertise and technology, policymakers, planners, and stakeholders can unlock the economic potential of the ocean while safeguarding its ecological integrity and resilience for future generations. As we continue to explore and exploit the vast potential of our marine resources, we must recognize the importance of hydrography in promoting sustainable development and responsible stewardship of our oceans. By investing in hydrographic research, technology, and education, we can unlock the secrets of the deep and harness the full potential of our marine environments for the benefit of humankind and the planet.

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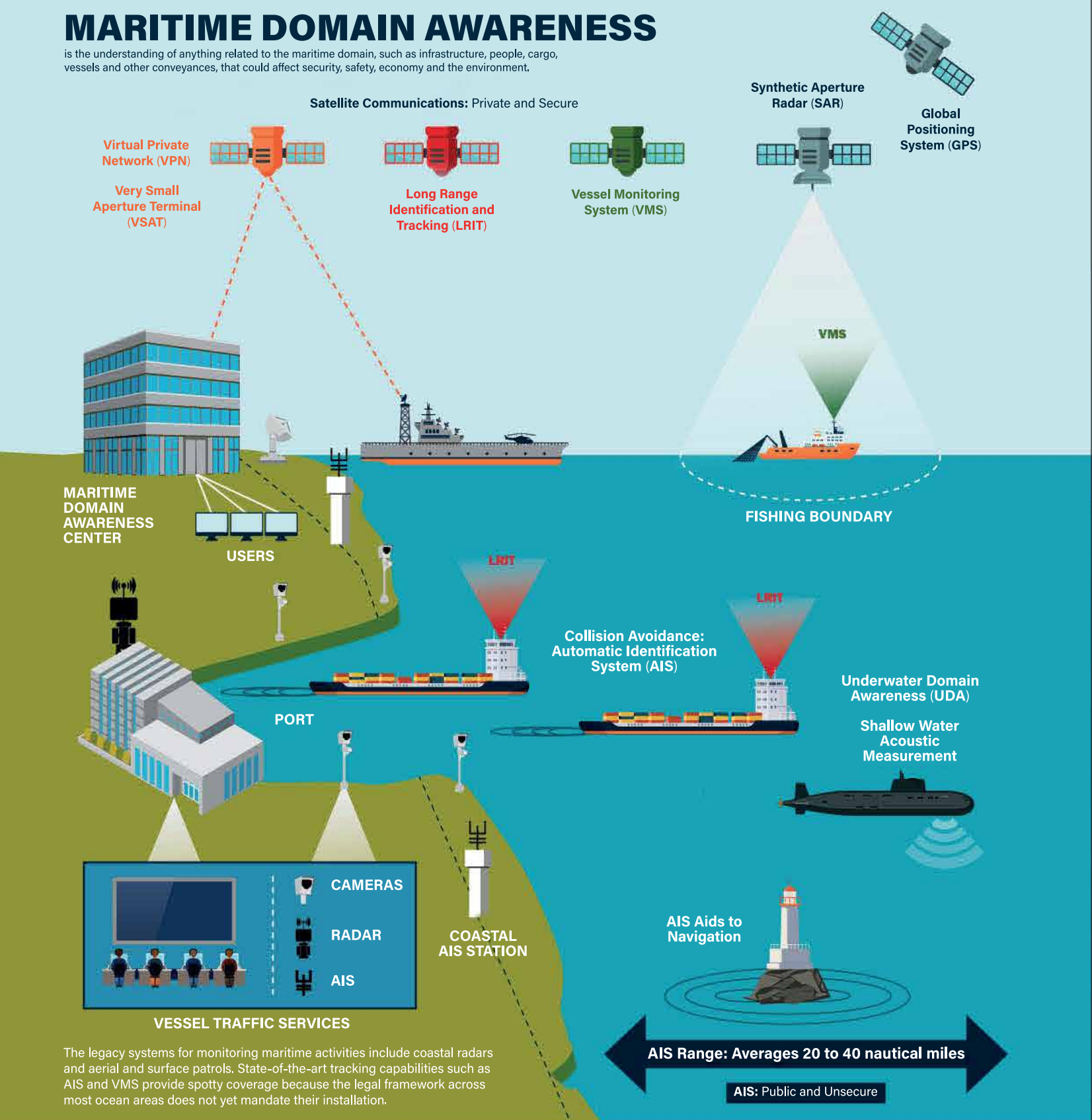
MARITIME DOMAIN AWARENESS

is the understanding of anything related to the maritime domain, such as infrastructure, people, cargo, vessels and other conveyances, that could affect security, safety, economy and the environment.



The legacy systems for monitoring maritime activities include coastal radars and aerial and surface patrols. State-of-the-art tracking capabilities such as AIS and VMS provide spotty coverage because the legal framework across most ocean areas does not yet mandate their installation.

Automatic Identification System (**AIS**) tracks vessels and functions as a transponder, broadcasting information in the VHF mobile maritime band.

AIS Akis to Navigation are guides that are broadcast over the AIS radio from onshore or offshore stations or virtually to display at designated locations on AIS-enabled radar or electronic chart systems.

Long Range Identification and Tracking (**LRIT**) is a satellite-based, real-time reporting mechanism that can locate vessels that would otherwise be Invisible and a potential threat.

Synthetic Aperture Radar (**SAR**) uses the microwave range of the electromagnetic spectrum to detect vessels, including at night or in poor visibility conditions.

Underwater Domain Awareness (**UDA**) pertains to MDA focused on the underwater sector to include sea lines of communication, coastal waters and varied maritime assets. In terms of security, It entails the proliferation of submarine and mine capabilities intended to limit access to seas and littoral waters as well as hostile actors.

Very Small Aperture Terminal (**VSAT**) satellite communications rely on Earth-based stations to receive and transmit real-time data.

Vessel Monitoring System (**VMS**) is a satellite communications system used by regulatory agencies to monitor the movement and location of commercial fishing boats.

Virtual Private Network (**VPN**) creates safe and encrypted connection over a public or less secure network, such as the Internet.

Sources: Pole Star, Absolute Software Corp.

OCEAN MONITORING

entails collecting and providing observational data to understand the current state of the ocean environment and what kind of changes oceans have undergone. Researchers, Industry experts and military technologists use various instruments and measuring techniques to monitor oceans.

Satellite measures sea surface temperature, sea level and sea ice, and also is used for ocean monitoring

High-Frequency Radar measures currents and waves from the land

Airborne Lidar measures atmosphere over the oceans and oceanic aerosol

Volunteer Observing Ship provides meteorological and oceanographic data

Drifting Ocean Buoy measures water temperature, wave height and wave period

Moored Buoy measures water temperature, salinity and surface meteorology

Blo-logging entails attaching sensors to marine animals to observe their behavior

Water Sampler with conductivity, temperature and depth sensors collects samples of seawater and measures the temperature, salinity and pressure of the ocean

Remotely Operated Vehicle is used for deep sea surveys, ocean floor sampling and equipment Installation

Air Gun and Streamer Cable are used for seismic surveys to investigate geologic features beneath the ocean floor

Expendable Bathythermograph measures temperature at differing ocean depths

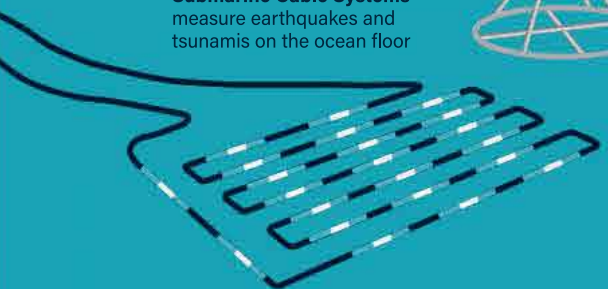
Underwater Glider Autonomous observation system

Autonomous Underwater Vehicles acquire ocean floor topography data and sub-bottom profiler data

Argo Float Drifting system measures temperature and salinity, while ascending and descending in the ocean

Multiple Corers collect sediment samples from the ocean floor

Submarine Cable Systems measure earthquakes and tsunamis on the ocean floor



Bottom-Mounted Acoustic Doppler Current Profiler measures ocean and coastal currents

Sediment Trap collects particles falling toward the ocean floor

Power Grab collects samples such as seabed minerals

Dredge Bucket collects sediment and rocks on the ocean floor

Sources: White Paper on the Oceans and Ocean Policy in Japan 2019, Ocean Policy Research Institute, Sasakawa Peace Foundation: Japan Agency for Marine-Earth Science and Technology. https://www.jamstec.go.jp/e/about/equipment/observe/

Article

Regional Cooperation on Maritime Science: The Potential Gateway out of South Asian Debacle

Nur Ahmed

It is a global observation that the South Asian region has not been much conducive to political cooperation at the regional level. Even the neighbouring Southeast Asian region had better success at forging regional cooperation. The South Asian countries have a rich history of socio-cultural bonding as the countries were under colonial rule as one subcontinent for a long time. The lineage of similarities goes way beyond the colonial era. However, the political leadership of the region has introduced different experimentation through platforms like SAARC and BIMSTEC. But the region has not come any closer to regional cooperation, let alone integration. The nature of the maritime domain is such that any activities require cooperation from and have potential impact on neighbouring littorals. We often forget that the ocean is one continuous body of water. Therefore, the maritime domain might be the next potential avenue to experiment on the South Asian enigma. However, one must start small and, that's where maritime science can come in. And this is not just wishful thinking; rather, we have a global example before us. Although the preceding references are not in the maritime domain, there are strong theoretical and practical implications because of the inherent nature of the maritime domain.

It has to be noted that scientific activities and discoveries are not necessarily apolitical. They have political implications as well as political objectives and goals. However, scientific collaboration has less political connotations than economic or socio-cultural cooperation. The Bay of Bengal littorals are vulnerable to extreme challenges in the maritime domain, like oil spillage, extreme weather events, marine pollution, etc. These challenges cannot be dealt without any collaborative frameworks among the state and non-state actors. Even if someone is not concerned about the maritime domain issues, one can imagine the disastrous situation in the event of a major oil spillage in the Bay of Bengal region. Maritime issues cannot be contained within territorial boundaries, and any event of oil spillage will undoubtedly affect all the littorals. Now,

the question one must ask is whether these littorals can face this kind of crisis. A follow-up question would be whether these littorals should pursue capacity development independently or go for a collaborative framework. The nature of the maritime issues and the benefits of regional cooperation in any domain, would present the second option as the most viable one.

The first steps should not be anything grand because of the miserable failures of some regional visions to forge political cooperation in South Asia. Seemingly apolitical, concerned scientists' collaborative studies on the marine ecosystem in the Bay of Bengal and the potential danger of an oil spillage might be a good starting point. The same goes for environmental scientists who can collaborate on studies regarding the impacts of global warming on the climatic conditions in the Bay of Bengal region and predict the nature of extreme weather events based on the current and past conditions. Universities and research organizations should lead in this regard, as these collaborations should have an institutional base. These collaborations will create the basis for orchestrating a political understanding among the littorals to develop coalitions to fight specific issues like oil spillage, marine pollution, climate change, etc. These issue-based coalitions will create a conducive political ambiance to forge collaboration in the maritime domain of the Bay of Bengal littorals. There are established platforms like the Indian Ocean Rim Association (IORA) and Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC). Still, these were established with grand political objectives. We have to start small, given the entrenched political backlogs regarding regional cooperation among South Asian nations.

The European Union (EU) might be the best example of global regional integration. The process of regional integration began in the early 1950s with the establishment of the European Coal and Steel Community (ECSC). The advent of the EU resembles a small and seemingly apolitical starting point. The journey of European integration was theorised by a school of thought named Neofunctionalism, and it was developed based on the political and economic integration of European countries. One of the fundamental arguments of Neofunctionalism is that when countries come together on a specific issue, it creates a conducive ground for further cooperation, the process of which was termed as 'spillover.' Another proposition of Neofunctionalism is that countries tend to transcend economic cooperation to political integration, leading to supranational authority like the EU. Economic issues are nonetheless not apolitical, but the notion of spillover is essential for the South Asian context. We have not seen any such thing happening in South Asia, because we tend to start off with grand political ambition designed to fail in the long run.

So, the new proposition is that the maritime domain is a good starting point for South Asian regional cooperation. If we specify our focus here, maritime science might be the most fitting stepping stone for creating a conducive ambiance for regional cooperation among South Asian littorals. Following the inferences of Neofunctionalism, scientists' collaboration on issues like oil spillage, marine pollution, climate change, marine fisheries, etc., might lead to the formation of a scientific community across the region which could result in political grouping in the form of minilaterals. There is no shortcut in this regard and considering the South Asian context, it is impossible to clear the deadlock within a short passage of time. However, the concerned stakeholders do not have the luxury of waiting anymore. The issues I have raised in this Op-Ed have the potential to catch political attention. It is astounding that there is no functioning regional grouping in South Asia on issues like oil spillage, marine pollution, marine resources, climate change etc. The prospect of the institutional gap can be complemented with the appeal of the proposed approach as a gateway out of the South Asian debacle might be a successful starting point. It has to be noted that the process will not be the same as the European, Southeast Asian, or African cases. Every region has its own socio-cultural and socio-political dynamics. Therefore, the suggested process might differ in practice, but the continuation of activities matters. So, the combination of institutional gap, political appeal, and uniqueness of the maritime domain might even be successful in implementing this neofunctionalist approach to get out of the challenge of regional cooperation in South Asia.

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Article

Marine Supply Chain Management: Opportunities in Bangladesh

Commodore Md. Abdur Razzak, NUP, ndc, psc, MPhil, BN (retd)

Bangladesh has a definite vision to become a developed country in 2041. To achieve this goal, the government has been strengthening marine supply chains and undertaking infrastructure development programs where the economy is the principal driver.

Both national and international trade is the fuel of the national economy. National trade is transported by sea, air, and land. Sea, by natural endowment, has been the most convenient means of trade through the changes in time and history. While the sea has been the 'great highway' connecting countries across the oceans, its management is vital to the safe and efficient use of the waterways.

The maritime domain or marine supply chain management, however, the way one may call it, entails a series of functions and activities undertaken by different public and private organizations. What is the scope of the supply chain in the context of the maritime domain?

Marine supply chain management functions and activities can extend inward on land as far as fifty kilometers from the shore. For example, many of the vital maritime establishments like shipbuilding, ports and port facilities, dockyards and repair facilities, refineries and fuel storage terminals, landing stations of single point mooring, etc., are essential links in the marine supply chain and located within the fifty-kilometer limit. The marine supply chain management primarily consists of regulators and operators. The Ministry of Shipping is the apex body of both regulators and operators. It acts as a facilitator through policy formulation and infrastructure development.

Ministry of Shipping has several subsidiaries that perform defined roles in managing the marine supply chain. Department of Shipping is an essential organ of the government. Port Authorities facilitate operations of maritime transports and faster cargo handling. Mercantile Marine Department deals with seafarers. Shipping Corporation is an essential carrier of national logistics. Marine supply chain management operators

include mainline operators, stevedores, inland vessel operators, container depots, etc. Academia is another potential contributor to the management of the marine supply chain. They can suggest the most advantageous course of action through research and complement the government's management initiatives.

Bangladesh has been progressing and will progress as the national trade is on the rise. In 2015-2016, national trade by sea was 76.437 million tons of cargo and 2.300 million TEUs containers. 2021-2022, the trade volume rose to 117.510 million tons and 3.262 million TEUs, respectively. While bulk cargo trade increased by 54% in just five years, containerized cargo is following steady growth. Modernization of ports and port facilities opens opportunities to investors, operators, and users. The construction of the Patenga Container Terminal has reportedly secured USD 1.7 billion in FDI.

Undoubtedly, trade volume will rise in the future. What will be the size of the exports and imports at the turn of 2040? How diversified will be the trade basket? What infrastructures and facilities will be necessary to handle the growing trade volume? The key challenges are predicting the trade volume and infrastructure requirements and their development. Academia, together with inputs from regulators, operators, and users of the marine supply chain, can help overcome these challenges.

Besides trade, another resource in the marine supply chain systems is the living and non-living deposits in the maritime zones. Unfortunately, we do not know what we have under the water. We have yet to set our dreams into action to know and extract untapped marine resources. This is a challenge waiting to be addressed to unleash opportunities.

Speed is one of the essences of the supply chain, whether it is a transportation service or otherwise. Goods got to move faster and at ease. Bangladesh is doing well in reducing shipping time. Bangladesh has started direct shipping to Europe. It is there with China. Direct shipping will be expanded up to American continent in the future. National flag carriers, which transport a small share of national trade, must be developed. Bangladesh should end existing third-country transit as early as possible and not accept new offers.

Vessel turn-around time in the ports has significantly improved due to the modernization of port facilities. The whole operation of Matarbari Deep Sea Terminal will open up multi-prong opportunities like employment, industrialization, maritime trade, etc. This component in our marine supply chain is poised to become a regional shipping hub and an essential hub of national economic activity.

Another vital link in the marine supply chain is the operator of inland waterways. They link the shipping on the seafront and end users of imports on the hinterland. They are also a link between manufacturers and their exports. With the growing trade volume, inland operators will have fair opportunities for profitable businesses. One of our inland fleet's weaknesses is that there are few vessels to engage in coastal trading.

The maritime domain is not full of opportunities only. There is a range of challenges originating from artificial and natural sources. Therefore, maritime security apparatus, like the Bangladesh Navy and Coast Guard is an essential constituent of the marine supply chain management system. Typical challenges we often encounter in the maritime domain are stowaways, drug trafficking, currency smuggling, smuggling of contrabands, illegal fishing, waste dumping at sea, theft, and so forth. Each component has different degrees of impact on marine activities. Implementation and enforcement of maritime laws and regulations are crucial for maintaining good order at sea. Bangladesh ensures a robust legal framework to prosecute those involved in illegal activities within its maritime boundaries. Through round the clock vigilance of Bangladesh Navy and Coast Guard ship, Bangladesh aims to create a secure maritime environment in the Bay of Bengal, fostering economic development and regional stability.

Keeping maritime challenges in check, a well-thought-out and well-designed strategic marine supply chain development plan and its consistent implementation can create diverse economic opportunities for Bangladesh.

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Article

Inland Waterway Transport: An Enormous Potential in Bangladesh

Commander Mohammad Mahmudul Hasan Khan, (H2), psc, BN

Preamble

Bangladesh being a riverine deltaic plain, historically her transportation relied on waterways. Gradually with the advent of technology other modes of transportation like railway, road and air became popular. However, the development of Inland Waterway Transport (IWT) gradually became marginalized. Bangladesh has made tremendous strides in recent times and has been one of the fastest-growing economies globally in the last decade. Moreover, the SDG target 3.6 refers to halving the number of road accidents while SDG target 11.2 refers to ensuring safe, affordable, accessible and sustainable transport systems by 2030. As such, Bangladesh needs to focus on Inland Waterway Transport (IWT) for sustain her economic growth as well as to achieve SDG targets.

Potential of Inland Waterway Transport

There is no alternative other than to focus on waterways transport being a riverine country. Bangladesh has a better connectivity through IWT to the main sea ports at Chittagong, Payra and Mongla. More than 50% of the economic activities of the country are located within 10 km away from navigable waterways. About 25% of the rural households have access to IWT. Particularly for the people living in the coastal areas amounting to 12.5% of rural population, where no alternative mode of transportation is available, IWT is the only means of transportation. Besides these, dynamic activities of private sector contributing to national economic growth like ship construction, cargo transportation etc. are dependent on IWT.

Inland Waterway Transport System in Bangladesh

Bangladesh being a country with many rivers, IWT is a major mode for the transport of goods and people. IWT is the cheapest mode of transport compared to road or rail. However, the sector needs more attention from the Government of Bangladesh since limited resources allocated to its development.

In addition, these resources were mostly used to develop the main routes (the ones most used by large mechanized vessels) while secondary rivers and transport using country boats (mainly rural and until recently non-mechanized vessels constructed in traditional design) were given second priority.

The total length of rivers in Bangladesh is estimated to be in the range of some 24,000 kilometers, providing a very high degree of penetration. Out of this total, 6,000 kilometers are accessible for movement of modern mechanized vessels during the monsoon season, and out of this, some 3,800 kilometers are navigable around the year. Country boats, in the number of several hundred thousands, are traditional vessels which have been plying inland and coastal waters for hundreds of years and which play a key role as a rural mode of transport of goods and people. Inland ports and other facilities include 44 inland ports, 133 launch stations and more than 1,000 minor landing points located in rural areas. The network also connects Chattogram, Mongla and Payra ports. The waterway network through which the cargo vessels move is classified into four categories, based on the depth of rivers.

Class	Indicated Draft (m)	Length (km)	% of Route	Classification Criteria
I	3.6	683	11	These routes are major transport corridors Where LAD of 3.6m is required to maintained round the year
II	2.1	1,000	17	These routes link major inland ports or places of economic importance to Class-I routes
III	1.5	1,885	32	Being seasonal in nature, it is not feasible to maintain higher LAD throughout the year
IV	<1.5	2,400	40	These are seasonal routes where maintenance of LAD of 1.5m or more in dry season is not feasible
Total		5,968	100	

Table 1: IWT Network Classification

From the perspective of freight transportation by IWT and considering the position of the major river ports, Bangladesh can be divided into five regions. Some of the regions and areas of IWT are:

Dhaka Region. It includes Dhaka, Narayanganj, Musnshiganj, Narshingdi, and Gazipur districts. The premier ports of this region include Dhaka and Narayanganj. Besides, there are handling facilities at Gabtoli, Aliganj, Pagla, Fatullah, and Kanchpur. In addition, Pangaon container terminal caters to container freight.

Northwest Region. The premier port of this region are Bagharbari and Nagarbari, the latter being the northmost port servicing the region along Jamuna. Shallow draft north of the port does not allow heavy cargo vessel movement.

Southwest Region. The premier ports of this region are situated in Faridpur and Noapara. In addition, private jetties in Khulna service this region.

Southeast Region. There are ports at Barishal and Daudkandi, and private jetties in Chattagram handle IWT cargo in this region.

Northeast Region. The Ashuganj-Bhairab and Chattak ports cater to the freight demand in this region.

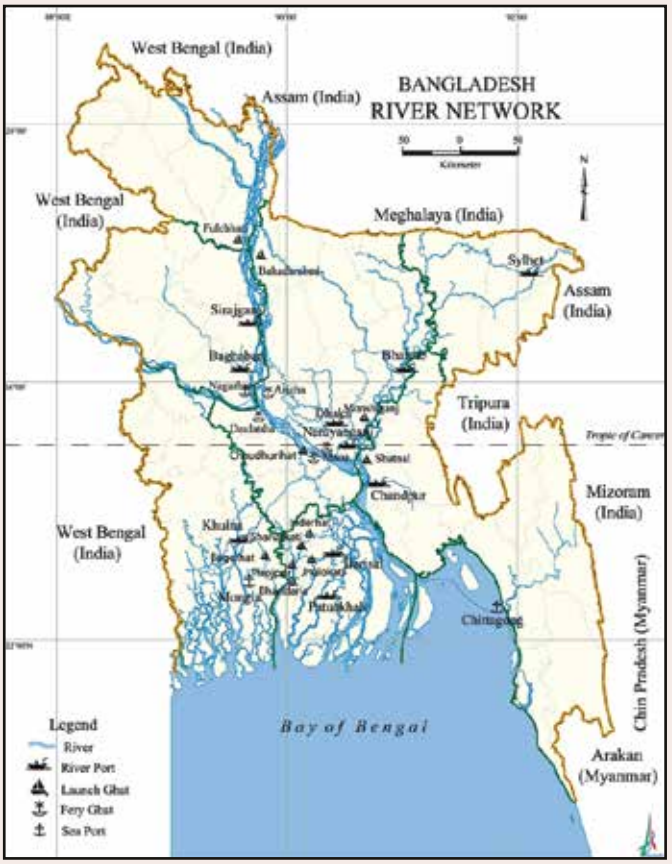

Figure 1: Bangladesh River Network (Source: https://biwta.portal.gov.bd/)

Some of the Important IWT Routes are appended below:

Dhaka/Narayanganj Inland Port to Chittagong Seaport IWT Route. This route is classified as Class-I and is of prime national importance. The route has adequate draft in most or its length except few spots where sedimentation deposits. The route also requires specially built vessel as it passes through an open coastal waterways of the Bay of Bengal and subject to facing rough seas.

Dhaka/Narayanganj Inland Port to Khulna IWT Route. This route is also classified as Class-I and is of national importance. The route has adequate draft round the year connecting Dhaudkhandi and Narayanganj inland liver ports with Mongla seaport.

Chittagong Seaport to Baghabari Inland Port IWT Route. This route falls under Class-II and Class-III waterways but requires much of hydrographic survey. The route is of national importance because much needed fue land fertilizer are carried to the northwestern part of Bangladesh through Baghabari inland port.

Inland Waterways Route to Northern Part of Bangladesh. For communication to Chatak and Sylhet the inland waterways route to the northern part of the country is classified as Class-I upto Bhairab Bazar and thereafter the depth reduces to 2.Im to 1.5m.

Chittagong-Ashuganj Route (900 km). Bangladesh Regional Waterway Transport Project-1 (Dredging in Chittagong-Dhaka- Ashuganj IWT Corridor along with associated linked routes and construction of terminal with allied infrastructure).

Mongla-Rooppur Route (460 km). Maintenance dredging is ongoing to facilitate Ruppur Project.

Class-IV Classified Routes. Class-IV classified routes are supposed to support vessel traffic of less than l.5m draft. However, approximately 1,000 km of classified waterways belonging to Class-IV classification becomes unusable in winter even for vessels of <1.5m draft.

Inland Container Terminal and Container Shipping Services

Coastal shipping for containers is developed mainly for imports from Chattogram Port (NCT) to the river ports near Dhaka. The number of containers carried by coastal shipping is approx. 26,000 TEUs yearly, which is only 1 % in 2.67 million TEUs of the total throughput of Chattogram Port. Currently 2 river ports are in operation; Pangaon ICT with 116,000 TEU capacity per annum and Ashugonj Riverport/ICT with a capacity of 4,00,000 TEUs (on completion of full construction). There is a private River Port/ICT also operating i.e. Summit Alliance (SAPL) with 100,000 TEU capacity per annum. In addition, 2 river ports are under construction; Rupayan Port & Logistic Services Ltd. (300,000 TEU capacity) and AK Khan Container Terminal (250,000 TEU). 2 more river ports are planned to be constructed; Kumudini Container Terminal (150,000 TEU capacity), and Ananda Container Port (400,000 TEU capacity).

Potentials of Regional Trade and Commerce through IWT

Bangladesh has a vast river network with neighboring country India. To ease the import-export with India, Bangladesh signed Indo-Bangla protocol on Inland Water Trade and Transit. The integration of transportation including all the activities in supply chain will lead towards to achieve competitive cost and delivery output efficiently. Though transportation system infrastructure is developing, lack of integration is the reason to achieve competitiveness in term of transportation yet.

Constraints in IWT System

The inland waterway system is not used to its full potential due to inadequate dredging and shortage of berthing facilities. The private sector is more efficient in dredging and offers a better capacity than the capacity of the BIWTA and at lower cost. Improved waterways have the potential to reduce transport costs for bulk cargo and provide better access to areas, such as in the North-West of Bangladesh, where road access is limited. The infrastructure problems on the inland waterways system are significant. There is high rate of siltation and bank erosion, and as a result it is difficult for the vessels to navigate along these waterways. Extensive dredging is required to maintain these waterways but unfortunately funds are not available for this work.

Conclusion

IWT is the cheapest mode of transport compared to road or rail. As such, due budget may be allocated to IWT as well as proper integration of logistics hub with the IWT system may get priority. Infrastructural development should cover sea ports and seamless hinterland connectivity with emphasis on IWT terminals and hubs. Therefore, Mainstreaming IWT into the national logistics network is the need of the time.

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BIMRAD Participated in "AFRAN Forum 2023: Fostering Collaborations for Sustainable Development in the Indian Ocean Region"

BIMRAD Correspondent

The Australian-French Association for Research and Innovation (AFRAN) hosted its annual forum on October 26 and 27, 2023, at Murdoch University in Perth, focusing on "Developing Research Connections for the Indian Ocean." This report provides an in-depth analysis of the forum, highlighting its objectives, structure, key events, and outcomes. The forum aimed to strengthen collaboration, innovation, and transformative thinking between Australian and French stakeholders, focusing on initiating and enhancing links between La Réunion Island and Australia.

With around 900 members, AFRAN facilitates bilateral research partnerships with global impact. The annual forum is a crucial event where stakeholders convene to showcase ongoing collaborations, discuss potential partnerships, and explore opportunities within a designated theme.

A three-day program hosted by the Australian Department of Foreign Affairs and Trade (DFAT) in collaboration with the Australian-French Association for Research and Network (AFRAN) was held in Perth, Australia, from October 25-27, 2023. The primary objectives of the 2023 AFRAN Forum were mainly to display current collaborations, facilitate the development of new connections, and discuss emerging opportunities in science and industry for the Indian Ocean region. The forum provided a platform for Australian and French stakeholders to strengthen high-level networks and promote their activities in research and innovation.

Forum Structure and Themes

AFRAN is structured into thematic communities, each focusing on a theme such as Energy, Bushfire and Natural Hazards, and Health. Additionally, the association operates local Hubs, including one in each Australian state, one in France, and one in the Pacific. The 2023 forum introduced a new Indian Ocean Hub to initiate and strengthen links between La Réunion Island and Australia, specifically focusing on Western Australia.

The program commenced with a one-day roundtable discussion on regional approaches to combatting IUU fishing, featuring

experts and academics from Australia and the northeast Indian Ocean region. A site visit to the Indian Ocean Marine Research Centre at the University of Western Australia provided attendees with first-hand insights into dedicated research facilities.

The subsequent two days hosted the AFRAN Forum on "Developing Research Connections for the Indian Ocean." Panels covered strategic collaboration, biodiversity, net-zero emissions, and a pivotal IUU fishing panel. Notably, it coincided with a visit by a French delegation working on renewable energies, enhancing networking opportunities between academia, research, and industry. A public event collaborating with the Australian Global Alliance promoted global health and environmental initiatives, emphasizing the forum's broader impact beyond research collaborations. DFAT's generous support, providing return economy class airfare, accommodation, and meals, ensured the seamless participation of attendees. The travel arrangements, coordinated by the French Embassy in Australia and AFRAN, enhanced the overall experience.

IUU Fishing Panel. One of the key highlights of the forum was the "IUU Fishing Panel," during which Afifat Khanam Ritika, a Research Officer from the Bangladesh Institute of Maritime Research and Development (BIMRAD), actively participated as a representative from Bangladesh. The panel attracted nearly 100 local and regional participants, fostering an open discussion on sustainable development in the Indian Ocean.

Policy Discussion. The IUU Fishing Panel commenced with a comprehensive review of existing policies and regulations about Illegal, Unreported, and Unregulated (IUU) fishing in the Indian Ocean region. Participants, including policymakers, researchers, and industry representatives, thoroughly examined the effectiveness of prevailing measures and identified potential gaps or areas for improvement.

During this segment, questions were addressed, such as -

- How well did existing policies and regulations address the challenges posed by IUU fishing?
- Were there loopholes that needed addressing, and what measures could be implemented to strengthen the regulatory framework?
- What role could international collaboration play in harmonizing policies to combat IUU fishing across borders?

Technological Solutions. Advancements in technology were explored as promising tools for monitoring and combating IUU fishing activities. The IUU Fishing Panel delved into the latest technological solutions, examining how innovations such as satellite tracking, artificial intelligence, and data analytics could be harnessed to enhance surveillance and enforcement capabilities.

Key discussion points included-

- An overview of cutting-edge technologies currently used in IUU fishing detection.
- Challenges and opportunities associated with implementing technological solutions.
- Strategies to foster collaboration between governments, research institutions, and technology providers to accelerate the adoption of these technologies.

International Collaboration: IUU fishing, being a transboundary issue, necessitated solid international collaboration. The panel emphasized the importance of information sharing, joint initiatives, and collaborative frameworks to address IUU fishing in the Indian Ocean region.

Discussion topics covered-

- Successful case studies of international collaboration in combating IUU fishing.
- The role of regional organizations, alliances, and treaties in facilitating cooperation.
- Strategies to overcome barriers to collaboration, such as differing legal frameworks and sovereignty concerns.

Environmental Impact. The IUU Fishing Panel explored the environmental consequences of IUU fishing, acknowledging the severe effects on marine ecosystems and biodiversity. Discussion points encompassed the ecological consequences of IUU fishing on marine ecosystems, case studies highlighting the damage caused and the long-term effects. The panel advocated for promoting sustainable fishing practices to mitigate environmental impact.

Community Engagement. Engaging local communities was recognized as a crucial aspect of combating IUU fishing. The IUU Fishing Panel explored ways to involve and empower communities to safeguard their marine resources and support sustainable fishing practices.

Key discussion topics included:

- Community-based initiatives and success stories in preventing IUU fishing.
- The role of education and awareness campaigns in empowering local communities.
- Strategies for creating a sense of shared responsibility and ownership among coastal communities.

The IUU Fishing Panel aimed to foster a comprehensive and collaborative discussion, bringing together diverse perspectives to develop actionable strategies for addressing IUU fishing in the Indian Ocean region. Insights and experiences, mainly from Bangladesh, undoubtedly enriched the dialogue and contributed to the formulation of practical solutions.

Achievements and Outcomes. The forum successfully showcased existing collaborations, facilitated the formation of new connections, and explored emerging opportunities in science and industry for the Indian Ocean region. The participation of international experts added a valuable perspective and contributed to the diversity of insights. The event also served as a platform for knowledge exchange, with stakeholders sharing expertise, research findings, and innovative solutions.

Regional integration was emphasized, particularly concerning La Réunion Island, where efforts have been made to build and develop regional academic and scientific networks. With its scientific expertise, research infrastructures, and operational capabilities, Australia emerged as a powerful partner in achieving successful collaborations in the Indian Ocean region.

Future Directions. Establishing the Indian Ocean Hub opens up new avenues for collaboration between La Réunion Island and Australia, paving the way for inclusive and sustainable development in the region. The success of the 2023 forum suggests a positive trajectory for future AFRAN events, with ongoing efforts to strengthen ties between Australian and French stakeholders and expand collaborations in the Indian Ocean Region.

The AFRAN Forum 2023 was a dynamic platform for fostering collaboration, innovation, and transformative thinking in the Indian Ocean region. By bringing together stakeholders from Australia, France, and beyond, the forum contributed to developing high-level networks. It showcased the collective efforts towards knowledge-based solutions for inclusive and sustainable development. As AFRAN continues to evolve, its role in promoting international research partnerships remains pivotal for addressing global challenges and driving positive change in the scientific and industrial landscape.

In conclusion, BIMRAD has attained a commendable standing within the international forum addressing maritime issues, owing to its proactive engagement in the program above.

খুলনা শিপইয়ার্ড লিমিটেড
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The Significance of the United Nations High Seas Treaty for Bangladesh

Honorable Prime Minister Sheikh Hasina signed the United Nations High Seas Treaty undertaken at the 78th UNGA session which is crucial for Bangladesh's economic development and sustainability signifying its importance on navigation and maritime heritage. The treaty, ratified by Bangladesh in September 2023, establishes international jurisdiction over two-thirds of the seas, allowing nations the right to engage in fishing, shipping, and scientific research.

Under the treaty, member states commit to protecting marine life and establishing marine protected areas (MPAs) following the guidelines of the Treaty on Biodiversity Beyond National Jurisdiction. This aligns with the global "30 by 30" goal to protect 30% of the world's land and sea by 2030. The treaty is seen as a watershed moment in marine conservation.

Bangladesh, known as the "Land of Rivers," relies on water for survival. The Bay of Bengal, extending into high seas, plays a vital role, providing fish as a primary nutrition source. The treaty ensures equitable sharing of genetic resource profits and promotes capacity development for developing nations like Bangladesh.

The diverse maritime ecosystem of Bangladesh faces threats from overfishing and habitat loss. The treaty aims to address these issues by promoting responsible fishing techniques and enforcing strict rules in international waters, safeguarding Bangladesh's fishery industry and contributing to global efforts against overfishing.

Climate change poses a serious risk to Bangladesh, with rising sea levels impacting agriculture and forcing coastal relocations. The treaty indirectly addresses climate change by promoting global cooperation to reduce greenhouse gas emissions and protect vulnerable coastal areas.

Transnational threats, including piracy and illicit fishing, are addressed by the treaty, fostering collaboration among governments to enhance maritime safety in the Bay of Bengal.

Despite potential challenges, such as funding and concerns about deep-sea mining, the treaty is viewed optimistically by world leaders and environmental activists. Bangladesh sees it as a source of optimism and promise, ensuring the protection of its waterways and a safer maritime future in the face of environmental and climatic concerns.

National Seminar on Bangladesh's First Deep Seaport: Matarbari Heralds a New Vista in the Bay of Bengal Region

The global exchange of goods heavily relies on maritime trade, particularly in the Indo-Pacific region, where the Bay of Bengal plays a strategic role. Japan's "Free and Open Indo-Pacific (FOIP)" vision aligns with the significance of the Bay of Bengal, connecting eastern and western hemispheres. Bangladesh's commitment to quality infrastructure, supported by Japan's "Multi-layered Connectivity" concept, focuses on large-scale projects like the Matarbari deep seaport. Japan's investment addresses Bangladesh's deep seaport limitations, potentially reducing shipping costs and boosting various industries, such as the Ready-Made Garments sector. The operational Matarbari deep seaport is anticipated to contribute significantly to foreign trade, potentially resulting in a 2% GDP increase.

The Ocean Policy Research Institute (OPRI) of the Sasakawa Peace Foundation in Japan executed the research project titled "Bangladesh's First Deep Seaport: Matarbari Heralds a New Vista in the Bay of Bengal Region" from October 2023 to March 2024. The culmination of this project will be shared with key stakeholders during a national seminar scheduled for March 19, 2024, hosted by OPRI-SPF. This seminar aims to disseminate the findings and insights gathered during the research project.

Climate Change Taking a Toll on Marine Life: Bay of Bengal Programme

The Bay of Bengal Programme Inter-Governmental Organisation (BOBP-IGO) has emphasized the need for increased research cooperation among member countries to address the impact of climate change on marine life in the Bay of Bengal. Dr. P Krishnan, Director of BOBP, highlighted factors such as climate change, rising river basins, and inadequate management leading to overexploitation and collapse of fish stocks in the region.

The Indian Ocean's accelerated warming, particularly affecting the migratory routes and spawning grounds of the Hilsa fish, a crucial commercial fishery, was discussed in a global conclave on mainstreaming climate change into international fisheries governance. Some fish stocks in the Bay of Bengal are declining, prompting urgent intervention for sustainable fisheries improvement.

Dr. Krishnan emphasized the necessity for a climate science network among member countries, citing challenges like limited capacity and funding for large-scale programs. He urged collaboration among Bay of Bengal nations to invest in research and development, enhance management practices,

and adopt sustainable fishing methods to protect the livelihoods of millions. The BOBP's proposed measures include financial mitigation, green fishing practices, and building healthy fish stocks.

Govt Determined to Harness Potential of Blue Economy

Fisheries and Livestock Minister SM Rezaul Karim emphasized the government's commitment to leveraging the ocean-based economy for the development of a prosperous Smart Bangladesh. Speaking at an event for the 42nd batch of Marine Fisheries Academy cadets, the minister highlighted the significance of marine resources and credited the establishment of the academy to Father of the Nation Bangabandhu Sheikh Mujibur Rahman in 1973. Minister Karim noted the diplomatic efforts of Prime Minister Sheikh Hasina in securing sovereign rights over 1,18,813 sqkm of maritime waters, paving the way for a thriving ocean-centric economy. He outlined the ministry's initiatives, including the Marine Fisheries Act, 2020, Marine Fisheries Harvesting Policy, 2022, and Marine Fisheries Rules, 2023, along with the implementation of the National Plan of Action to combat illegal fishing. The minister also highlighted the role of the Marine Fisheries Academy in producing skilled manpower crucial for sustainable marine resource exploration, extraction, and conservation, contributing significantly to the development of the blue economy.

Commercial Seaweed Cultivation: A New Frontier of Blue Economy

Cox's Bazar's Salsa Beach and Ukhiya's Mankhali have been identified as prime locations for seaweed cultivation in Bangladesh, marking a new phase in the country's blue economy. The initiative, led by Chattogram Veterinary and Animal Sciences University, follows a successful pilot project funded by the World Bank. Professor M Nurul Absar Khan highlights the favorable conditions for seaweed growth, including cool weather and clean saltwater.

Engaging 25 experienced fishermen, the project aims to showcase seawater's potential beyond fishing. Researchers have identified key seaweed varieties such as Gracilaria and Ulva Intestinalis for cultivation. With optimized cultivation from September to March and a harvest frequency of 15-20 days, the university has introduced three seaweed-based products: dry seaweed, seaweed powder, and seaweed chips.

Chattogram Veterinary University's seaweed products, including affordable alternatives to imported varieties, are gaining attention in the market. With each 100 grams containing 7% protein and 66-69% minerals, the university's seaweed is positioned as a nutritious option. The marketing team conducts regular campaigns, offering products like dry seaweed, seaweed laver, and seaweed powder at competitive prices.

Researchers anticipate a two to three times profit per kilogram of seaweed after production, projecting a significant role for seaweed in Bangladesh's blue economy. The World Bank project targets a $25 billion market by 2028, recognizing the global demand for seaweed. Entrepreneurs and local communities in Cox's Bazar have already been involved in seaweed cultivation, and the university encourages investment in this low-risk sector.

With growing interest, several companies in Bangladesh are looking to market Chattogram Veterinary University-produced seaweed. Prof Md Faisal, the research coordinator, anticipates signing contracts with these companies, marking a crucial step toward integrating seaweed into Bangladesh's economic landscape.

Bangladesh Starts Trial Tuna Fishing from Bay in February, 2024

The Department of Fisheries is gearing up to launch a trial tuna fishing project in the Bay of Bengal's exclusive economic zone and international waters in February of next year. Despite having a substantial exclusive economic zone, Bangladesh presently exploits only a fraction, limiting access to tuna and pelagic fish from deeper waters. The absence of surveys in the maritime zone has been a hindrance, delaying tuna fishing, even with permission granted to 19 firms. In an effort to attract domestic investors, the Department of Fisheries will initiate a pilot project utilizing two ships from China, focusing on tuna caught with a longline. Successful implementation of this initiative could open new avenues in Bangladesh's blue economy, potentially leading to increased private investments and facilitating exports to Japan and Europe.

Originally scheduled from July 2020 to December 2023, the project has recently been extended until June 2025 due to financial constraints. The project cost, now reduced to Tk55.21 crore, involves the acquisition of two vessels from Uni Marine Services Pte Ltd of China. This procurement is being made under special government approval, notwithstanding a directive against vessel acquisition due to a financial crisis. The vessels will be utilized for the experimental project, aiming to tap into the untapped potential of tuna fishing in deeper waters.

Tuna fishing in the region falls under the regulations of the Indian Ocean Tuna Commission, of which Bangladesh became a member in 2018. Besides tuna fishing, the country plans to conduct a survey at depths of 200 meters in its maritime waters. Negotiations are ongoing to determine Bangladesh's share of tuna extraction within the commission, with encouragement for increased participation in tuna extraction activities. This ambitious project represents a strategic move by the Department of Fisheries to explore and harness the untapped marine resources, potentially reshaping the landscape of Bangladesh's involvement in the global fisheries market.

COP28: Bangladesh Seeks Science-Based Solution to Global Climate Crisis, Demands Doubling of Adaptation Funding

The Bangladeshi delegation at COP28 in Dubai has urged a scientific approach to address the climate change crisis. Saber Hossain Chowdhury, the prime minister's special envoy for climate change, emphasized the need for tough decisions on fossil fuels based on scientific evidence to limit global temperature rise to 1.5 degrees Celsius. Bangladesh expressed disappointment over the Global Goal on Adaptation draft and called for a doubling of climate adaptation funding. The delegation stressed political commitments from major carbon emitters and leadership from developed countries. The conference aims to adopt ambitious targets for carbon emission reduction and express countries' willingness to combat climate change. The Loss and Damage Fund was activated, and Bangladesh is ready to receive funds. The final agreement is crucial for the well-being of all nations, emphasizing the need for cooperation and abandoning obstructionist mentalities. The conference concludes on Tuesday.

BIMRAD Participated in the “Golden Jubilee" Celebration of the Territorial Waters and Maritime Zones Act, 1974

Bangladesh Navy commemorated the Golden Jubilee of the enactment of the Territorial Waters and Maritime Zones Act, 1974 (Act No. XXVI of 1974) on Thursday, 22 February 2024. This pivotal legislation, formulated by the Father of the Nation, Bangabandhu Sheikh Mujibur Rahman, was celebrated at the Bangabandhu International Conference Centre with the esteemed presence of the Honourable Prime Minister, Sheikh Hasina, as the Chief Guest.

This landmark act laid the groundwork for defining Bangladesh's territorial waters and maritime zones within the Bay of Bengal. It established a framework for governing and claiming rights over the sea and its resources, including determining maritime boundaries and outlining measures to control marine pollution and promote marine scientific research.

The Chief of Naval Staff, Admiral M Nazmul Hassan, OSP, NPP, ndc, ncc, psc delivered the welcome address, and Hon'ble Minister of State, Ministry of Shipping, Mr. Khalid Mahmud Chowdhury, MP, delivered the speech as a special guest while Rear Admiral Md. Khurshid Alam (retd), Secretary to the Maritime Affairs Unit, delivered the keynote speech on the occasion of the golden jubilee of the enactment of the 'Territorial Waters and Maritime Zones Act, 1974'. In the seminar session, learned maritime intellectuals discussed various issues in building a developed and prosperous Bangladesh through the best use of the maritime economy. The seminar focused on future prospects and the need for a mutual relationship between all ocean-centric organizations to manage the sea sustainably and effectively.

The Hon'ble Prime Minister emphasized the Act's significance in paving the way for the peaceful utilization of maritime resources, adhering to principles of fairness and equity. She firmly believes that properly and equitably using our maritime resources will propel our nation toward economic prosperity. The Prime Minister acknowledged the immense potential of Bangladesh's maritime resources and stressed the need to harness them sustainably for the nation's progress.

The Bangladesh Institute of Maritime Research and Development (BIMRAD) actively participated in organizing the Golden Jubilee celebration. The Institute's contributions in arranging maritime stalls by the stakeholders were instrumental in showcasing Bangladesh's maritime prowess.

The Golden Jubilee celebration of the Territorial Waters and Maritime Zones Act, 1974, served as a testament to Bangabandhu Sheikh Mujibur Rahman's visionary leadership and unwavering commitment to safeguarding Bangladesh's maritime interests. The event also underscored the Blue Economy's importance in driving the nation's economic growth and development. BIMRAD's active participation further solidified its commitment towards promoting maritime research and dissemination of scientific knowledge to the global community.

BIMRAD Prticipated on “Indian Ocean Security Conference phase III”

During his address at the recent Pathfinder Indian Ocean Security Conference phase III hosted at Cinnamon Grand Colombo, President Ranil Wickremesinghe emphasized Sri Lanka's unwavering commitment to fostering stability and cooperation in the Indian Ocean. He underscored the nation's strategic position aimed at preventing major power rivalries and ensuring the freedom of navigation in the region.

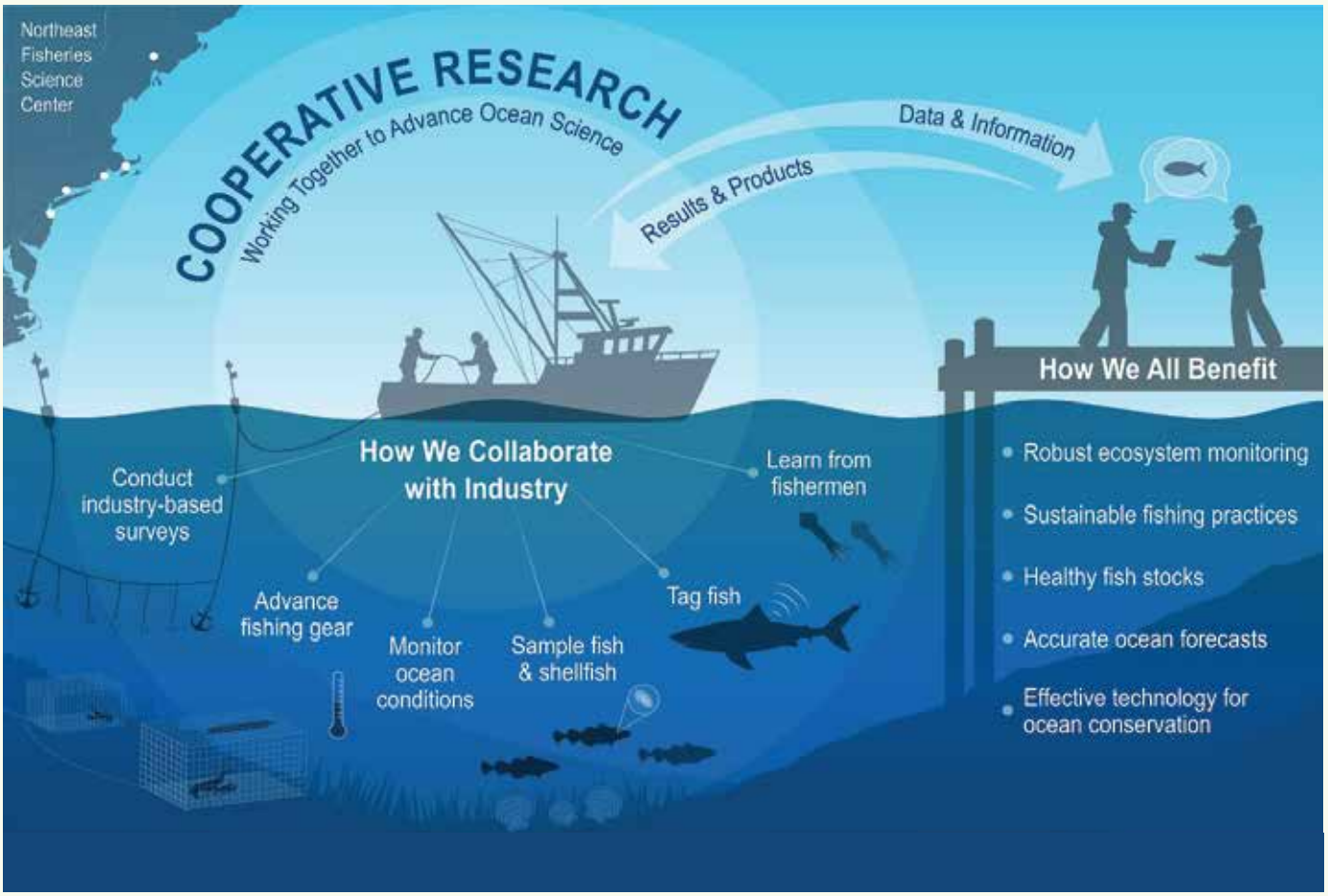
President Wickremesinghe highlighted Sri Lanka's active role as guardians of prosperity in the Red Sea, driven by its commitment to freedom of navigation. He pointed out the crucial role of the Suez Canal, citing the negative impact on the Colombo port during its ten-year closure following the Six-Day War. The President emphasized the imperative of safeguarding unrestricted navigation in the Indian Ocean.

The address also touched upon emerging issues, particularly security concerns in the undersea domain, prompting a reassessment of strategic approaches. President Wickremesinghe expressed the belief that the future lies in the Indian Ocean and stressed the importance of understanding Sri Lanka's role within the broader Indo-Pacific framework. He acknowledged the evolving dynamics of the Indo-Pacific, raising questions about the country's positioning and potential involvement in regional conflicts.

The ongoing two-day conference involves delegates from various nations, highlighting the significance of the Indian Ocean in global security and supply chain resilience.

In conclusion, President Wickremesinghe reaffirmed Sri Lanka's dedication to promoting stability and cooperation in the Indian Ocean region. He emphasized the importance of maintaining an inclusive approach that respects the historical significance of the Indian Ocean and considers the perspectives of its diverse stakeholders for long-term peace and prosperity.

Notable attendees at the event included US Ambassador Julie Chung, Japan's Deputy Assistant Minister for Southwest Asian Affairs Hayashi Makoto, Founder of Pathfinder Mr. Milinda Moragoda, Co-Chairmen of the Pathfinder Indian Ocean Security Conference, Mr. Bernard Gunathilake & Mr. Shivshankar Menon, along with High Commissioners, Ambassadors, and officials from Ministries and line institutions of the Ministries and the tri-forces. Afifat Khanam Ritika, Research Officer participated in the Seminar on behalf of BIMRAD.



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Navigating Adversity: Dreams of Resilience Along Bangladesh's Vulnerable Coast

Rafiqul Islam Montu

Bangladesh's coastal areas have endless potential. The livelihood of millions of people is based on fish resources extracted from sea and rivers. Many live and earn their living in various income-oriented activities, including salt farming, dried fish production, crab farming, and shrimp farming. The expansion of agriculture on the coastal islands' alluvial soils has changed many people's fortunes. Many people have changed their economic status by growing soybeans, Capsicum, and other cash crops. Mineral sand on the beach is another possible name for the coastline. The tourism sector also has endless potential along the coast. These potentials of the coast can be further expanded by developing the blue economy. Meanwhile, the government has taken multifaceted steps to develop the blue economy.

The 710 km coastline along the southern coast of Bangladesh has endless potential, but multifaceted obstacles have limited the opportunity to develop that potential. Natural hazards are significant obstacles to that potential in coastal areas. The effects of climate change are already visible in the region. Sea level rise is disrupting people's lives and all their livelihood activities. Many potentials of the coastal region are not being developed due to a lack of proper and scientific initiatives. The coastal region has a lot of agro-based industrial potential. The list includes shrimp farming, crab farming, salt farming, dry goods production, oyster farming, pearl farming, and even cattle and dairy farming. As there can be area-based agricultural development projects, there can also be agro-based industries. There is also potential in transport and tourism. Just as there is potential for mineral sand on the beach, there are endless resources under the sea. These industries indicate great potential not only for the coast but also for Bangladesh.

Field observation revealed that the coast's soil is continuously becoming fertile due to the accumulation of sediments from the sea and rivers. Various crops are grown on the islands built on the banks of the river. Different classes of people are developing agriculture-based projects on their initiative for livelihood. Some are taking risks, like shrimp farming and fish

farming. Farmers have demanded proper government and NGO cooperation in developing these fields where marine science and technology can play a vital role.

Speaking about the potential of the coast, Anwar Hossain, a resident of Rahmatpur village of Chittagong's ancient island of Sandwip, said, 'The silverfish in the sea brings smiles to the fishermen's faces and brings economic prosperity to their homes. The golden rice of the field brings joy to the farmer's house. Coastal people have developed a close relationship with nature. Overcoming the wall of a thousand fears, the struggling people of the coast seek a livelihood amid all possibilities. But step by step, they face danger.' Khalilur Rahman, a fisherman of Dakshin Sakuchia village of Dwip Upazila Manpura in Bhola district, said, 'People who survive fighting with nature only look for possibilities. Join in trying to get one meal for the family. But the people moving upstream are constantly suffering. People here have little chance to live well using natural resources. The government should pay attention to this. Initiatives should be taken to develop the potential of the coast.'

A similar picture emerges from conversations with professionals at various levels about the coast's potential. During the discussion, many questioned whether proper planning is needed to raise the potential. But it doesn't look like that. Laws and policies made in this regard are not being implemented. Many say that despite a lot of information and technological investment at the government and NGO levels about the endless potential of the coast, there is less chance to develop the potential.

Figure 1: Every Year, The Accumulation of Sediment on the Coast Creates Many New Land Masses

It is known that, more than 1 million people on the coast are directly and indirectly involved in fishing. However, the existing obstacles in fishing are challenging to overcome. There are technical problems in sea fishing and financial problems for fishermen. Natural hazards create more obstacles to people's income-oriented activities. Sikandar Ali, a fisherman from Kalapara, said, 'We have to go fishing in the sea with advance money from the people whereas there is no guarantee of my return home. No one will take responsibility for my family if I get caught in a storm while fishing in the sea. But to repay the moneylender's loan ignoring all fears, we are forced to risk our lives fishing in the sea or river.

People Who Lost Everything Also have Dream

Seventy-five-year-old Solaiman of Sandwip stood on the river's bank, raising his fingers and trying to draw the boundaries of new pastures. His house, plants, pond, farming land, everything is drowned in this river. He chased the river and retreated. At the last age of Solaiman's life, he hopes to see new pastures in that river. He remembers the old story again. It is the story of the Rahmatpur area on Meghna Bank west of Dwip Upazila. Known as an erosion-prone area, the erosion of this area has stopped, and now new pastures have been found. At low tide, one can walk far over the silt. According to the locals' idea, this char is about 20 kilometers long. Many people of this area are weaving new dreams of life like Solaiman around this char.

The island and the entire coast have a pattern of erosion and formation. New chars are emerging in various areas, including Hatia, Manpura, Maheshkhali, Kutubdia, Char Montaj, Rangabali, and Galachipa. The land area is increasing. Although these new chars are supposed to be given to the real landless people, these chars usually go to the dominants. Landless people wait for grazing land for years. But their names do not appear in the list of land that has been awakened. Somewhere, the new land comes under the control of the forest department. There is a dispute between the forest department and the residents. But proper distribution of this land among the landless can help develop the coast's potential.

It can be seen in different areas of Sandwip that erosion is coming, and one dam has disappeared. People moved their houses and built houses next to the new dam. The people here are seeing the mango or coconut trees planted as a hobby, the ponds and ghats built with great care, and the graveyards of relatives are all disappearing. During the conversation, the devastated people said that no one comes to inform them of the indescribable misery that has descended on their lives due to shifting houses several times a year. There was no place for a piece of head, so they took shelter on the side of the broken dam. They try to survive somehow. They will get back the lost land; this is a story of hope.

Another picture is from Manpura in Bhola Dwip district. Having lost their ancestral wealth, some are trying to make a living in small businesses on the banks of the river. Some lost their homes and took refuge in boats. Sleeping, eating, drinking, or fishing for livelihood is done there. Even after moving 8-10 times due to an adverse environment, stability did not come into their life. Their eyes are towards the land that has risen on the new island far away. But another war must be fought to get a piece of land there. Even after getting the land documents, many people do not find a place in the new pasture. In Bhola

Dwip Upazila Manpura, Char Nizam and Char Kalatali do not have accommodation for self-employed people. Due to erosion, people of different areas, including Andirpar, Ramnewaz, and Sakuchia, live their days with extreme hardship. They changed houses a maximum of 14 times in one life. However, stability did not come. Refugees who are threatened by multifaceted disasters have nowhere to go. Those with some money can buy land and build a house elsewhere, but those who do not have that ability are lying here.

Due to various natural calamities such as river erosion, floods, rising tides, and cyclones, many people in the country's coastal areas have lost everything and are looking for shelter here and there. Experts identify them as climate-displaced. According to a study conducted by the Association for Climate Refugees (ACR) and Young Power in Social Action (YPSA), about 6 million people have already been displaced in the country due to climate change. These refugee people of Manpura belong to them.

There are new forages in different areas of the coast. The area's people dream a lot about the new char; they pay the outstanding government fees and keep the land documents in order. The development potential of the coast may change if the people of the coast get absolute ownership of the newly awakened islands. Temporary people can't conduct any activities permanently. They can't engage in any particular work where there are many problems with life and livelihood. Mohammad Shahjahan, team leader of the YPSA HLP program, a private development organization working on the rights and rehabilitation of climate-displaced people, said that it is essential to help Bangladesh government to take climate action properly. What is standard today is that climate adaptation plans and programs are opaque and prone to corruption. It is essential to resolve these issues as soon as possible. He said civil society can be an active observer in this field. Regional and international groups, especially donor countries, should support efforts to eradicate corruption and bring transparency. Funding alone is not enough to implement policies and programs on climate displacement. Oversight of funds is imperative, and proper implementation of activities is required to be ensured.

Massive Potential for Agriculture in Alluvial Soil

A new scenario, field after field of Capsicum (sweet pepper) in fertile alluvial soil! Actually, a bumper crop is coming with a reasonable price. The return on investment is also satisfactory. And so farmers are becoming interested in capsicum cultivation along with other crops. They claim that if the price of seeds is reduced and the import of Capsicum from outside the country is stopped, there can be a revolution in the cultivation of this crop. It is just a story of the island district Bhola. There are thousands of such success stories in agriculture along the coast.

The crops seen in the cities, the farmers in the villages knew their names, are now grown by the farmers on the coastal islands. Many crops like Capsicum grow in the fertile soil of the coast. The coastal region has shown great potential in multi-purpose agriculture, including rice, chili, soybean, watermelon, wheat, maize, almonds, mustard, sesame, pulses, various pulses, and vegetables. Farmers in coastal districts Bhola, Patuakhali, Pirojpur, Laxmipur, Noakhali, Chittagong Cox's Bazar, and Barguna are benefiting by planting new crops.

Figure 2: Many Crops are Grown on the Fertile Land of the Coastal Islands

Those involved in coastal agriculture said that coastal land is suitable for all types of agriculture. But in this case, natural disasters and lack of necessary sponsorship are the biggest obstacles. Even if the farmers plant with risk, they usually cannot bring the crop home. Crops are damaged yearly due to various calamities, including the untimely rise of tidal water, increase in water salinity, river erosion, and cyclones. Coastal district Lakshmipur leads in the cultivation of cash crop soybeans. In just a few years, about 75 percent of the total soybean production in the country is being produced in this district. Due to this success, Lakshmipur became known as 'Soyland.' However, aside from Laxmipur, soybeans are being produced in different coastal districts: Noakhali, Chandpur, Barisal, Bhola, Patuakhali, and Noakhali. Farmers demand support from the government to expand soybean cultivation and get fair prices.

Many places in the coastal region have a reputation for rice production. One of the known areas is Subarnachar in Noakhali. This area has been identified as an economic area as a rice production area. Different varieties of rice are grown in this area. During the paddy harvesting season, many people from different areas come to Subarnachar to work in paddy harvesting. But farmers in Subarnachar, known as a paddy area, are counting losses. It is difficult for them to get through the year by cultivating paddy. If there is a bumper yield, the paddy-rice market will decrease, and if the price is slightly better, the yield will not be good.

Inadequate fertilizer and seeds, irrigation crisis, and lack of proper advice are added to the hostile nature. Farmers complain that although the soil of Subarnachar is very fertile for paddy production, there is a lack of adequate effort regarding the facilities of the farmers. Most of the farmers in the whole upazila are small, and most do not have their land. The number of farmers cultivating their land is very few. Small farmers take land from owners and cultivate it. The small farmer himself bears all the expenses during cultivation. But the owner of the land has to pay half of the produce. As a result, small farmers can never benefit. The island area of the coast has excellent potential for watermelon and almond cultivation in fertile land. Over the past few years, this possibility has developed even more. Farmers benefit from growing these profitable crops on the island's newly fertile land. However, the farmers claim that this profitable crop is facing various risks.

On the one hand, there is natural antagonism; on the other, there is the risk of not getting a fair price in the market. In addition, there is the violence of business people's syndicates and extortionists. However, farmers can benefit more if the potential for coastal watermelon and almond cultivation is developed.

Salt Production is the Survival Dream of Many Families

Let's start with clay. A small amount of salt particles were present in the soil. Salt was made by taking mud from the field. That situation has changed. Now, the shiny white salt is available in the field. There have been many changes in the farming process. Production volume is increasing year by year. Farmers try. This is where proven salt farming potential is enormous. But what if there is a possibility? There is no initiative to develop potential. The salt sector has been neglected for years. Such is the tone of regret in the words of the salt farmers of the Chakra area of Cox's Bazar. They say there is no lack of effort and no end to Khatuni. Farmers are willing to pay more labor. But the government's attention is needed first of all. Appropriate initiatives should be taken to implement laws and policies. If necessary, new policies should be made. The salt sector should be saved not only for the sake of the farmers but also for the sake of the country.

Figure 3: There are Many Problems in Salt Cultivation, Yet Salt Cultivation is the Dream of Many People on the Southeast Coast

During the season, field after field of shiny white salt can be seen in the remote villages of Chakra, Maheshkhali, and Kutubdia of Cox's Bazar. Farmers prepare to store salt before the onset of monsoon. Some store salt under the ground, while others wrap it in polythene on top of the ground. Due to a lack of fair price, the salt remains in the field for years without being sold. The coastal areas of the country, especially Cox's Bazar and Chittagong areas, have been producing salt using the 'natural solar system' for a long time. However, planned salt production started in 1961 as a government initiative. Since then, under the overall supervision of the Ministry of Industry, Bangladesh Small and Cottage Industries Corporation (BCIC) has been responsible for monitoring the salt production situation as the only central institution of the government. The quality of salt produced in the country has increased. The country has achieved self-sufficiency in salt production. Even a situation like the export of salt has arisen. And in this regard, BCCI has various initiatives. However, this sector faces severe changes daily due to not being able to pay fair prices to the farmers. The salt policy was made in 2011 to expand the salt sector and increase farmers' opportunities. It alleged that a group of profiteers are plotting to destroy this industry by violating many clauses of this policy, including salt farmers.

Farmers said that more and more farmers in Cox's Bazar and Chittagong region are cultivating salt due to the polythene method of salt production. As a result, the amount of salt

Figure 4: The Production of Dried Fish Employs Many Coastal People

production is also increasing. Minimal salt had to be imported in the past. Day by day, that demand has come down to zero quota. Salt farmers believe that it is possible to benefit the farmers by adequately marketing the salt produced in the country through the farmers. The people concerned complain that despite the vast potential, there is no interest from the government or the private sector in this salt sector. The government has recognized this industry as an industrial product rather than an agricultural one. As a result the farmers are deprived of the subsidy given at the agricultural level. In the natural calamity of 1991, the interest on the loans of self-employed salt farmers was not waived. Declaring salt farming as an agricultural product, salt farmers have demanded all kinds of agricultural subsidies as farmers. They said salt farmers face various kinds of calamities every year. The scale of disasters due to climate change has increased significantly in the last few years.

Salt traders said that at least 360 salt mills have been built in different parts of the country for refining and marketing the produced salt. Among these mills, at least 50 small and big mills have been established in the district, including 40 mills centered in Islampur, the BCIC industrial city of Cox's Bazar Sadar. At least half a million farmers and their families are involved in this profession. However, the manufactured salt and salt mills have become hostage to the six mill owners in the country. Farmer's labor is not evaluated correctly. Due to this, farmers have lost interest in salt farming. To save the country's potential salt sector, the people associated with salt farming raised eleven-point demands, including implementing the salt policy. The Bangladesh Salt Growers Association leaders said saving the salt sector only by implementing government-approved salt policies is possible. And if the salt sector survives, about two million people in this industry will survive. Sources of the Salt Growers Association say that although the government approved the National Salt Policy in 2011 to develop the potential of the salt sector, including domestic salt cultivation and market expansion, protecting the interests of salt growers, the farmers are not getting any benefit. In violation of the policy's provisions, the profit-making mill owners indulged in importing salt from abroad, causing a salt shortage.

'Blue-Economy' Will Bring Back Good Days

There is enormous potential for a blue economy based on marine resources all along the coast. Marine resources can enrich the entire economy of Bangladesh through appropriate initiatives and measures. This possibility has expanded after the settlement of maritime boundary disputes with Myanmar in 2013 and India in 2014. Bangladesh can carry out resource extraction activities in a more than 1 lakh 18 thousand 813 square kilometers marine area. Extensive research is needed to unlock the hidden potential of the ocean floor. Various steps have already been taken to develop the blue economy.

Experts say that marine resources will play a significant role in the economic development of Bangladesh. Proper use of marine resources can increase the national economic growth

to double digits. But for this, we have to move forward by formulating integrated plans.

The correct and appropriate use of the potential of Bangladesh's sea resources has been opened through the victory of the sea. In 1994, Professor Gunter Pauli proposed the Blue Economy as a sustainable and environmentally friendly model to outline the economy of the future. Countries worldwide seek ocean resources to meet their current and future needs.

According to research sources, the world's population will be around 9 billion in 2050. The sea must be looked to to provide food for this vast population. The ocean economy continues to contribute manifold to the global economy. Between 3 and 5 trillion US dollars of activity occurs around the oceans annually. Marine fish, plants, and animals provide 15 percent of the protein for the world's 430 million people. 30% of the world's gas and fuel oil is supplied from various gas and oil fields on the seabed. By increasing the knowledge of marine biodiversity, developing a marine medicine industry is possible.

According to various sources, the economy has become popular around the world. This issue was at the center of discussion in the international conferences held in the past years. Among them, Rio+20 in 2012 and the Asian Conference on Ocean Affairs, Food Security, and Blue-Growth in Bali in 2013 are particularly noteworthy. Economy is also at the root of the development strategy of various international organizations, including the Economic Aid and Development Organization, the United Nations Environment Program, the World Bank, FAO, and the European Union.

Future planning should focus on the resources and potential of Bangladesh's coast. Planning should emphasize the ground level while also reflecting the people's voice.

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Hilsa shad, Tenualosa ilisha or Ilish is the National Fish and declared as the Geographical Indication (GI) product of Bangladesh. The fish comprises the most important and largest single species of the open water fishery of the country. It currently contributes about 12% of the total fish production, 27.5% of capture fisheries production and 1% of national GDP.

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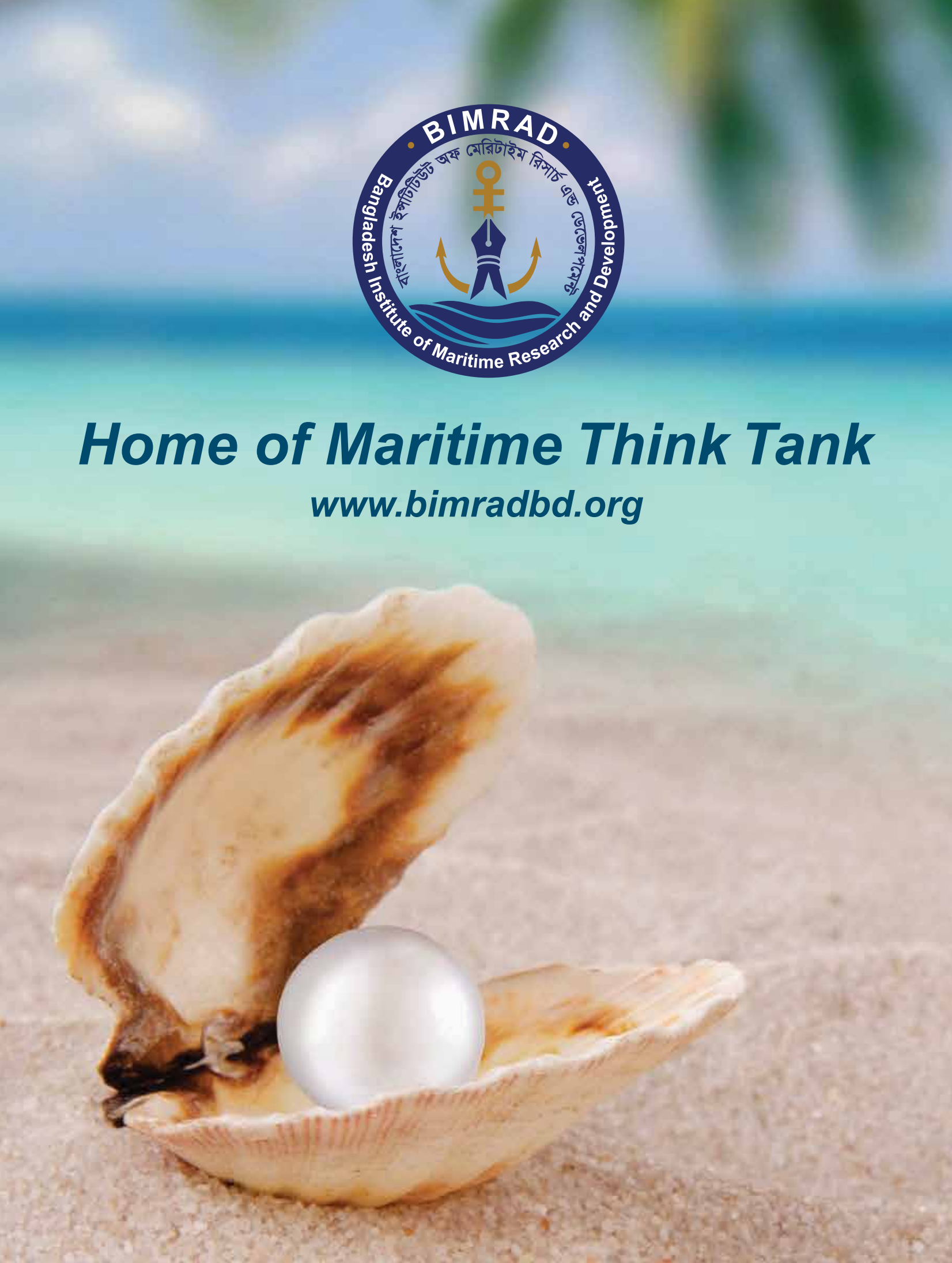

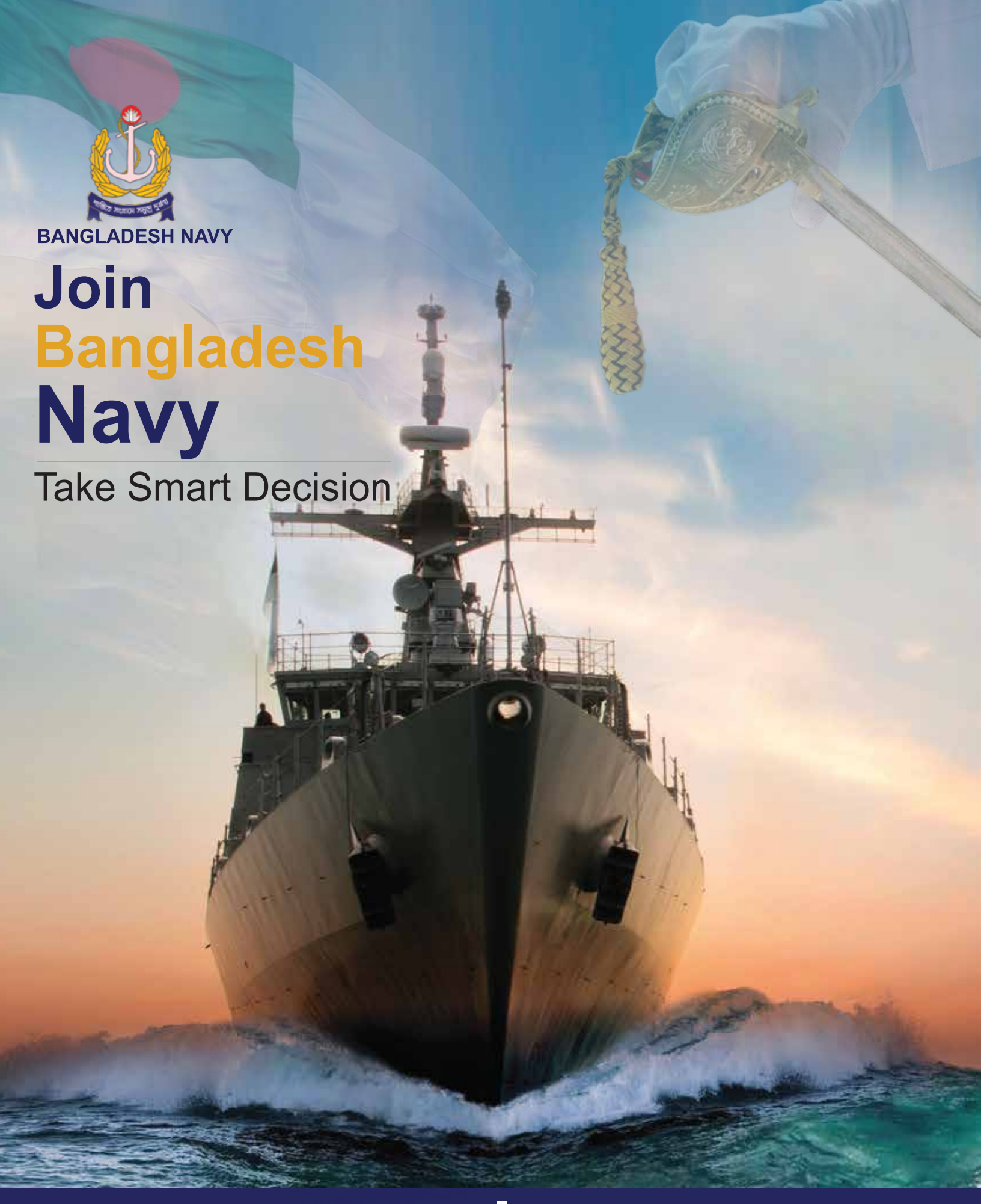

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ISSN 2959-5444