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MARITIME CAMPUS

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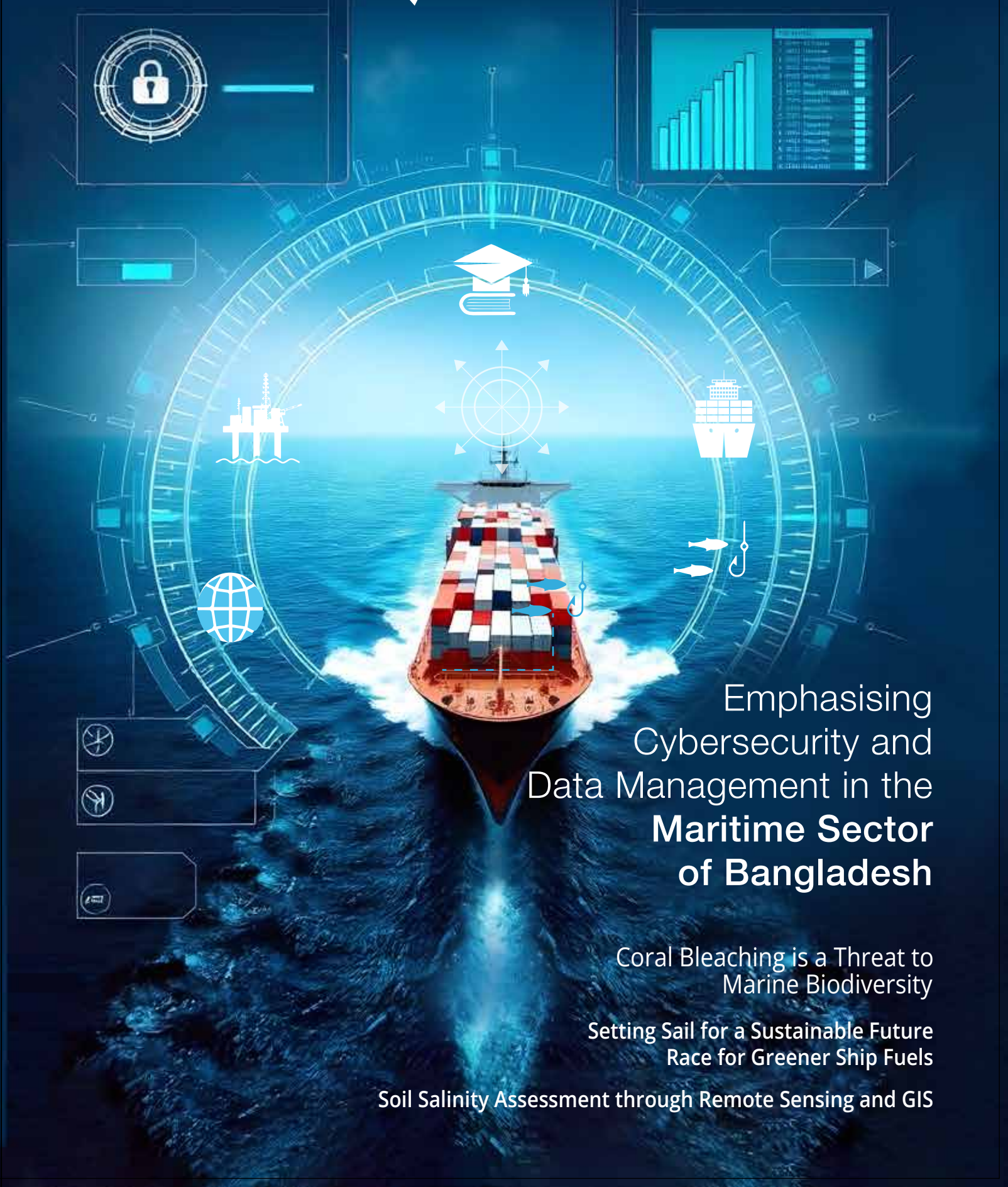


Emphasising Cybersecurity and Data Management in the **Maritime Sector of Bangladesh**

Coral Bleaching is a Threat to Marine Biodiversity

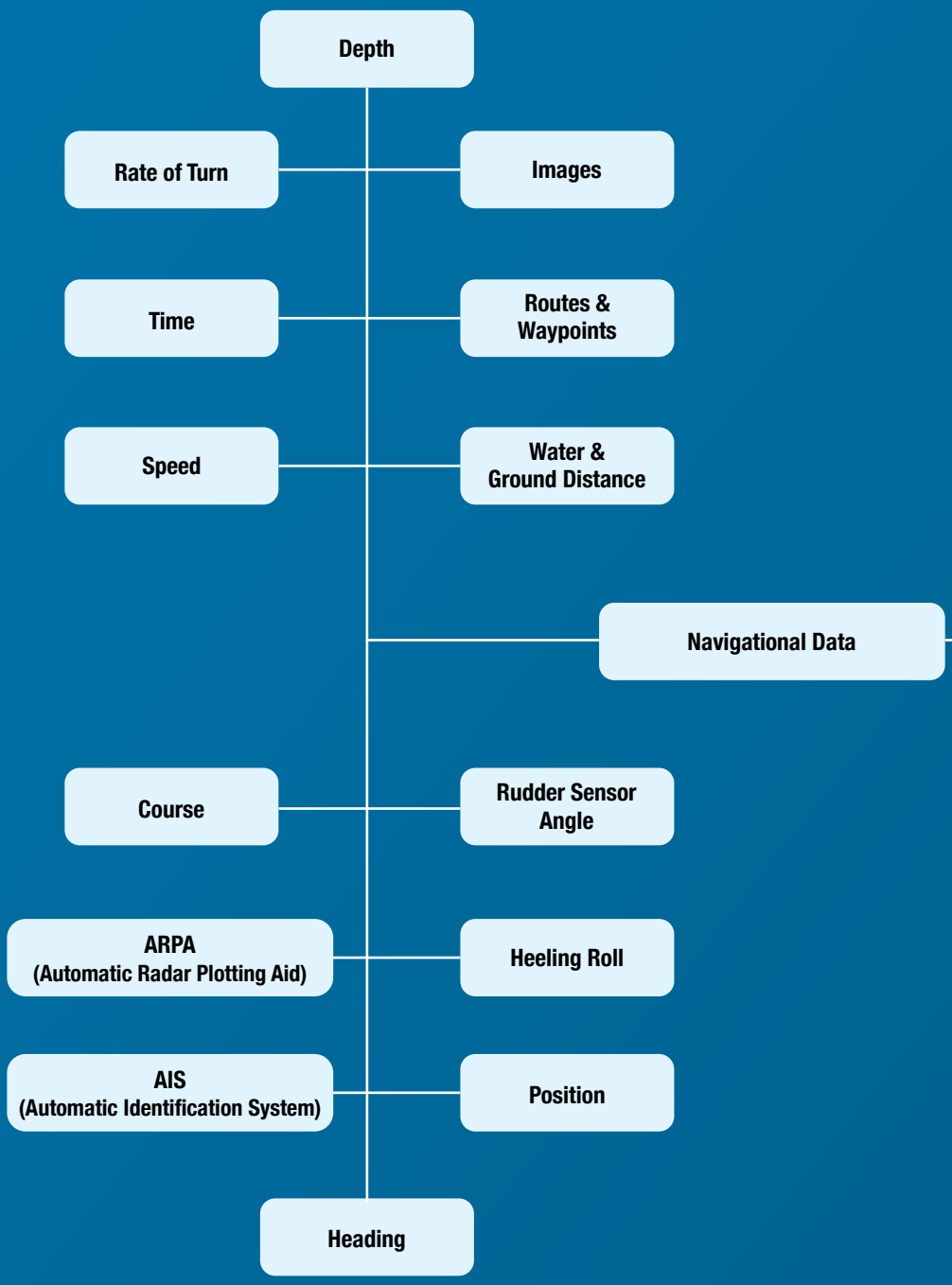
Setting Sail for a Sustainable Future
Race for Greener Ship Fuels

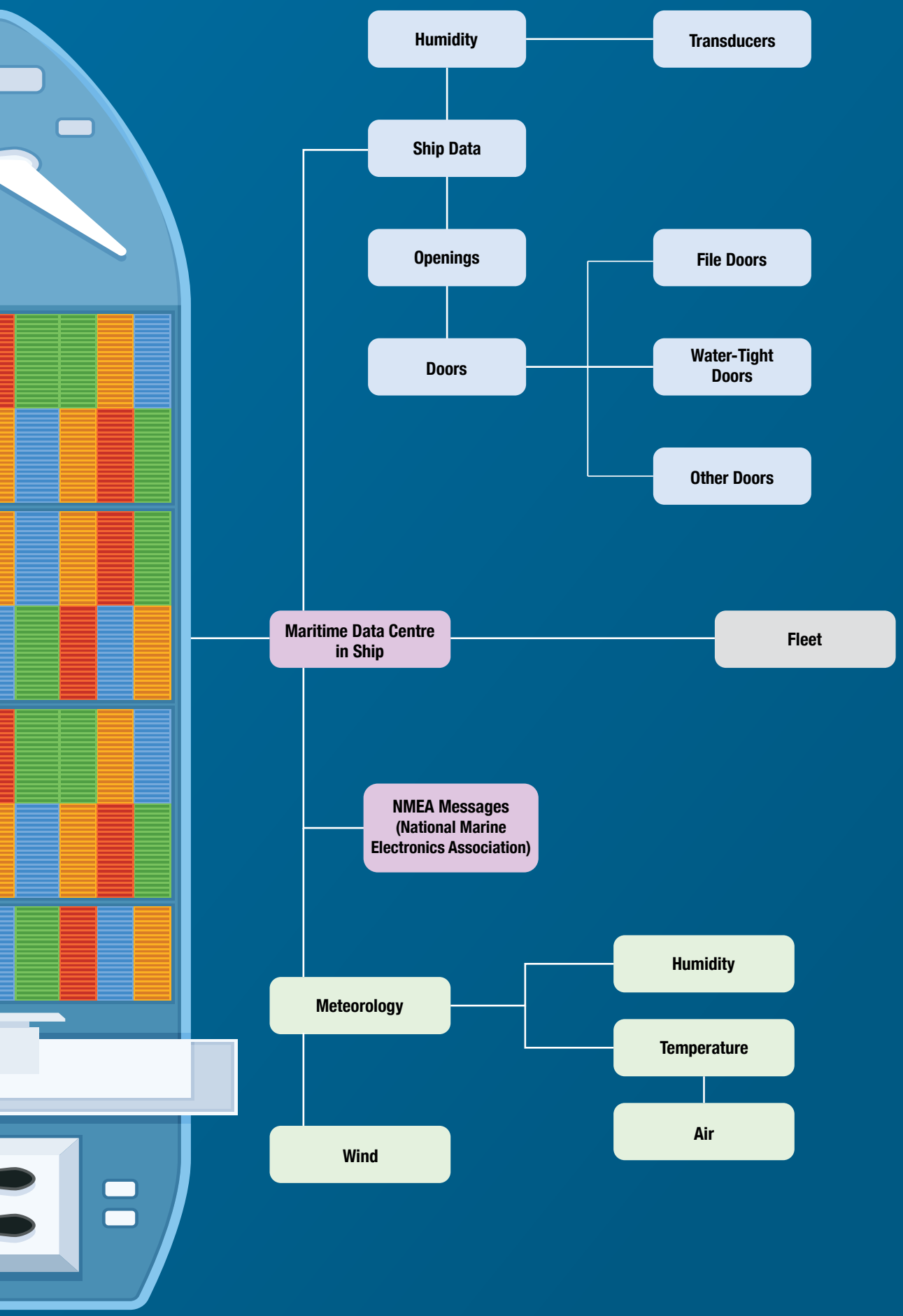
Soil Salinity Assessment through Remote Sensing and GIS

INFOGRAPHIC

On Maritime Big Data

Big data is used to manage ship sensors and for predictive analysis, which is needed to prevent delays and improve the overall operational efficiency of the industry. In the shipping industry, proper cargo tracking is essential to ensure the necessary safety and confidentiality.




Humidity
Transducers
Ship Data
Openings
File Doors
Doors
Water-Tight Doors
Other Doors
Maritime Data Centre in Ship
Fleet
NMEA Messages (National Marine Electronics Association)
Meteorology
Humidity
Temperature
Air
Wind

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Editorial

Towards a Sustainable and Secure Maritime Future

As we stand on the brink of unprecedented technological advancements and environmental challenges, the maritime sector is poised for transformative growth and innovation. This issue delves into the critical topics shaping the future of maritime education, environmental stewardship, and technological progress in Bangladesh and beyond. Our Lead Story, *"Enhancing Maritime Education: Emphasising Cybersecurity and Data Management in the Maritime Sector of Bangladesh,"* addresses the urgent need for advanced educational frameworks to counter rising digital threats.

In the *Academia* section, *"Setting Sail for a Sustainable Future: Race for Greener Ship Fuels"* explores a pivotal moment in the shipping industry's journey to reduce its environmental footprint. Traditional fuels like heavy fuel oil (HFO) have significantly contributed to air pollution and greenhouse gas emissions. However, a transformative change is on the horizon as the industry explores innovative, sustainable fuel alternatives. Dive into the race for eco-friendly ship fuels and discover how the maritime world is charting a course toward a cleaner, greener future.

Our *Focus* article, *"Coral Bleaching: A Threat to Marine Biodiversity"*, sheds light on the severe risks facing one of Earth's most vibrant ecosystems. Coral reefs play a crucial role in providing habitats for marine life, protecting coastlines, and supporting millions of livelihoods. Yet climate change-induced coral bleaching is wreaking havoc on these underwater marvels globally, including in the Bay of Bengal. We explore the causes, consequences, and the imperative need for a strategic plan to preserve these ecosystems—and the communities that rely on them—for generations to come.

In *Ocean Health* section, *"Soil Salinity Assessment through Remote Sensing and GIS"* discusses the environmental challenge of soil salinisation. This phenomenon leads to soil degradation, desertification, and significant losses in agricultural productivity. With over 105.6 million hectares in Bangladesh now affected, soil salinity endangers food security and farming livelihoods, particularly in coastal regions. Explore the causes, effects, and the urgent need for solutions to curb this growing environmental threat through advanced technologies like remote sensing and GIS.

Our *New Waves* section takes you on a historical journey *"From Dugout Canoes to Modern Trawlers: A Deep Dive into Fishing Vessels,"* highlighting the evolution of fishing technology and its impact on the maritime industry. Additionally, embark on *"A Geological Adventure on Bangladesh's Southern-most Island,"* uncovering the unique geological features and the potential they hold for education and tourism.

Our *Campus Canvas* brings you the latest news on BSMRMU events and developments, underscoring our commitment to excellence in maritime education and research.

The *Maritime Bangladesh* section presents updates on the nation's maritime progress and activities, highlighting initiatives that drive growth and innovation in the sector. Finally, *Around the World* offers notable news from the global maritime sphere, keeping you informed about international trends, advancements, and collaborative efforts.

We invite you to immerse yourself in this edition of *Maritime Campus* and join us in shaping the future of the maritime sector of Bangladesh.

Smooth sailing,

Captain Saad Emon Eshtiaque, (S), psc, BN
Editor and Controller of Examinations
BSMR Maritime University
Email: editor.mc@bsmrmu.edu.bd

CONTENTS

Emphasising Cybersecurity and Data Management in the Maritime Sector of Bangladesh

Maritime Campus desk

Introduction

In today's rapidly evolving digital landscape, maritime industries face unprecedented challenges and opportunities driven by technological advancements. Bangladesh, as a maritime nation with strategic access to the Bay of Bengal, is particularly vulnerable to emerging digital threats within the maritime sector. Cybersecurity and data management are critical areas of focus, especially given the increasing reliance on digital technologies for operational efficiency, navigation, and logistics.

To safeguard Bangladesh's maritime assets and ensure the security of its maritime operations, it is imperative to incorporate cybersecurity and data management education into the curricula for maritime students and professionals. This shift will equip the next generation with the necessary tools to defend against digital threats and leverage data analytics for operational improvements.

This article discusses the significance of cybersecurity and data management education for maritime students and professionals in Bangladesh. It also presents a comprehensive plan for how BSMR Maritime University (BSMRMU), the nation's premier maritime education institution, can play a pivotal role in leading this educational revolution.

The Rise of Digital Threats in Maritime Industries

The global maritime sector is increasingly dependent on digital technologies to manage operations, enhance safety, and improve efficiency. However, this shift comes with substantial risks. Digital threats, including cyberattacks, data breaches, and malware, are becoming more sophisticated and prevalent in the maritime sector. The International Maritime Organization (IMO) acknowledges the

critical need for cybersecurity measures in its 2021 Maritime Cyber Risk Management guidelines.

Common Digital Threats in Maritime Industries

1. Cyberattacks on Vessel Operations: Many modern vessels are equipped with complex computer systems for navigation, communication, and cargo management. These systems are vulnerable to hacking attempts, which can disrupt operations, mislead navigational data, or even jeopardise the safety of the vessel and its crew.

2. Data Breaches in Logistics and Supply Chains: Maritime shipping relies heavily on data to coordinate global supply chains. If sensitive information is compromised, it can result in financial losses, legal repercussions, and reputational damage. Additionally, attackers can exploit vulnerabilities in logistics software, causing disruptions in global trade.

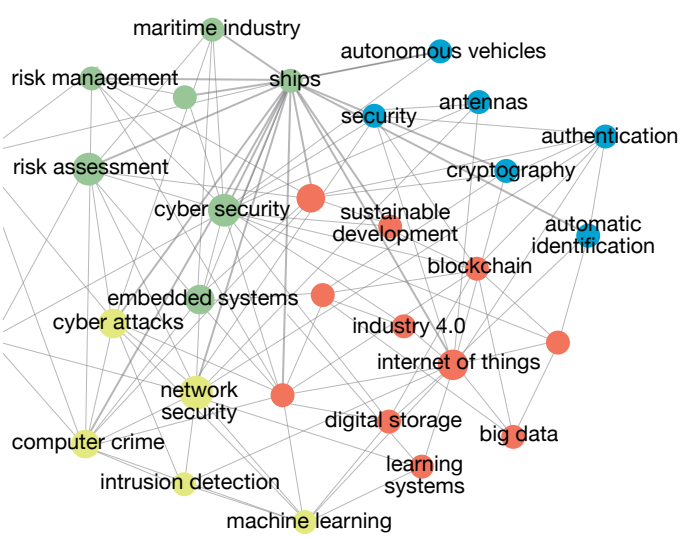
3. Ransomware: Ransomware attacks can target port infrastructure, shipping companies, and maritime authorities. By locking critical systems, cybercriminals can demand ransom in exchange for the release of operational control, leading to costly downtime and potentially life-threatening situations.

4. Phishing Attacks: These types of cyberattacks often target employees in the maritime industry. A simple click on a malicious email link can grant attackers access to internal systems, allowing them to steal confidential data or gain control of operational networks.

As digitalisation accelerates in the maritime sector, Bangladesh must stay ahead of these challenges. Educating maritime students and professionals about cybersecurity and data management is essential for safeguarding the nation's maritime interests and ensuring the sector's resilience against digital threats.

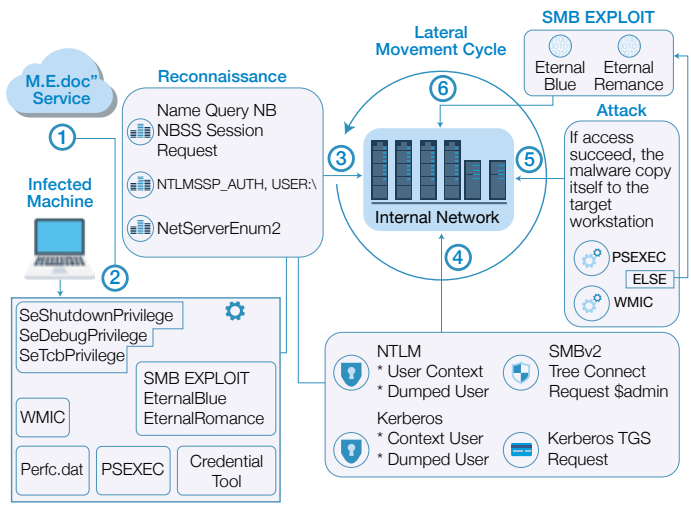
Real-Life Case Studies on Cybersecurity and Data Management in Maritime Industries

To highlight the urgency and importance of cybersecurity and data management in the maritime sector, we will explore several real-life case studies involving cyberattacks and data management challenges significantly impacted maritime operations. These examples underscore the need for Bangladesh, particularly BSMRMU, to integrate cybersecurity and data management education into its curriculum.



1. Maersk Cyberattack (2017) – The Impact of NotPetya Malware

One of the most significant cyberattacks in the maritime industry occurred in June 2017, when A.P. Møller-Maersk, a global shipping giant, fell victim to the NotPetya malware attack. This ransomware crippled the company's operations, causing Maersk to lose access to its IT systems across 600 locations in 130 countries.



NotPetya Malware: Lateral Movement Graph

Impact: The attack halted Maersk's shipping and logistics operations for nearly ten days, forcing the company to manually handle shipments. This led to significant delays in global supply chains. Maersk estimated a financial loss of around $300 million due to the cyberattack. Additionally, the company had to rebuild its entire IT infrastructure, a massive undertaking given the scale of the company.

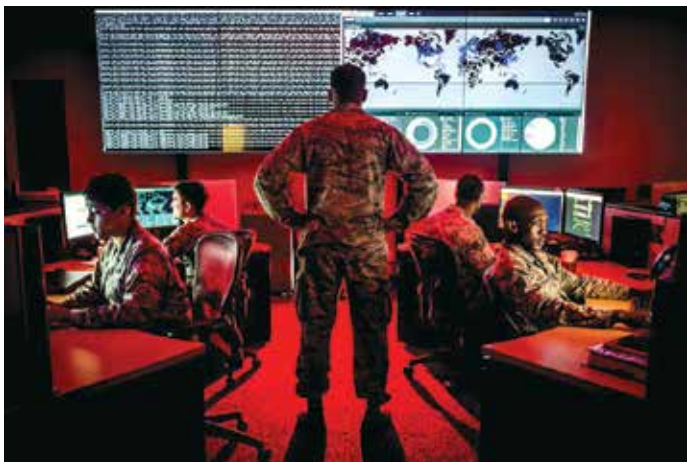
Lessons for Maritime Education: The Maersk incident highlights the critical importance of robust cybersecurity systems and contingency planning. For BSMRMU students, this case illustrates the devastating effects of a cyberattack on a global company, underscoring the need to study cybersecurity risk management. Incorporating lessons from the Maersk attack into BSMRMU's curriculum can demonstrate the necessity of immediate response strategies, data recovery, and system redundancy in maritime cybersecurity practices.

2. Port of San Diego Ransomware Attack (2018)

In September 2018, the Port of San Diego was hit by a ransomware attack that significantly disrupted its IT systems. The attackers encrypted the port's data and demanded a ransom for the decryption keys. This attack severely impacted the port's administrative functions, although operational activities such as ship movements were largely unaffected.

Impact: The attack delayed the port's ability to process payments, issue permits, and provide crucial services to its customers. In response, the port collaborated with cybersecurity experts and law enforcement to recover its systems. They refused to pay the ransom and instead focused on restoring their services through backups and cybersecurity measures.

Lessons for Maritime Education: This case highlights the need for real-time incident response plans and the importance of data backup and recovery strategies. It illustrates how a cyberattack can paralyse administrative functions, which are essential for port operations. BSMRMU could use this case to teach students about the ethical implications of dealing with ransomware attacks and the necessity of a robust backup system in port operations.



US authority invests in stronger cybersecurity measures for ports and critical maritime infrastructure

3. COSCO Shipping Cyberattack (2018)

China Ocean Shipping Company (COSCO), one of the largest shipping companies in the world, was hit by a ransomware attack in July 2018. This attack primarily targeted COSCO's U.S. operations, disrupting email communication and other business functions. The attack prompted the company to shut down its IT systems across the Americas, although the shipping operations themselves were not impacted.

Impact: COSCO experienced significant disruptions in its communication channels, affecting its ability to handle customer queries and process documentation efficiently. The company had to implement manual operations temporarily, leading to delays in responding to customer requests.

Lessons for Maritime Education: The COSCO case emphasises the importance of secure and resilient communication systems within the maritime industry. BSMRMU can use this case study to explore how cyberattacks targeting non-operational systems can still severely impact customer service and business operations. Teaching about the need for secure email systems and regular cybersecurity audits could be valuable in training future maritime professionals to mitigate these risks.

4. Iran Cyberattack on US Ports (2013)

In 2013, it was revealed that Iranian hackers had targeted several critical U.S. infrastructure systems, including the Port of Houston. The cyberattacks, which were part of a broader campaign against U.S. financial institutions, aimed to disrupt operations at one of the busiest ports in the world. Although the hackers failed to cause significant damage, the attempt highlighted the vulnerability of critical infrastructure to state-sponsored cyberattacks.

Impact: The Port of Houston and other targeted facilities were able to thwart the attacks thanks to proactive cybersecurity measures. However, the incident demonstrated the potential for state-sponsored cyberattacks to disrupt critical maritime infrastructure. The attacks prompted U.S. authorities to invest in stronger cybersecurity measures for ports and critical maritime infrastructure.

Lessons for Maritime Education: This case study underscores the geopolitical dimension of cyberattacks in the maritime industry, particularly the risks posed by state-sponsored cyber adversaries. BSMRMU can integrate this case into its curriculum to highlight the importance of national cybersecurity policies and

Types of maritime cyber attacks

By using data analytics, maritime professionals can make informed decisions about vessel routing, fuel consumption, cargo handling, and maintenance schedules

international collaboration in protecting maritime infrastructure. It also demonstrates the need for students to understand the geopolitical landscape in which cyberattacks occur.

5. Port of Antwerp Data Breach (2011-2013)

The Port of Antwerp, one of Europe's largest ports, experienced a sophisticated cyberattack that lasted from 2011 to 2013. A criminal gang infiltrated the port's IT systems to manipulate container tracking data, allowing them to smuggle drugs by altering the location and identification of containers. The gang used hacking techniques to gain access to the port's logistics systems, enabling them to retrieve containers without detection.

Impact: The attack allowed the criminals to smuggle large quantities of drugs through the port undetected. It took two years for authorities to uncover the full extent of the cyberattack. The breach highlighted the vulnerability of logistics systems and the need for enhanced cybersecurity measures to prevent such incidents in the future.

Lessons for Maritime Education: This case demonstrates how cyberattacks can have direct physical consequences, such as facilitating smuggling operations. It also illustrates the importance of securing logistics systems in ports to prevent criminal activity. BSMRMU can use this case to teach students about the importance of integrating cybersecurity with physical security measures, especially in high-stakes environments such as ports.

Importance of Data Management in Maritime Operations

Data is the lifeblood of modern maritime operations. Accurate data management enables shipping companies, port authorities, and maritime service providers to optimise logistics, improve decision-making, and enhance the safety of maritime activities. However, improper handling of data can lead to inefficiencies, errors, and vulnerabilities.

Role of Data Analytics in Maritime Industries

Data analytics is the process of examining large sets of maritime data to identify patterns, trends, and insights. With the use of data analytics, maritime professionals can make informed decisions about vessel routing, fuel consumption, cargo handling, and maintenance schedules. Furthermore, predictive analytics can help forecast potential risks and allow for proactive measures, ensuring operational efficiency and safety.

Examples of Data Analytics in Maritime Operations:

Fuel Optimisation: Analysing data on fuel consumption patterns can help vessel operators adjust routes, speeds, and schedules to minimise fuel usage, saving costs and reducing carbon emissions.

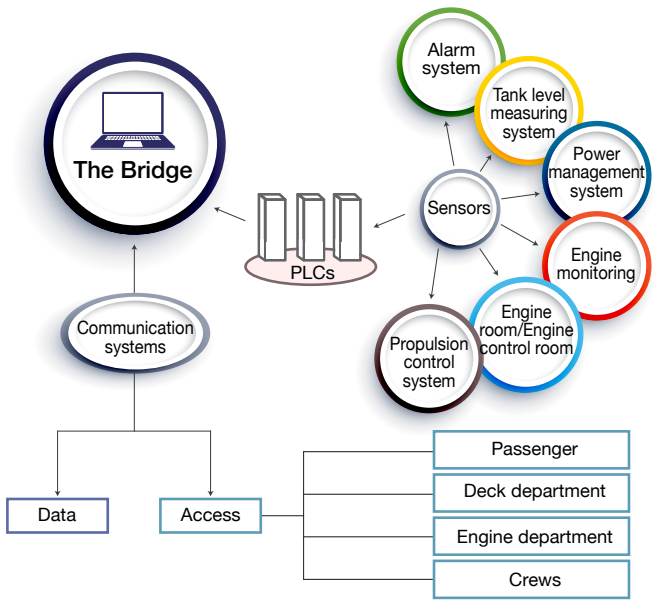
Maintenance Scheduling: Predictive analytics can identify signs of wear and tear in vessel machinery, enabling timely maintenance and preventing costly breakdowns at sea.

Cargo Management: By analysing real-time data on cargo weight, dimensions, and handling, shipping companies can optimise storage capacity and reduce turnaround times at ports.

These data-driven solutions can significantly improve the operational efficiency of the maritime industry in Bangladesh, providing a competitive edge in global shipping markets. However, the effective use of data analytics relies on a workforce that is well-versed in data management and analysis techniques.

The Role of BSMRMU in Leading Maritime Cybersecurity and Data Management Education

As the premier maritime educational institution in Bangladesh, BSMRMU is uniquely positioned to lead the nation's efforts in maritime cybersecurity and data management education. BSMRMU's



One of the important tasks of maritime cyber security is to protect the communication bridge between all the technologies of the ship

leadership in this field will not only enhance the skill sets of maritime professionals but also strengthen Bangladesh's standing in the global maritime industry.

Key Areas for BSMRMU to Focus On

1. Developing Comprehensive Cybersecurity Courses for Maritime Students

BSMRMU should introduce specialised cybersecurity modules tailored for the maritime sector. These courses should cover critical areas such as cybersecurity risk management, threat detection, and incident response. By equipping students with practical knowledge of how to protect maritime systems from cyberattacks, BSMRMU can create a skilled workforce capable of safeguarding the nation's maritime infrastructure. Additionally, collaboration with international maritime cybersecurity experts will ensure that BSMRMU's curriculum aligns with global best practices and standards, providing students with a competitive edge in the global job market.

2. Integrating Data Management and Analytics into Maritime Curricula

BSMRMU should incorporate data management and analytics into the core maritime curriculum, ensuring that all students develop a solid understanding of how to collect, store, and analyse maritime data effectively. Courses should cover topics such as big data analysis, machine learning, and predictive analytics, providing students with the tools to make data-driven decisions. Offering practical hands-on projects where students can work with real-world maritime data sets will allow them to apply their knowledge in realistic scenarios. This will prepare them for the challenges they will face in their careers and help bridge the gap between academic theory and industry practice.

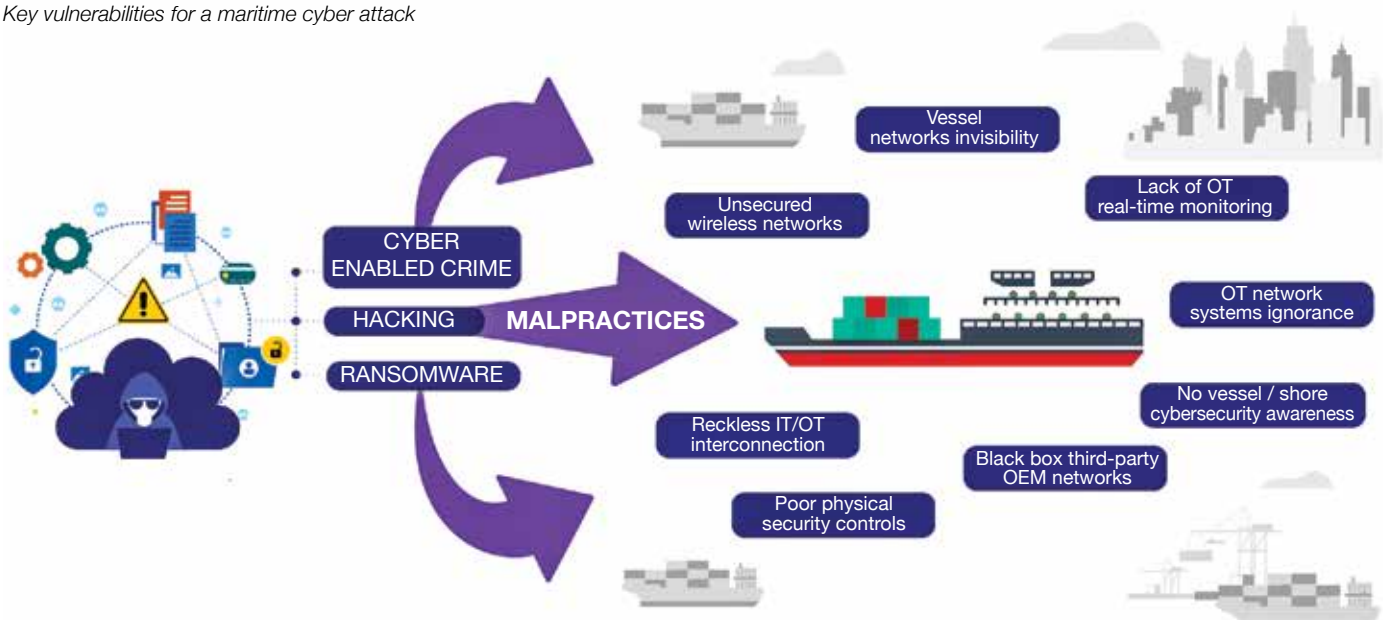
3. Establishing Research Collaborations in Maritime Cybersecurity and Data Management

BSMRMU should seek to establish research partnerships with other universities, research institutions, and maritime organisations around the world. These collaborations will enable the university to stay at the forefront of cybersecurity and data management research, ensuring that its educational programmes reflect the latest developments in the field. The university can also host conferences and workshops on maritime cybersecurity, bringing together experts from academia, government, and industry to share insights and promote best practices.

4. Investing in State-of-the-Art Training Facilities

To effectively train students in cybersecurity and data management, BSMRMU should invest in state-of-the-art simulation labs and training facilities. These facilities can simulate real-world cyberattack scenarios, allowing students to develop and test their response strategies in a controlled environment. Data analytics laboratories equipped with advanced software and tools will enable students to work on large maritime data sets and gain practical experience in data-driven decision-making. The use of artificial intelligence (AI) and

Key vulnerabilities for a maritime cyber attack



BSMRMU enables opportunities for students to participate in hackathons, data challenges, and cybersecurity competitions, allowing them to showcase their skills in a competitive environment

machine learning in these labs will expose students to cutting-edge technologies that are shaping the future of maritime operations.

5. Engaging with the Maritime Industry for Internships and Apprenticeships

BSMRMU should actively collaborate with the maritime industry to provide students with internship and apprenticeship opportunities. By working directly with shipping companies, port authorities, and maritime technology firms, students will gain practical experience in cybersecurity and data management. Industry partnerships will also help BSMRMU align its curriculum with the needs of employers, ensuring that graduates are well-prepared to meet the demands of the job market.

6. Raising Awareness and Building a Culture of Cybersecurity

In addition to formal education, BSMRMU should focus on building a culture of cybersecurity awareness within the maritime community. By hosting workshops, seminars, and awareness campaigns, the university can educate both students and maritime professionals about the importance of cybersecurity in protecting critical infrastructure. Furthermore, the university can develop cybersecurity guidelines and protocols tailored specifically for the maritime industry, providing a framework for companies and institutions to enhance their digital security measures.

Realistic and Tangible Plan for BSMRMU

1. Curriculum Development

Form a dedicated team of faculty members and industry experts to design a cybersecurity and data management curriculum, ensuring it aligns with international maritime standards. The team will also work on creating practical case studies for students to solve real-world problems.

Launch new degree programmes specialising in “Maritime Cybersecurity” and “Data Analytics for Maritime Operations,” targeting both undergraduate and postgraduate students.

2. Faculty Development

Invest in the professional development of BSMRMU faculty by offering them training in the latest cybersecurity and data analytics technologies. BSMRMU can also establish exchange programmes with leading global maritime universities to bring in experts who can enhance the teaching and research capacities of the faculty.

3. Partnerships with Industry ≈ Government

Establish partnerships with shipping companies, port authorities, and the Bangladesh Navy to create cybersecurity protocols and data management frameworks that can be implemented across the maritime sector. BSMRMU should work with government bodies to create national policies on maritime cybersecurity.

Organise annual cybersecurity and data analytics conferences that bring together international and domestic stakeholders to discuss the latest trends, threats, and solutions in the maritime sector.

4. Implementation of Research and Development Initiatives

Develop a dedicated Maritime Cybersecurity and Data Analytics Research Centre within the university, focusing on innovative solutions to maritime cybersecurity challenges and the use of big data in maritime operations.

Collaborate with global maritime cybersecurity firms to create joint research projects that will keep Bangladesh at the forefront of innovation in the field.

5. Student Engagement and Professional Development

BSMRMU should provide opportunities for students to participate in hackathons, data challenges, and cybersecurity competitions, allowing them to showcase their skills in a competitive environment.

Offer short certification courses in maritime cybersecurity and data analytics for working professionals, enabling them to upgrade their skills and stay relevant in the rapidly changing maritime industry.

Conclusion

Cybersecurity and data management are no longer optional elements of maritime education and they are essential components in ensuring the safety, security, and efficiency of maritime operations. By focusing on these areas, BSMRMU has the potential to become a global leader in maritime cybersecurity education. Through a comprehensive strategy that includes curriculum development, industry partnerships, and research initiatives, BSMRMU can play a pivotal role in safeguarding Bangladesh’s maritime future.

Setting Sail for a Sustainable Future

Race for Greener Ship Fuels

Md. Mostafa Aziz Shaheen

The shipping industry is currently facing a critical challenge: reducing its environmental impact. Traditional fuels, such as heavy fuel oil (HFO), are significant contributors to air pollution and greenhouse gas emissions. The industry is exploring various sustainable alternatives in order to transition to a cleaner future. The industry can broadly classify the frontrunners in this race for eco-friendly ship fuels into three groups, each with its own prospective contenders:

1. Biofuels: When manufactured sustainably, bio fuels offer a carbon-neutral alternative by harvesting renewable sources such as plant oils or agricultural waste. Biodiesel, a modified form of vegetable oil, has shown promise in this regard. Maersk, a leading shipping company, has effectively concluded trials with biodiesel blends, thereby illustrating their potential for practical application. [Source: FAME biodiesel for marine applications] However, it is imperative to guarantee a sustainable and ample supply of feedstock, such as used heating oil or palm oil. It is essential to ensure a balance between responsible land-use practices and biofuel production in order to prevent unintended environmental consequences.

2. Electro fuels: Using renewable electricity to develop synthetic solutions. Renewable electricity and captured carbon dioxide or nitrogen combine to produce electro fuels, which are synthetic fuels. This effort represent exciting prospect for significant greenhouse gas emissions reduction. Ammonia, a potential game-changer, is currently the subject of active research. Wärtsilä and other prominent engine manufacturers are currently developing engines that can operate on ammonia, which will facilitate their future adoption. [Source: Wartsila ammonia generators] In this perspective, E-Methanol is another promising alternative. Renewable electricity and captured CO2 can generate methanol, an additional contender in the electro fuel race. Compared to conventional fuels, it is more environmentally friendly and can seamlessly integrate into existing infrastructure. Infrastructure development and large-scale electro fuel production are still in the early stages. The industry must overcome critical obstacles, such as the establishment of a global network of refuelling stations and the reduction of production costs.

3. Hydrogen: Hydrogen, a clean-burning fuel that produces only water vapor as a byproduct, making it an appealing solution. Nevertheless, the technical challenge of storing the highly volatile gas in adequate quantities for extended voyages persists. Despite their limited use, pilot projects are currently running for hydrogen-powered ferries and short-range vessels. These initiatives offer valuable data for the advancement of technology for larger ships. [Source: Hydrogen Ferry Experiment] However, developing secure and efficient methods for storing large quantities of hydrogen onboard ships is a significant challenge. Furthermore, the establishment of a hydrogen refuelling infrastructure for locations worldwide necessitates a significant investment.

Multi-Fuel Future and the Road Ahead: The competition for the future of ship fuels has yet to produce a single victor. The most suitable option for a specific vessel will be contingent upon factors such as infrastructure availability, cargo type, voyage length, and ship size. In the near future, a variety of solutions may emerge: Liquefied natural gas (LNG) may serve as a bridge though it is a costly option. Although it is not a zero-emission fuel, it emits significantly fewer greenhouse gases than HFO and burns cleanly.

Biofuels for Shorter Voyages: Because of their existing infrastructure and potential for carbon neutrality, bio fuels are a viable option for shorter routes, particularly for smaller vessels.

Electro fuels and Hydrogen on the Horizon: After production costs decrease and technology advances, electro fuels such as ammonia and e-methanol, as well as hydrogen, may become the dominant fuels for long-distance shipping.

The role of the International Maritime Organisation (IMO) plays a critical role in navigating the path towards decarbonisation. Additionally, IMO is actively contributing to the industry's transition to decarbonisation. They have set ambitious targets for reducing greenhouse gas emissions from ships, and these regulations will persist in their efforts to encourage innovation in the development and adoption of greener fuels. The maritime sector is on the brink of a substantial transformation. Support from various maritime organisations (such as flag states, classification societies, bunker suppliers, shipping companies, etc.) is critical in the development of future green fuels. Ships can embark on a more sustainable future by adopting a diverse array of greener fuels, thereby guaranteeing a healthier planet and clearer oceans for future generations.

Md. Mostafa Aziz Shaheen

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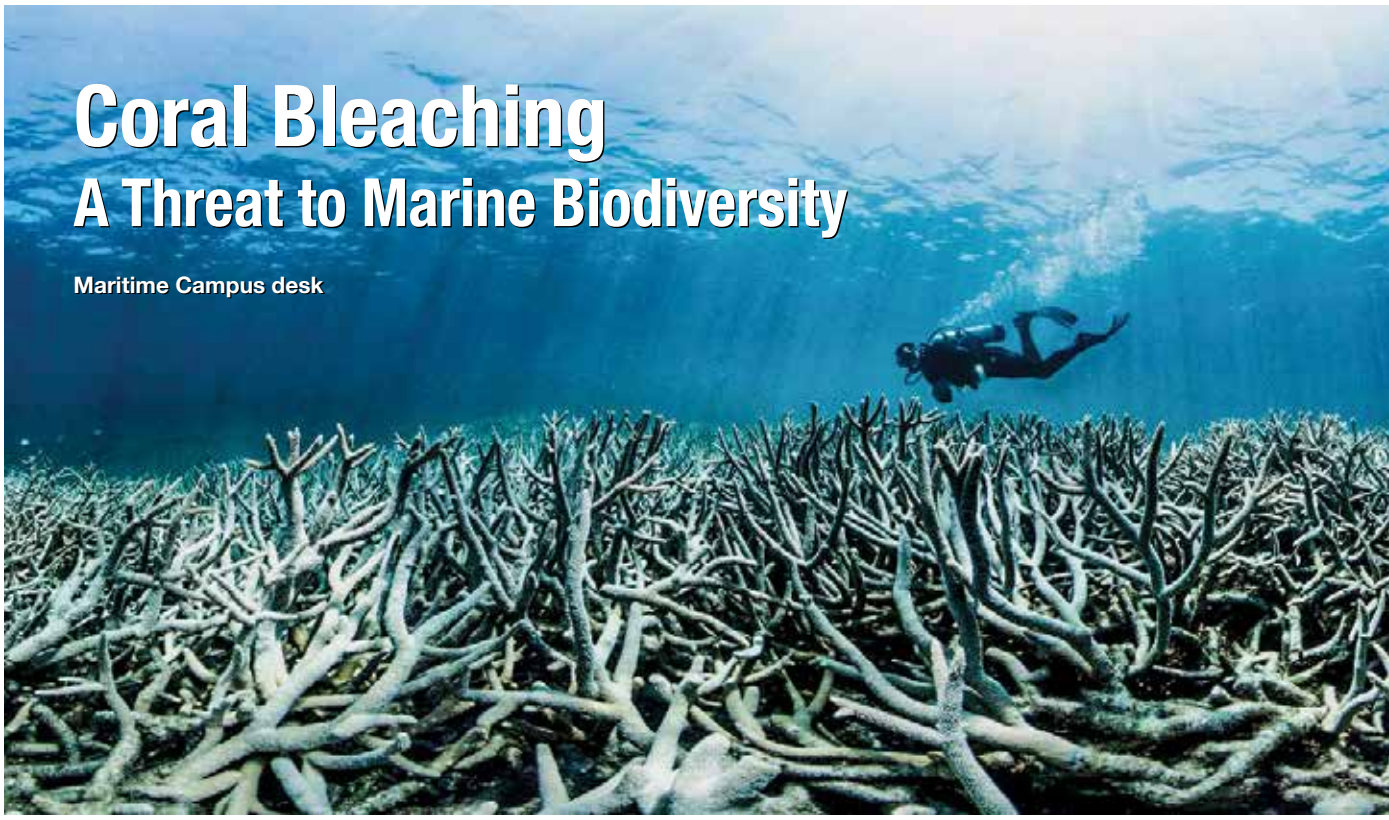


Coral Bleaching
A Threat to Marine Biodiversity

Maritime Campus desk

Coral reefs are one of the most diverse and vital ecosystems on the planet. They serve as a critical habitat for marine species, protect coastlines from erosion, and support livelihoods through tourism and fisheries. However, coral reefs are facing a growing existential threat: coral bleaching. This phenomenon, driven largely by climate change, is causing widespread damage to coral reefs worldwide, including those in the Bay of Bengal. The bleaching of corals has profound implications not only for marine life but also for the millions of people who depend on healthy coral ecosystems for food, income, and protection.

This article will explore what coral bleaching is, how it affects biodiversity, and the importance of implementing a clear and strategic roadmap to halt coral bleaching, particularly in the Bay of Bengal.

What is Coral Bleaching?

Coral bleaching occurs when corals expel symbiotic algae, known as zooxanthellae, living within their tissues. These algae are critical to coral health as they provide the corals with nutrients through photosynthesis and are responsible for the vibrant colours of coral reefs. However, when exposed to environmental stressors, particularly elevated sea temperatures, corals become stressed and expel these algae. Without zooxanthellae, corals lose their primary food source, their vibrant colours fade, and they turn white or “bleach.”

Bleached corals are not dead but they are in a state of vulnerability. If stressful conditions persist for extended periods, corals can starve and eventually die. Even if conditions improve, recovery is not always guaranteed, and frequent or severe bleaching events can lead to long-term coral degradation.

Causes of Coral Bleaching

The primary driver of coral bleaching is climate change. Rising global temperatures, particularly those of ocean waters, have made coral bleaching more frequent and widespread. However, other stressors also contribute to coral bleaching, including:

Ocean Acidification: As atmospheric carbon dioxide increases, oceans absorb more CO_2, leading to higher acidity levels. This weakens the ability of corals to build and maintain their calcium carbonate skeletons.

Pollution: Runoff from agriculture, industry, and sewage introduces pollutants such as nitrogen and phosphorus into the ocean, which can stress corals and encourage the growth of harmful algae.

Overfishing: Removing key species from the reef ecosystem can upset the ecological balance, making coral reefs more susceptible to stress.

Coastal Development: Habitat destruction and increased sedimentation from construction can smother corals and reduce the quality of the water they rely on for nutrients and photosynthesis.

Impact of Coral Bleaching on Biodiversity

Coral reefs support approximately 25% of all marine species despite covering less than 1% of the ocean floor. This staggering biodiversity includes fish, mollusks, crustaceans, sponges, and sea turtles, among others. Coral reefs provide shelter, breeding grounds, and feeding areas for these species. When corals bleach, it affects the entire ecosystem both directly and indirectly.

Loss of Habitat: Coral reefs are the foundation of many marine ecosystems. When corals die, reef structures degrade, leaving marine species without the necessary habitats for protection, reproduction, and feeding. Many species are specialised to live in coral environments, and without them, their populations can rapidly decline.

Disruption of Food Chains: Many fish species rely on coral reefs for food. As the reefs degrade, these species are deprived of their

primary food sources, leading to a decline in their populations. This can disrupt the balance of the entire marine food chain, as predator-prey relationships are disturbed.

Economic Impact on Fisheries: Coral reefs are vital for sustaining fish populations that support commercial and subsistence fishing industries. As reef ecosystems collapse, fish stocks decrease, threatening food security for millions of people who rely on reef-associated fisheries.

Loss of Ecosystem Services: Healthy coral reefs provide a range of ecosystem services, including coastal protection from storms, supporting tourism industries, and carbon sequestration. The loss of these services due to coral bleaching can have widespread socio-economic consequences.

The Bay of Bengal: A Vital but Vulnerable Region

The Bay of Bengal is home to a variety of coral reefs, notably around the Andaman and Nicobar Islands and parts of the eastern coast of India. These reefs, though not as extensive as the Great Barrier Reef, play a crucial role in supporting marine biodiversity and local economies. The bay is also highly vulnerable to the impacts of climate change, with rising sea temperatures, increasing ocean acidity, and pollution all posing significant threats to its coral reefs.

The implications of coral bleaching in the Bay of Bengal are severe. The region's fisheries heavily depend on reef health, and the loss of coral ecosystems would directly affect millions of people who rely on these fisheries for their livelihoods. Furthermore, the degradation of coral reefs would reduce the natural protection they provide to coastal communities from storm surges, exacerbating the risk of flooding and coastal erosion in a region already prone to such hazards.

Roadmap for Halting Coral Bleaching in the Bay of Bengal

Given the urgent need to protect the coral reefs in the Bay of Bengal, a comprehensive and coordinated roadmap is necessary. The following strategies provide a detailed approach to halting coral bleaching and promoting reef resilience in the region:

Climate Action and Carbon Emission Reduction

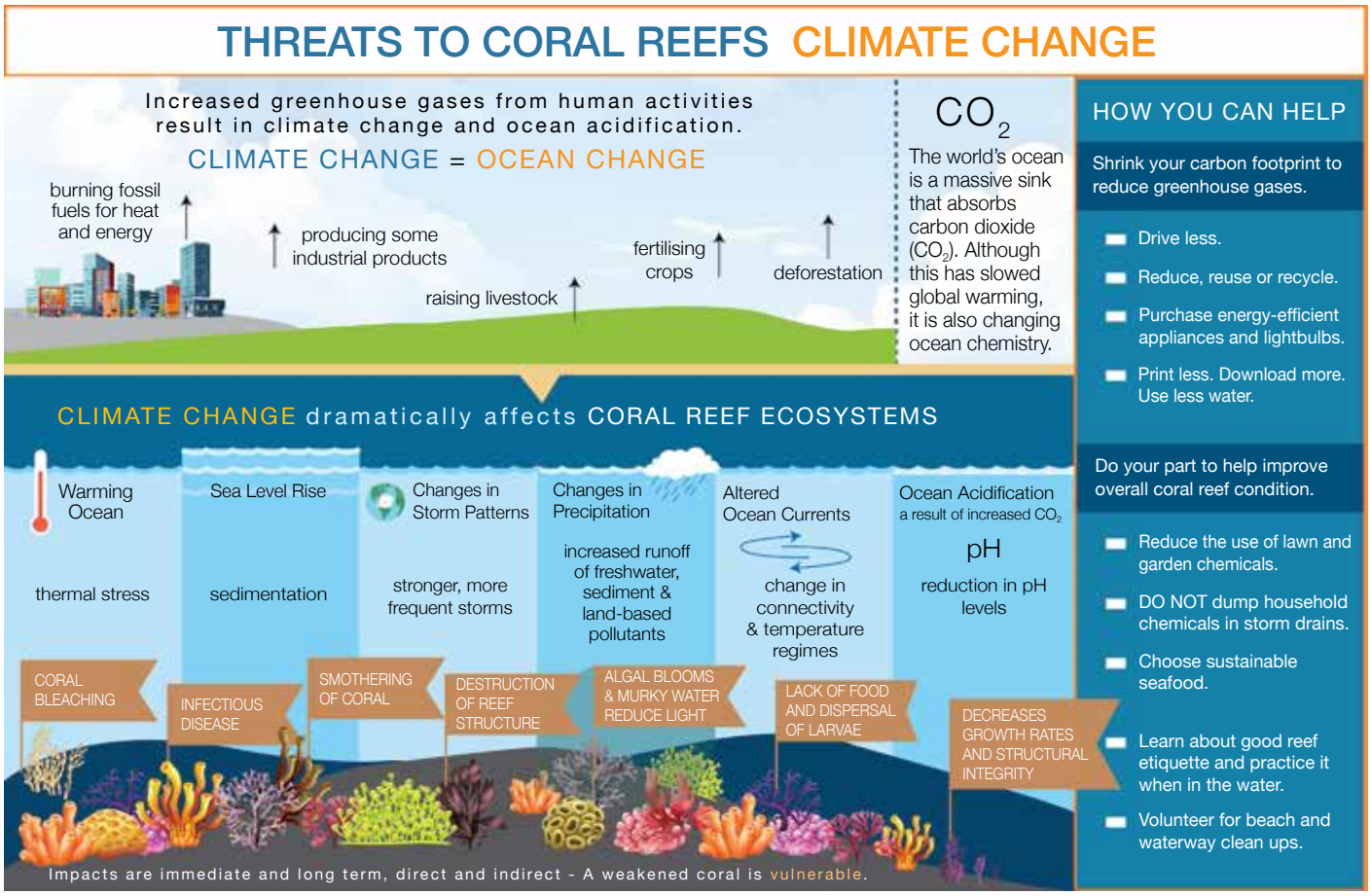
The root cause of coral bleaching is global climate change, and mitigating this threat requires international collaboration to reduce greenhouse gas emissions. Governments in the region, including India, Bangladesh, Myanmar, and Sri Lanka, should enhance their commitments under the Paris Agreement by setting ambitious carbon reduction targets. Investments in renewable energy, energy efficiency, and carbon capture technologies should be prioritised. Additionally, local conservation efforts must integrate climate resilience measures, including the promotion of low-carbon coastal development.

Marine Protected Areas (MPAs)

Expanding and enforcing Marine Protected Areas (MPAs) in the Bay of Bengal is crucial to provide safe zones for coral reefs. MPAs limit harmful activities such as overfishing, coastal development, and tourism pressures, which can exacerbate coral stress. These protected zones can act as refuges where coral reefs can recover and remain resilient to the changing climate. Governments must commit to creating, enforcing, and adequately funding MPAs in the region, ensuring local communities are involved in their management and benefit from the ecosystem services they protect.

Local Pollution Control

Reducing land-based pollution entering the Bay of Bengal is essential to maintaining water quality and coral health. Coastal and industrial cities in the region should implement stricter regulations on wastewater treatment, agricultural runoff, and industrial pollutants. Education and outreach programmes should promote the use of sustainable farming practices that minimise the use of chemical fertilisers and pesticides. Additionally, mangrove restoration projects can serve as natural filters for coastal waters, trapping sediments and pollutants before they reach coral reefs.



Restoration and Resilience Projects

Active restoration efforts are essential to help degraded coral reefs recover. Coral gardening and artificial reef projects can effectively rebuild damaged ecosystems. In the Bay of Bengal, these restoration techniques should focus on coral species that are more resistant to bleaching and heat stress. Marine biologists and local authorities can collaborate on innovative restoration methods, such as re-seeding coral larvae and using artificial structures to mimic natural reef environments. These projects should be supported by adequate funding, research, and community involvement.

Sustainable Fishing Practices

Overfishing not only depletes key species but also disrupts the balance of reef ecosystems. Introducing sustainable fishing practices, such as seasonal fishing bans, the use of selective fishing gear, and stricter enforcement of fishing regulations, can help maintain fish populations and protect reef health. Establishing community-based fisheries management systems where local fishers have a vested interest in reef protection could prove beneficial.

Tourism Management and Ecotourism

Coastal tourism is a significant source of income for many communities in the Bay of Bengal, but it can also contribute to coral degradation through physical damage, pollution, and unsustainable practices. Implementing sustainable tourism initiatives, such as regulating the number of visitors to sensitive reef areas, prohibiting destructive activities like anchoring on reefs, and promoting eco-friendly tourism options, is essential. Local communities should be educated about the importance of coral reefs and trained in sustainable tourism practices that balance economic development with conservation.

Monitoring and Research

Long-term monitoring of coral reefs is critical for understanding their health and resilience to climate change. Research institutions in the Bay of Bengal should collaborate with international partners to establish a comprehensive monitoring network that tracks coral bleaching events, water quality, and reef recovery rates. Data collected through these efforts can inform adaptive management strategies, allowing for timely interventions to protect and restore reefs. Governments and private sectors should fund research into innovative solutions for coral conservation, including breeding heat-resistant coral species and developing climate-adaptive restoration methods.

Conclusion

Coral bleaching represents one of the most immediate and visible consequences of climate change, with devastating effects on marine biodiversity and human livelihoods. The Bay of Bengal, with its unique marine ecosystems, is highly vulnerable to coral degradation. However, by implementing a comprehensive roadmap that includes climate action, local conservation efforts, and community involvement, there is hope for reversing the trends of coral bleaching. Protecting these vital ecosystems is not only a moral imperative for biodiversity but also an economic necessity for the millions of people who depend on healthy reefs for their well-being and survival.

From Dugout Canoes to Modern Trawlers

A Deep Dive into Fishing Vessels

Md.Towhidur Rahman

A fishing vessel is a type of boat or ship used to catch fish in a lake, sea, or river. These vessels can be employed for deep-sea and freshwater fishing. Larger fishing vessels are typically required for deep-sea ocean fishing due to its heavy output and difficulties, whereas smaller boats are used for freshwater fishing.

History of Fishing Vessels

Before the standardisation in the 1950s, the design of fishing vessels varied from region to region. Traditional vessels were made of wood, but due to their high maintenance cost and shorter life spans, they became obsolete, consequently, safer and more durable materials are now used for building fishing vessels. Rafts and dugout canoes are regarded as the oldest fishing vessels, made from tree bark, tree logs, and stones. The oldest fishing boat dates back to the Neolithic Period (about 7000 to 9000 years ago). After these simpler boats, around 4000 B.C., the Egyptians developed the first multi-oarsmen long and narrow vessels. In the 15th century, the Dutch designed a drifter that became a blueprint for the later European fishing boats. By the 17th century, the British developed a dogger, slightly smaller than herring buses but capable of carrying tonnes of fish at a time. The trawler, the modern fishing vessel, was developed in the 19th century at Brixham harbour and was hailed as the 'Mother of Deep- Sea Fisheries.' Further development resulted in stern trawlers and electronically assisted commercial fishing vessels we use today.

Based on the purposes, fishing vessels are categorised into three classes-

- Commercial fishing vessels
- Artisanal fishing vessels
- Recreational fishing vessels

Common Types of Fishing Vessels

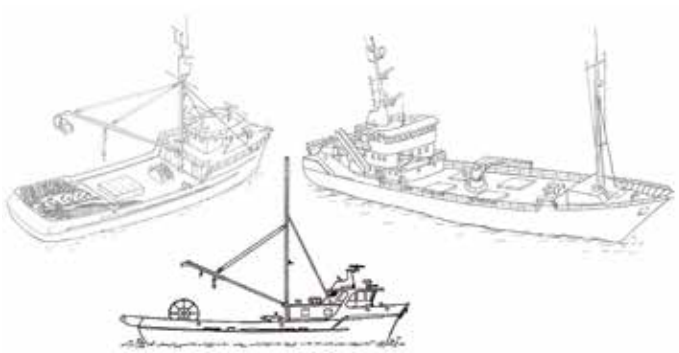


Illustration of three types of seiners: an American seiner (left), a European seiner (top right) and a drum seiner (bottom right)

Seiners

Seiners use surrounding or round haul nets (See Fishing Gear), such as purse seines and lampara nets, to surround schools of pelagic fish near the surface. Like other modern vessels, seiners can vary by the types of equipment that are used and the geographical region in which they are used. Traditionally, seine fishing was done by hand, but modern seining began in 1960 with the introduction of the hydraulic winches and power blocks.

Trawlers

Trawlers drag funnel-shaped trawl nets through the water to catch fish or shellfish. They operate primarily in two methods:

1. Bottom/Benthic Trawlers: These are designed to drag the trawl nets either just above or along the seafloor, targeting various types of groundfish like Sole and semi pelagic species like Ocean (Pink) Shrimp. Fishing bottom trawlers travel no faster than 4 knots (4.6 mph).

2. Midwater/Pelagic Trawlers: Similar to bottom trawlers, midwater trawlers are designed to fish within the water column, targeting schooling pelagic fish like Pacific Hake and Widow Rockfish. Midwater trawlers are larger than bottom trawlers because the trawl

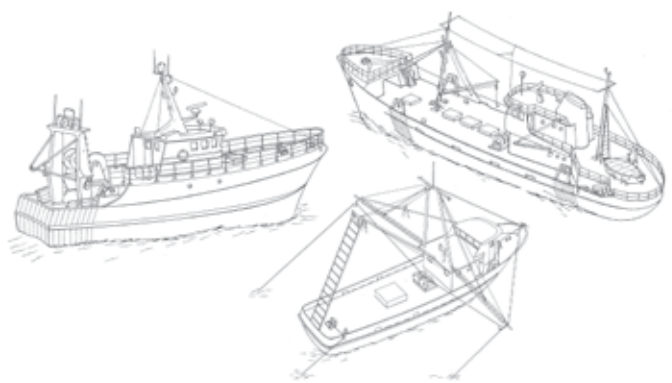


Illustration of three types of trawlers: stern trawler (left), side trawler (top right) and an outrigger trawler (bottom right)

nets used are larger and must be dragged at greater speeds to target the faster swimming pelagic fishes.

Trap Setters

Trap setters are designed for using traps or pots to catch shellfish, such as Dungeness Crab, and other demersal fish species. Pots may be left on the seafloor from 1-3 days or longer. Unlike most other vessels that use sonar, echosounders, or other types of fish finding

Illustration of a small trap setter (top) and a large trap setter (bottom)

equipment, captains of trap setters typically rely on their knowledge of the local fishing grounds to determine where to set their traps and thus where to find the targeted species.

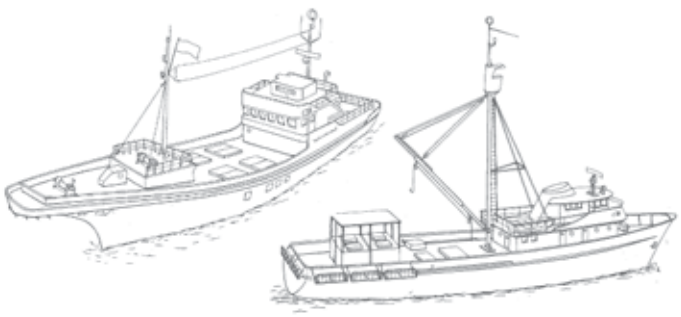


Illustration of a Japanese type (left) and an American type (right) of pole and line vessels

Illustration of a troller with multiple lines deployed from the outriggers (poles to the side) and stern

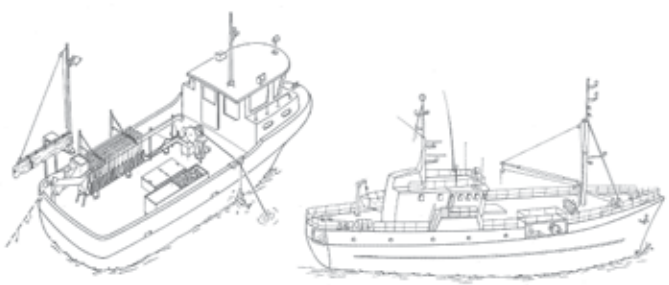


Illustration of a small longliner (left) and a large longliner (right)

Line Vessels

Line vessels are boats that fish using hook-and-line gear. There are four primary classifications of line vessels: jigger vessels, longliners, pole and line vessels, and trollers.

Gillnetters

There are two basic types of gillnetters: a traditional gillnetter and a set netter. Both types of vessels fish with gillnets, however traditional gillnetter vessels remain attached to the net during fishing operations, while set netter vessels are not attached to the net (i.e., deploy drift

Illustration of a gillnetter

gillnets). The size of both types of vessels can range from small open boats and canoes (2 m, 6.5 ft) operating inshore and coastal waters to large, specialised vessels that operate in the open ocean (15 m, 49 ft). The smaller vessels deploy and haul the nets by hand, while larger vessels use hydraulic or mechanical net haulers.

Dredgers

Like trawlers, dredgers drag a fishing device behind the vessel. However, rather than a net, dredgers drag a dredge, which consists of a heavy frame with an attached mesh bag. Some dredges have a rake-like device or teeth along the bottom of the frame to assist in remains targeted shellfish species from the seafloor. As the dredge is dragged along, the shellfish are pulled up from the seafloor and

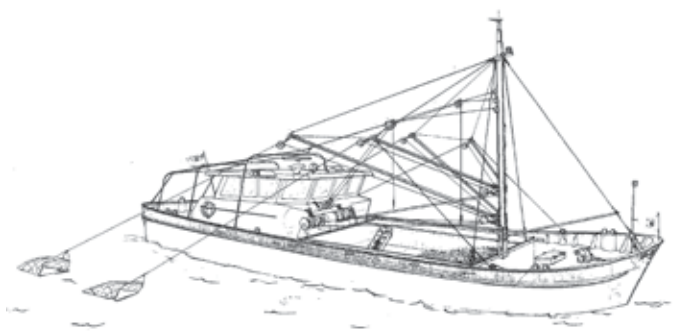


Illustration of a dredger

collected in the bag. Dredgers may operate in rivers and estuaries, as well as in coastal waters offshore. A generalised deck arrangement does not exist for dredge vessels, and they can vary in size. Most dredge fishing in the United States occurs along the east coast and no dredge fishing occurs in California waters. In the Northeast, dredgers target Scallops and Clams, while along the MidAtlantic and South Atlantic coasts dredgers target Clams and Oysters.

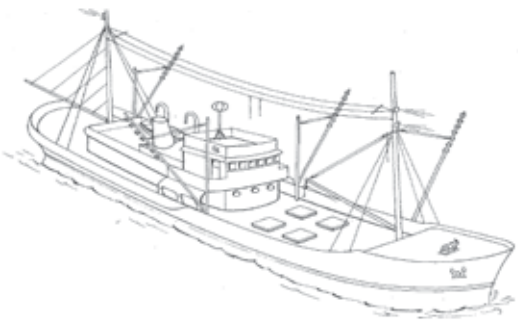


Illustration of a lift netter

Lift Netters

Similar to gillnetters and seiners, lift netters are designed to fish with large nets. Lift netters deploy and retrieve large lift nets over the sides of the vessel using outriggers. Often the vessels use powerful lights to attract fish to the surface. Lift netters are typically greater than 10 m (33 ft) in length. The smaller boats typically have an open deck layout and have few mechanised features, while the larger decked vessels are designed for open-ocean fishing and are equipped with mechanised winches to help with the deployment and retrieval of the nets. Small lift netters are used in both commercial and artisanal fisheries in Southeast Asia and Africa, whereas Russians in the Caspian Sea use larger lift netters. Lift netters primarily target various species of Pacific Sardines and other schooling pelagic species.

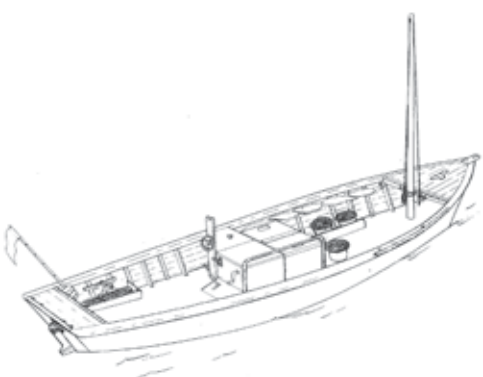


Illustration of a small-undecked handliner

Handliners

Handliners are typically small to medium sized vessels, less than 12 m (39 ft) in length, without any distinctive features for gear handling. In contrast to many other commercial fishing vessels, most handliners are undecked vessels, meaning that they lack any covered compartments or a covered hull.

Common Fishing Crafts in Bangladesh

Crafts used in small-scale artisanal fisheries of Bangladesh are mostly based on traditional wooden canoes that have been modernised by the addition of outboard gasoline motors, storage, and sometimes a small space for the fishers. The use of sail and paddle power is common. Fishing crafts are built traditionally with locally available materials by rural carpenters with planks and furnished by coal tar and burned oil.

K**osha Nauka**

Kosha Nauka is a non-mechanised country boat with blunt ends. The open deck without having any hood is made of whole or split bamboo pieces or wood in some cases, and oars are made of bamboo poles. Usually, there is no sail, but when present, it is located in the anterior half of the boat. The boat is used for fishing in small inland canals and shallow waters to catch small fish.

Dinghi Nauka

Dinghi Nauka is a small, shallow rounded bottom boat with a pointed bow, generally used in areas close to shore and inland water bodies. Smaller boats may lack decks, while the larger ones usually possess a deck made of bamboo splits or betel nut trees. Usually, there is no hood, but when present, it is located in the posterior part of the boat. While Dinghi Nauka was traditionally non-mechanised, now mechanisation is an increasing trend.

Trawler

The trawler is an extraordinarily strong dug-out spindled shape boat with the fore and hind ends bluntly pointed. The bottom of the boat is rounded. The stern is 1-1.5 m higher than the bow. Engines propel the vessel, and a team of fifteen crew members is required to operate the vessel. The boat is generally used for operating a gill net fixed purse net. Trawlers are also used for the transportation of goods and passengers.

Tempu Nauka

Tempu Nauka is a round-bottom, mechanised boat operated usually by a team of thirteen crew members. Some variations of Tempu Nauka are available based on shape and size, namely ‘Rotala’ and ‘Matowala.’ The front part of ‘Rotala’ is pointed and has a round bottom and extended arrowhead, in the case of ‘Matowala the front part is not- pointed and the back part is not as pointed as the front side. The Tempu Nauka is generally used for gill net and fixed purse net (Behundi Jal, Bata Jal) fishing.

Chandi Nauka

Chandi Nauka is slightly prolonged on both ends with a much-pointed anterior end. The bottom is flat or rounded and the stern of this boat is much higher than the bow. Strong flatforms made of wood are present on both ends, while the central region is provided with detachable split bamboo-decking. A bamboo or wooden hood is present in the anterior part. Usually, they have no sail, but a second topsail is sometimes seen over the sail to increase the speed.

Balam Nauka

Balam Nauka is a strongly built spindle-shaped boat with bluntly pointed anterior and posterior ends. The anterior and rear ends are 1-1.2 m higher than the bow. A wooden hood is present in the posterior part. It has a robust platform made of wood on both ends. The bottom is rounded, and the square-shaped sail is set in the anterior part if present. Also, it has a strong steering paddle made of wood attached to the posterior end.

Shampan

Shampan or Shampan Nauka is used mainly in Chittagong and Cox’s Bazar regions. The posterior part is divided into two pointed parts; the bow is pointed and raised above the water. It is used for fishing in the estuaries and the shallow coastal waters of the Bay of Bengal.

(Image credit: Food and Agriculture Organisation of the United Nations)

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KNOW MORE

Cyber Risk Management Approach

Identify threats

Understand the external cyber security threats to the ship.

Understand the internal cyber security threats posed by inappropriate use and lack of awareness.

Respond to and recover from cyber security incidents

Respond to and recover from cyber security incidents using the contingency plan. Assess the impact of the effectiveness of the response plan and re-assess threats and vulnerabilities.

Establish contingency plans

Develop a prioritised contingency plan to mitigate any potential identified cyber risk.

Identify vulnerabilities

Develop inventories of onboard systems with direct and indirect communications links. Understand the consequences of a cyber security threat on these systems.

Understand the capabilities and limitations of existing protection measures.

Assess risk exposure

Determine the likelihood of vulnerabilities being exploited by external threats.

Determine the likelihood of vulnerabilities being exposed by inappropriate use. Determine the security and safety impact of any individual or combination of vulnerabilities being exploited.

Develop protection and detection measures

Reduce the likelihood of vulnerabilities being exploited through protection measures.

Reduce the potential impact of a vulnerability being exploited.

A Geological Adventure on Bangladesh's Southern-most Island

Abdullah Al Jami

St. Martin's Island, a small coral island nestled in the Bay of Bengal, stands as Bangladesh's hidden gem. As the country's sole coral island, it beckons thousands of tourists each year with its pristine beaches, fascinating geology, and rich marine life. Recently, a group of eager oceanography students from the 4th batch of BSc. In Oceanography Programme at BSMR Maritime University (BSMRMU) embarked on an exciting three-day field trip to explore this natural wonder. Led by the knowledgeable lecturer, Mr Md. Al Amin, the students set out to uncover the geological secrets of this unique island, transforming textbook knowledge into tangible experiences.

Day 1: Decoding the Rocky Shore

Corals vs. Concretions: A Detective's Guide

The adventure began on the eastern rocky shore of St. Martin's Island. Here, the students faced their first challenge: distinguishing between dead corals and concretions. To the untrained eye, these formations might look deceptively similar, but Mr Md. Al Amin revealed the subtle differences that set them apart.

Corals, the students learned, are the skeletal remains of marine invertebrates. These calcium carbonate structures once housed vibrant polyps, forming the backbone of the island's marine ecosystem. Concretions, on the other hand, are mineral masses formed within sedimentary strata through the precipitation of minerals in the spaces between sediment grains.

To differentiate between the two, the group employed the HCl test. They observed how coral skeletons vigorously effervesced when exposed to the acid, a result of the reaction between hydrochloric acid and calcium carbonate. Concretions, while still reactive, showed milder effervescence, depending on their mineral composition. This firsthand experience not only sharpened the students' observational skills but also highlighted the importance of field testing in geological studies. They realised that what might seem like a simple rock to a casual observer could, in fact, be a treasure trove of information about the island's past.

Nature's Plumbing: Groundwater Seepage

As they explored further along the shore, the group witnessed a fascinating natural phenomenon: groundwater seepage. This process, where groundwater flows from areas of high pressure to lower pressure towards the coastline, plays a crucial role in the island's ecosystem.

Md. Al Amin explained how some factors influence this underground water movement. Recharge rates, distance from recharge areas, elevation of the water table, coastal slope, tides, and seasonal fluctuations all play a part in this complex system. The students learned that the primary aquifer of St. Martin's Island is made up of

porous sandstone and shale sediments, forming a semi-confined coastal aquifer system. This revelation sparked a discussion about the island's freshwater resources and the potential impacts of climate change on this delicate balance. The students began to understand how interconnected the island's geological features were with its ability to sustain life and human habitation.

Tectonic Tales: The Island's Formation

Before concluding the first day, Md. Al Amin shared insights into the island's formation. He explained that St. Martin's Island is part of an anticline formation, with the nearby Arakan mountains also forming an anticline, while the Naf River represents a syncline formation.

This information painted a picture of the massive tectonic forces at play in shaping the region. The students were amazed to learn that the very ground they stood on was once the floor of an ancient sea, uplifted and shaped by the collision of tectonic plates over millions of years.

Day 2: From Lagoons to Coquina Beds

Keya Trees and Coastal Defence

The second day started at a lagoon on the west beach, where the group encountered the island's natural coastal defence system. Sand dunes, populated by *Keya* trees *Pandanus odoriferous*, form the first line of protection against storm surges and tsunamis.

The students observed how these hardy trees, with their prop roots and long, spiky leaves, were perfectly adapted to the coastal environment. They discussed how these natural barriers, along with coral concretions, might help prevent seawater intrusion into the island's aquifer. This led to a broader conversation about coastal management and the importance of preserving natural defence systems in the face of rising sea levels and increasing storm intensity due to climate change.

Conglomerates: A Rocky Time Capsule

At Konapara, the group stumbled upon conglomerate rocks – sedimentary formations composed of rounded gravel-size clasts in a finer-grained matrix. These rocks offered a glimpse into the island's geological past, revealing how erosion and deposition shaped the landscape over millions of years.

Md. Al Amin explained how these conglomerates formed through the deposition of gravel transported by streams, rivers, glacial meltwaters, or marine processes like longshore drift. The students examined the various rock and mineral types embedded in the conglomerates, each telling a story of its origin and journey. The discovery of fossiliferous conglomerate rocks added an extra layer of excitement. These rocks contained recognisable fossil skeletal remains or their impressions dispersed throughout the matrix. As the students carefully examined these ancient remnants, they couldn't help but imagine the diverse marine life that once thrived in these waters millions of years ago.

Coral Growth Lines: Sea Level Indicators

At Golachipa, Md. Al Amin introduced the students to coral growth lines. These lines, visible in the coral structures, serve as natural records of past sea levels and environmental conditions. The lateral growth of corals provided evidence of sea level changes in the region over time.

This discovery led to a discussion about how corals can be used as proxies for past climate conditions, offering valuable data for climate scientists and oceanographers. The students realised that the island itself was a living laboratory, holding clues to Earth's past climate in its very rocks and structures.

Coquina Beds: A Seashell Playground

In Dakhin Para, the group encountered coquina beds – formations composed entirely of shell fragments. This discovery painted a vivid picture of the area's past as a shallow sea teeming with marine life.

Md. Al Amin explained that in the geological past, this area was under the sea in a shallow marine condition, buzzing with biological activity. Over time, biological sedimentation occurred, leading to the formation of these thick coquina beds. The students learned how these beds, over millions of years, could transform into sandstone and potentially serve as aquifers in the future. This realisation highlighted the dynamic nature of geology, where today's seashells could become tomorrow's water sources.

The group also noted the difference in coquina bed thickness between Dakhin Para and Uttar Para, attributed to tectonic activity and past biological productivity. This observation led to a discussion about the uneven distribution of groundwater resources on the island.

Coastal Landforms: Spits and Tombolos

The journey to Zinzira Dwip introduced the students to fascinating coastal landforms. They observed how longshore drift created a spit

– a long, thin depositional landform extending into the sea from the southern tip of the island.

Md. Al Amin explained how the spit formed through the transport of loose sandy sediments by littoral currents parallel to the shoreline. The curving elongation of the spit into the sea, they learned, was due to the dominant northern wave approach and sediment transport direction.

The emerging land connection between the end of the spit and a neighbouring islet, known as a tombolo, highlighted the dynamic nature of coastal geomorphology. The students learned how wave refraction around the islet leads to sediment accumulation and beach accretion, forming this wind-swept tombolo connection. This lesson in coastal dynamics helped the students understand how seemingly static landscapes are in constant flux, shaped by the relentless forces of wind and water.

Burrows and Ripple Marks: Traces of Ancient Life

At Chera Dwip, the group identified burrows or gastroliths in the rock formations. Md. Al Amin explained that these fossil traces were left by organisms that bored or tunnelled into sediments millions of years ago.

The students examined the horizontal, vertical, and inclined cylindrical traces filled with sediment different from the surrounding matrix. They learned how these burrows become preserved as fossils when the sediment is later lithified into stone, providing valuable information about ancient ecosystems and environmental conditions.

Nearby, the group observed multi-directional ripple marks on the shore. These preserved patterns in the rock offered insights into the direction and strength of ancient currents and waves, adding another layer to their understanding of the island's geological history.

Day 3: Tidal Treasures at Darianagar

Heterolithic Bedding: A Tidal Tale

On the final day, the group visited Darianagar in Cox's Bazar, where they observed heterolithic bedding – alternating layers of sand and shale. This formation told the story of a tidal environment where both sand and clay particles were deposited in equal amounts, resulting in a wavy bedding pattern.

Md. Al Amin explained how these alternating layers form in tidal environments, where the energy of the water fluctuates regularly. During high energy periods, sand is deposited, while during low energy periods, finer clay particles settle out of the water column.

This observation allowed the students to reconstruct the ancient environment of the area, imagining a coastline where tides regularly advanced and retreated, leaving behind this distinctive layered pattern in the rocks.

Concretions Inside Sedimentary Layers

In the same area, Md. Al Amin pointed out concretions embedded within the sedimentary layers. These spherical or ovoid-shaped masses of mineral matter provided further evidence of the complex geological processes at work in the region.

The students learned how these concretions form through the precipitation of minerals in the spaces between sediment grains, often around a nucleus such as a shell fragment or organic matter. This process, they realised, could provide valuable information about the chemical conditions present when the sediments were deposited.

More Than Just a Tourist Paradise

As the field trip ended, the students realised that St. Martin's Island and the surrounding coastal areas are far more than just tourist destinations. They are living laboratories of geological processes, testaments to the ever-changing nature of our planet. From the intricate dance of groundwater seepage to the formation of coastal landforms, every aspect of the island tells a story of transformation over millions of years.

The experience left the students with a deeper appreciation for the complexities of coastal environments and the importance of preserving such unique ecosystems. They learned that beneath the surface of this tropical paradise lies a wealth of geological information, waiting to be uncovered by curious minds.

This field trip served as a reminder that sometimes, the most valuable lessons are found not in textbooks, but in the layers of rock beneath our feet and the ebb and flow of the tides. For these budding oceanographers, St. Martin's Island will forever remain a symbol of nature's ingenuity and the endless wonders waiting to be discovered in the field of earth sciences.

As they returned to their classrooms, the students were no longer just learners, but explorers who had touched the pages of Earth's history. They had seen firsthand how the present is a key to the past, and how understanding our planet's history is crucial for predicting and preparing for its future. This geological adventure on Bangladesh's only coral island had not only enhanced their academic knowledge but had also ignited a passion for discovery that would fuel their future careers in oceanography and earth sciences.

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BSMR Maritime University Distributes Winter Clothing to Underprivileged Communities in Chattogram

BSMR Maritime University (BSMRMU) in Bangladesh distributed winter clothing to underprivileged people and orphans on 4 Jan 2024 at the site of its permanent campus project in Hamidchar, Chattogram. By being Present There Vice-Chancellor of the University, Rear Admiral Mohammad Musa, OSP, NPP, rcds, afwc, psc, PhD, distributed blankets to more than 400 people.

Admission Test for 2023-24 Academic Session Conducted by BSMRMU

The First Year Undergraduate (Honours) Admission Test for the 2023-24 academic session at BSMR Maritime University, Bangladesh, was conducted on the 2nd and 3rd of February 2024. The test was held in two shifts on each day across multiple locations, including Dhaka, Chattogram, Khulna, Rangpur, Barisal, Pabna, and Sylhet.

This year, the university received a total of 22,863 applications for just 200 seats across five programmes under four faculties, reflecting the intense competition for admission.

BSMR Maritime University Observes Martyrs' Day and International Mother Language Day 2024

BSMRMU, Bangladesh, observed "National Martyrs' Day" and "International Mother Language Day 2024" with a series of commemorative programmes on 21 February 2024. A delegation led by the Vice-Chancellor, Rear Admiral Mohammad Musa, paid tribute to the language martyrs at the Central Shaheed Minar in the morning.

Following the tribute, a cultural programme was organised at the university, reflecting of the significance of the Language Movement and International Mother Language Day. The event was graced by the Hon'ble Vice-Chancellor as the Chief Guest. Special prayers were offered for the souls of the language martyrs, the universal use of the Bengali language, and the prosperity of the nation and the university.

BSMR Maritime University Organised a Seminar on "Smart Bangladesh"

BSMR Maritime University, Bangladesh, the only maritime university in the country, hosted a seminar titled "Smart Bangladesh" at its temporary campus in Dhaka. The distinguished Vice-Chancellor, Rear Admiral Mohammad Musa, OSP, NPP, rcds, afwc, psc, PhD, presided over the event as the Chief Guest. Mr Dwijendra Chandra Das, the Innovation focal point at the UGC, presented his paper on "The University's Initiative and Execution to Build a Smart Bangladesh." Another keynote presentation was delivered by Dr Forhad Zahid Shaikh, Chief of e-Governance at a2i, on "The Role of Universities & Maritime Sectors in Developing a Smart Bangladesh." During the seminar, the Vice-Chancellor awarded prizes to the winners of the Innovation Showcasing. Representatives from the Bangladesh Marine Academies and the Marine Fisheries Academy were also in attendance. In alignment with the Smart Bangladesh initiative, the university has implemented systems such as D-Nothi, the BSMRMU Integrated Management System (BIMS), a Learning Management System (LMS), Online Leave Management, Online Financial Management, Virtual Classroom, and Online Library Management.

Construction work of Permanent Campus for BSMR Maritime University Inaugurated in Chattogram

The construction of buildings for the "Establishment of Permanent Campus of BSMR Maritime University, Bangladesh" was officially inaugurated on 4 March 2024 by the university's Vice-Chancellor, Rear Admiral Mohammad Musa, at Hamidchar, Chattogram. The inauguration ceremony was attended by the Project Director, Registrar, and other university officials.

The permanent campus is being developed on approximately 106.66 acres of land in the Hamidchar area, encompassing Char Rangamatia and Bakolia, under the jurisdiction of Chattogram Port and Chandgaon Thana. The construction of the university's permanent campus, which spans 106.66 acres of land in Hamidchar, Chattogram, is progressing rapidly. Since its establishment in 2013 as the country's only specialised public maritime university, BSMRMU has been conducting its academic activities at a temporary campus in Pallabi, Dhaka. The university is dedicated to producing skilled professionals for Bangladesh's maritime sector.

BSMR Maritime University Arranges Meeting on Good Governance as Part of National Integrity Strategy

As part of the National Integrity Strategy Plan for 2023-24, BSMR Maritime University held a meeting on 6 March 2024 to discuss the establishment of good governance within the institution. The meeting saw the participation of a wide range of stakeholders, including Deans, the Registrar, faculty members, officers, staff, students, and representatives from national daily newspapers.

During the session, Commodore Md Zakirul Islam, Chairman of the Deans Committee, and Commodore Md Monir Uddin Mollick, Registrar, addressed various questions from the stakeholders. They assured attendees that the necessary initiatives would be taken to meet the governance goals outlined in the strategy plan.

BSMRMU Team Wins Champion Title at Interactive Cares Idea Competition

The BSMRMU team emerged as champions in the Interactive Cares Idea Competition held on 20 April 2024. The winning team comprised Sifatul Alam and Pranto from the 4th batch of Port Management & Logistics, and Noor Mohammad Shuvo from the 3rd batch of Naval Architecture & Offshore Engineering.

The competition featured 250 teams from 51 prestigious universities across Bangladesh, showcasing the high calibre of participants. The BSMRMU team's achievement highlights their innovative prowess and strong representation of the university.

International Seminar on "Sustainable Ocean Economy: Advancing Bangladesh's Blue Growth" organised by BSMRMU

On 29 April 2024, BSMRMU hosted an International Seminar titled "Sustainable Ocean Economy: Advancing Bangladesh's Blue Growth" at the National Science and Technology Complex in Dhaka. The seminar featured prominent figures, including the Hon'ble Education Minister, who graced the concluding session as Chief Guest, and the Honourable Chief of Naval Staff, Admiral M Nazmul Hassan, who attended the opening session as Chief Guest. Special guests included Rear Admiral (retd) Md. Khurshed Alam, Secretary of the Maritime Affairs Unit at the Ministry of Foreign Affairs, His Excellency Iwama Kiminori, Ambassador of Japan to Bangladesh, and Prof. Dr Mohammed Alamgir, Chairman (Additional Charge) & Member of the UGC. BSMRMU Vice-Chancellor Rear Admiral Mohammad Musa delivered the welcome address.

In his speech during the concluding session, the Chief Guest highlighted the crucial role of maritime education and research in implementing the Blue Economy Policy. Admiral M Nazmul Hassan underscored BSMRMU's pivotal role in shaping the next generation of maritime professionals through high-quality education and training.

Prof. Dr Mohammed Alamgir praised the rapid progress of BSMRMU and expressed optimism about the university's potential to contribute significantly to the nation's economic growth. His Excellency Iwama Kiminori emphasised the longstanding Bangladesh-Japan bilateral relations and Japan's commitment to supporting Bangladesh's development, particularly in the blue economy sector. Rear Admiral (retd) Md. Khurshed Alam discussed the various applications of ocean science and the opportunities for new research to support sustainable development in Bangladesh.

Vice-Chancellor Rear Admiral Mohammad Musa thanked all participants and urged collaboration to advance the country's maritime sector.

The seminar featured papers presented by maritime experts and academicians from India, China, the Netherlands, the UK, and Bangladesh. The event included one plenary session and three parallel technical sessions. Additionally, a poster presentation competition was held, showcasing contributions from students across various universities. The seminar was attended by representatives from various ministries, the UGC, civil and military officers, academics, diplomats, and maritime organisations.

BSMRMU Celebrates Independence Day 2024 with Enthusiasm

BSMRMU commemorated Independence Day 2024 with due dignity at its temporary campus on 26 March 2024. The Vice-Chancellor, Rear Admiral Mohammad Musa, was present as the Chief Guest for the occasion.

The day's events began with a rendition of the national anthem by members of the Cultural Club. Students actively participated in various activities, including poetry recitation, essay competitions, photography, and concept art contests. Additionally, the university's central library and archive organised an exhibition featuring books on independence and the Liberation War.

Addressing the gathering, the Vice-Chancellor distributed prizes to the winners of the competitions. The event was streamed live on BSMRMU's official Facebook page.

BSMRMU Celebrates World Oceans Day 2024

On 9 June 2024, BSMRMU marked World Oceans Day 2024 with a series of events themed "Awaken New Depth: Catalysing Action for Our Ocean and Climate." The university held a seminar at its auditorium to celebrate the occasion.

The keynote speech was delivered by Prof. Dr Mizan R. Khan from Independent University of Bangladesh. Prof. Dr Mohammad Nazir Hossain, Head of the Department of Genetic Engineering and Marine Biotechnology at BSMRMU, also gave a significant address. In addition, Nandita Pal, a student of Oceanography and Hydrography, and Itmam Haider, a student of Naval Architecture and Offshore Engineering, presented two scientific papers during the seminar.

The celebration included a quiz and art competition, with BSMRMU Vice-Chancellor presenting prizes to the winners. The event highlighted the university's commitment to raising awareness and encouraging action for ocean and climate issues.

The University Hosts Orientation Programme for New Students

BSMRMU organised an Orientation Programme on 10 March 2024, for the newly admitted students of its 7th batch of BSc in Naval Architecture and Offshore Engineering (NAOE), 8th batch of BSc in Oceanography, 6th batch of both BBA in Port Management & Logistics and LLB in Maritime Law, and 5th batch of BSc in Marine Fisheries. The Vice-Chancellor of the university was present as the Chief Guest for the event.

Registrar Commodore Md Monir Uddin Mollick delivered the welcome address, and the programme was attended by the Treasurer, Deans, faculty members, officers, staff, and students. Notably, parents of the newly enrolled students were also present and expressed their satisfaction with the university's management and the quality of education provided.

The event included a screening of a documentary on BSMRMU, and the new students received briefings on the university's rules and regulations, security protocols, examination procedures, financial matters, and library usage from the relevant officers. The university warmly welcomed the new students to this specialised institution.

BSMR Maritime University Vice-Chancellor Visits JAMSTEC and Yokohama City University

On 21 May 2024, Rear Admiral Mohammad Musa, Vice-Chancellor of BSMR Maritime University (BSMRMU), visited the head office of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC). During the visit, the Vice-Chancellor engaged in discussions with Dr Tetsuya Miwa, Director of JAMSTEC, about potential opportunities for joint international exchange and research collaboration between BSMRMU and JAMSTEC.

Following the discussions, Dr Miwa provided a tour of JAMSTEC's research facilities, including the oceanographic research vessel, Kaimei. The Vice-Chancellor also met with Prof. Dr Yoshihiro Ishikawa, President of Yokohama City University (YCU). They held bilateral talks concerning collaborative research and academic exchanges involving faculty and students between BSMRMU and YCU.

Rear Admiral Musa briefed Prof. Ishikawa on BSMRMU's achievements and future development prospects, highlighting potential collaboration opportunities with Japanese universities. The Vice-Chancellor, accompanied by Professor Dr Mohammad Nazir Hossain, Head of the Department of Genetic Engineering & Marine Biotechnology at BSMRMU, also visited various research and educational facilities at YCU.

BSMRMU Hosts Seminar on Sustainability of Matarbari Deep Sea Port

The Institute of Bay of Bengal and Bangladesh Studies (IBBBS) at BSMR Maritime University (BSMRMU) organised a Research Finding Dissemination Seminar titled "Evaluating Matarbari Deep Sea Port's Sustainability Roadmap: A Triple Bottom Line Approach" at the National Science and Technology Complex in Dhaka on 13 May 2024. The Vice-Chancellor of BSMRMU, Rear Admiral Mohammad Musa, attended as the Chief Guest.

Special guests included the acting Chairman of the Bangladesh Institute of Maritime Research and Development (BIMRAD), Rear Admiral Md. Zohir Uddin, and the Ambassador of the Kingdom of the Netherlands to Bangladesh, H.E. Irma van Dueren. Commodore Md Minarul Hoque, Director of IBBBS, welcomed attendees and provided an overview of the research efforts.

The seminar focused on evaluating the current state of Matarbari Port in alignment with the JICA project plan, exploring the conceptual framework for a sustainable port, and assessing the sustainability status of Matarbari Deep Sea Port. Research findings were presented by a dedicated team from BSMRMU, BIMRAD, and STC Next Netherlands, contributing a range of perspectives and expertise to the discussion. This research forms part of a project supported by the Orange Knowledge Program, NUFFIC, in collaboration with STC Next of the Netherlands.

BSMR Maritime University Holds 37th and 38th Syndicate Meetings

The 37th Syndicate Meeting of BSMR Maritime University (BSMRMU) took place on 21 January 2024 at the conference room of the university's temporary campus located at 14/6-14/23, Pallabi, Mirpur-12, Dhaka-1216. The meeting was chaired by the Vice-Chancellor, Rear Admiral Mohammad Musa, OSP, NPP, rcds, afwc, psc, PhD.

During the meeting, several significant academic and administrative decisions were made, including the approval of recruitment, the permanentisation of teachers, officers, and employees, the endorsement of amended scholarship rules, and the renaming of the Department of Genetic Engineering & Marine Biotechnology.

The 38th Syndicate Meeting of BSMR Maritime University (BSMRMU) was held on 23 April 2024 at the university's temporary campus in Mirpur-12, Dhaka. The meeting was chaired by the Vice-Chancellor, Rear Admiral Mohammad Musa, OSP, NPP, rcds, afwc, psc, PhD.

During the session, several key academic and administrative decisions were made. These included the approval of recruitment, the permanentisation of teachers, officers, and employees, and financial backing for publishing research papers in Scopus-indexed journals. Additionally, the curriculum for LLB (Honours) and LLM in Maritime Law was approved, alongside the BSMRMU Business Incubator-Startup Blue Policy.

The Syndicate Members of BSMRMU

The Academic Council Members of BSMRMU

BSMR Maritime University Hosts 42nd and 43rd Academic Council Meetings

The 42nd Academic Council Meeting of BSMRMU was held on 5 March 2024 at the conference room of the university's temporary campus in Pallabi, Mirpur-12, Dhaka. The meeting was chaired by the Vice-Chancellor, Rear Admiral Mohammad Musa.

Several significant academic decisions were made during the meeting. These included the approval of the BSMRMU Business Incubator-Startup Blue Policy, financial backing for publishing research papers in Scopus-indexed journals, and the Memorandum of Understanding (MoU) between BSMRMU and the NOTC. The council also approved the academic calendar for affiliated institutes, thesis topics and supervisors, and the examination committees for both undergraduate and postgraduate programmes. Additionally, an extension of the registration period was sanctioned.

The 43rd Academic Council Meeting of BSMR Maritime University (BSMRMU) took place on 5 June 2024 at the university's temporary campus. The meeting was chaired by the Vice-Chancellor.

A range of significant academic decisions were made, including the approval of the curriculum outline for the Department of Marine Fisheries & Aquaculture and a new short course on the Essential Perspectives of the Blue Economy. The council also sanctioned a tuition fee waiver for scholarship students and agreed to an increase in ID card fees for teachers, officials, and students.

Other decisions included the approval of the syllabus for the Department of Genetic Engineering and Marine Biotechnology, the formation of various examination committees, and the academic calendar. Additionally, thesis topics and supervisors for various batches were approved, as well as the extension of the registration period and the introduction of a retake exam policy.

Inspection of Bangladesh Marine Academy, Chattogram

The Office of the Inspector of Academies/Institutes at BSMR Maritime University conducted an inspection of Bangladesh Marine Academy in Chattogram on 20 May 2024. The inspection team, led by the Dean of FSA, visited a range of training facilities within the academy and engaged with faculty members on various issues.

The team provided directions and guidelines to both faculty members and cadets. During the visit, they toured numerous facilities, including academic classrooms, the academic and administrative buildings, the chart work room, engineering drawing room, laboratory, library, computer lab, cadet block, workshop, gymnasium, auditorium, medical centre, and the firefighting block.

On 21 May 2024, the team toured various facilities within the academy and engaged with faculty members to discuss a range of issues. During the visit, the team provided directions and guidelines to both faculty members and cadets. Their inspection included a thorough review of several key areas, such as the academic and administrative buildings, classrooms, the bridge model room, workshop, library, cadet block, laboratory, fish museum, swimming pool, auditorium, and gymnasium. Additionally, the Assistant Inspector (Academies/Institutes) from the office participated in the 84th, 85th, and 86th Academic Council Meetings, as well as in the admission process for the 44th batch of Marine Fisheries cadets.

BSMRMU Inspection Team Evaluates MAS Marine Academy for Affiliation

On 27 March 2024, an inspection team from the Office of the Inspector (Academies/Institutes) of BSMR Maritime University visited the International Maritime Academy in Gazipur. Notably, this is the only non-government affiliated maritime academy in the country.

On 19 May 2024, a special inspection team from BSMR Maritime University (BSMRMU) visited MAS Marine Academy in Chattogram to assess its suitability for affiliation. The team, led by the Dean of FSA, conducted a thorough review of the academy's facilities.

The inspection included visits to various areas such as academic classrooms, the firefighting block, playground, library, medical centre, language lab, seamanship model room, chart work room, engineering drawing room, workshop, cadet block, gymnasium, auditorium, and parade ground.

Following the facility tour, the team engaged in discussions with the Principal, teachers, and officers of MAS Marine Academy to address various affiliation issues. The team then proceeded to the National Maritime Institute in Chattogram to evaluate its simulator training facilities.

Vice-Chancellor Inspects Bangladesh Marine Academy in Sylhet

On 29-30 May 2024, Rear Admiral Mohammad Musa, OSP, NPP, rcds, afwc, psc, PhD, the Vice-Chancellor of BSMR Maritime University, led an inspection team to Bangladesh Marine Academy in Sylhet. During the visit, the Admiral was honoured with a guard of honour and observed a cadet parade, taking salute from the cadets. He also planted a sapling in front of the Admin and Academic Block.

The inspection team toured various facilities at the academy, including classrooms, laboratories, the computer lab, cadet block, library, workshop, seamanship model room, medical centre, swimming pool, playground, language lab, chart work room, engineering drawing room, firefighting block, gymnasium, auditorium, pump room, and electric substation.

The Vice-Chancellor provided necessary directives and guidelines to the faculty members and cadets, addressing various issues and offering valuable insights. All officers from the Office of the Inspector of Academies/Institutes accompanied the Vice-Chancellor during the visit.

BSMRMU Inspection Team Visits Bangladesh Marine Academy in Rangpur

On 7 February 2024, the Inspector (Academies/Institutes) of BSMR Maritime University led an inspection team to Bangladesh Marine Academy in Rangpur. The team conducted a comprehensive tour of the academy's facilities, including academic and administrative buildings, classrooms, the chart work room, engineering drawing room, laboratory, library, computer lab, cadet block, workshop, gymnasium, auditorium, medical centre, and firefighting block.

During the visit, the team engaged with faculty members to discuss various issues and provided insights on improvements. The Inspector also participated in the 3rd Meeting of the Governing Body of Bangladesh Marine Academy, Rangpur.

Inspection Team Visits International Maritime Academy and BMTI

On 27 March 2024, an inspection team from the Office of the Inspector (Academies/Institutes) of BSMR Maritime University visited the International Maritime Academy in Gazipur. Notably, this is the only non-government affiliated maritime academy in the country.

During the visit, the team inspected various facilities including the academic and administrative buildings, classrooms, workshop, library, cadet block, laboratory, auditorium, and gymnasium.

Following the inspection at the International Maritime Academy, the team proceeded to the Bangladesh Maritime Training Institute (BMTI) to evaluate its simulator training facilities.

Bangladesh Calls for Collective Efforts in Responsible and Sustainable Ocean Management

At the 9th Our Ocean Conference held in Athens, Greece, Bangladesh emphasised the need for collective action in the responsible and sustainable management of the world's oceans. Speaking on 17th April during a high-level panel discussion of foreign ministers, Bangladesh's Foreign Minister highlighted the importance of this issue on the conference's concluding day. The conference had commenced on 15th April.

The Foreign Minister stressed that sustainable ocean management must strike a balance between the socio-economic development of coastal communities and the preservation of the marine environment. He underscored the necessity of responsible and sustainable use of ocean and marine resources to ensure the long-term well-being of our planet, which is the only home for humanity and future generations.

During the conference, various countries pledged approximately USD 10 billion to support the development of systems for biodiversity conservation, ecosystem enhancement, and green shipping—initiatives aimed at reducing environmental impact beyond national boundaries. However, these commitments have yet to be fully realised.

The panel discussion also featured contributions from the foreign ministers of host countries Greece, Costa Rica, Cape Verde, and Sao Tome and Principe, among others.

A Decision is Made for Maheshkhali Integrated Development Authority

The government has decided to establish an authority for the integrated development of Matarbari and Maheshkhali in Cox's Bazar. On 17th April, the Cabinet granted in-principle and final approval to the draft of the 'Maheshkhali Integrated Development Authority Act, 2024.'

Development activities in Matarbari were initiated by the Japanese government during the visit of the Prime Minister of Japan to Bangladesh in 2014, following a joint declaration between the two countries. Building on this, the initiative aims to create an economic zone centred around Matarbari, encompassing deep-sea facilities, essential infrastructure, and identifying key areas for comprehensive development.

Under the new law, the primary responsibility of the authority will be to implement a land use master plan within the designated area, ensuring that land is utilised effectively. The overarching goals include attracting foreign investment and reducing lead times for export and import activities.

Establishment and Operation of Laldia Container Terminal Deal Signed

A significant agreement has been signed between the PPP Authority, Chittagong Port Authority, and the International Finance Corporation (IFC) to establish and operate the Laldia Container Terminal at Chittagong Port under a Public-Private Partnership (PPP) model. The contract was signed on 1st June, with key figures present, including the CEO of the PPP Authority, Md. Mushfiqur Rahman; Director General of the Prime Minister's Office-1 (Additional Secretary), Nafiul Hasan; Chittagong Port Authority Member (Harbour & Marine), Commodore M. Fazlar Rahman; IFC Regional Manager (PPP Transaction Advisory Services-Asia), Thomas Lubeck; IFC South Asia PPP Hub Leader, Moazzam Ahmed Mekan; Director General of the PPP Authority, AKM Abul Kalam Azad; and Md. Anwarul Habib, along with other senior officials.

Bay Terminal's Four Terminals Gets USD 8 Billion Investment

An investment of USD 8 billion, both domestic and foreign, is being directed towards the construction of four terminals as part of the proposed Bay Terminal project at Chittagong Port. This substantial investment will be allocated across three terminals dedicated to the loading and unloading of goods, an oil and gas terminal, and a channel created through breakwater construction. The Chairman of the Chittagong Port Authority shared this information during a meeting with journalists in celebration of the port's 137th founding anniversary, held at the Fazlur Rahman Munsi Auditorium. The meeting was attended by port members and department heads.

Highlighting this as the largest foreign investment in Bangladesh's history, the port chairman noted that the most significant portion of the investment will be directed towards the terminal for gas and oil discharge. East Coast Group, in collaboration with foreign organisations, will lead this project with an investment of USD 350 million. Additionally, three terminals for container and goods handling will be constructed. Of these, PSA International from Singapore and DP World from the UAE will each invest USD 150 million to build and operate two separate terminals. The multipurpose terminal has been proposed by Abu Dhabi Ports Group, potentially involving an investment of USD 1 billion. Furthermore, an investment of USD 590 million is being planned for channel construction through the creation of breakwater.

The chairman also mentioned that the master plan for the Bay Terminal has been finalised, with land acquisition and design work nearing completion. The next steps involve preparing cost estimates and determining the quality of work required, which are expected to be completed within the next two to three months. Following this, the tender process will commence.

He further announced that the construction of the country's first deep-sea port terminal will begin soon, with field-level work starting promptly after receiving government approval. The deep-sea port will be capable of accommodating large vessels.

Regarding Denmark's APM Terminals investment in Laldia, the port chairman mentioned that a survey for the terminal's construction has been completed. A contract with the Danish company to build and operate the terminal is expected to be signed later this year.

Bangladesh and Qatar Sign 10 Agreements and MoUs

Bangladesh and Qatar have signed a total of five agreements and five memorandums of understanding (MoUs) to enhance cooperation across various sectors. These agreements and MoUs were signed on 23rd April.

The five agreements include a mutual investment promotion and protection agreement between the two nations, an agreement on the avoidance of double taxation and prevention of tax evasion, a legal cooperation agreement, a maritime transport agreement, and an agreement to establish a joint business council between business organisations from both countries.

The five MoUs encompass a range of collaborative efforts, including cooperation in diplomatic training, higher education and scientific research, youth and sports, manpower, and port management.

After 74 Years, New Import-Export Law is Introduced

The Bangladesh Import and Export (Control) Act of 1950 has been a cornerstone of trade regulation for decades. However, after 74 years, a new law is being introduced to modernise and expand the framework. This new legislation, known as the 'Import and Export Act, 2024,' aims to integrate the service sector with the trade of goods. Notably, the term 'regulation,' present in the previous law, will not be included in the new version.

The Cabinet has given its in-principle approval to the draft of the 'Imports and Exports Act, 2024,' which now includes provisions for the services sector. Under this new law, the import and export of services will require approval from the Ministry of Commerce. The approval for this updated legislation was granted during a cabinet meeting held on April 1.

The Cabinet Secretary highlighted that the new law introduces several updates to the previous legislation. While the earlier law focused solely on goods, the new act expands to cover commercial service activities as well. This means that both the import and export of services will now need the Ministry of Commerce's approval, marking a significant shift in the country's trade policy by including services alongside commodities.

Bangladeshi-Flagged Ships Surpass 100 in Numbers

The number of sea-going ships flying the Bangladeshi flag has now exceeded one hundred, marking a significant milestone for the country's maritime sector. The fleet currently consists of 101 vessels with either permanent or temporary registration. The latest addition to the fleet is MV Jahan-1, a vessel owned by the KSRM Group. Built in 2018, the ship is nearly new, and the average age of the ships added to the national fleet in recent years is less than ten years.

Captain Sabbir Mahmud, the Chief Officer of the Department of Shipping, highlighted that Bangladeshi entrepreneurs have been actively expanding the fleet by adding ships over the past few years. He anticipates that if this trend continues, the number of domestic ships could reach two hundred by 2028.

According to Chittagong Customs, the KSRM Group purchased this ship for USD27.2 million. The vessel, which is approximately 200 metres long, has a cargo capacity of 61,000 tons. With this latest addition, the KSRM Group's fleet now comprises 24 vessels, with a total investment exceeding USD300 million.

Shahriar Jahan Rahat, Deputy Managing Director of KSRM Group, noted that government policies in this sector have become much more investment-friendly, which has encouraged ongoing expansion. This growth is not only bringing foreign currency into the country but also providing employment opportunities for skilled professionals.

Captain Sabbir Mahmud further stated that since independence, 361 sea-going ships have been registered under the Bangladeshi flag. Of these, 101 vessels are currently in service, while the remainder were sold for scrapping due to being unfit for operation.

The private sector shipping industry in Bangladesh began 46 years ago. While early pioneers like Atlas Shipping are no longer in operation, large industrial groups are now leading the way in investment. These red-and-green-flagged ships are now operating from port to port across the globe, representing Bangladesh on the international stage.

Largest Share of Foreign Loan Allocated to Transport Sector

The transport sector continues to be the government's top priority, with one-third of the anticipated USD30.89 billion in foreign loans for the current and next two fiscal years earmarked for this sector. These funds are intended for projects approved by development partners.

Among the 115 projects listed by the Economic Relations Department (ERD), 30 are focused on road and rail connectivity, with a proposed loan allocation of USD10.7 billion. The energy sector follows, with USD4.77 billion expected in foreign funding for seven projects. Significant projects include Dhaka's Metro Line-5, the Kalurghat rail-road bridge in Chittagong, the Dhaka-Comilla railway line, a railway container depot at Dhirashram in Gazipur, and a container terminal at Chittagong Port.

These loan agreements are expected to be finalised over the next three financial years, up to 2025-26, with project implementation planned within five years of signing. The emphasis is on infrastructure development to support trade and investment, with USD10.7 billion allocated specifically for road and rail connectivity.

According to the ERD's monthly updated list of projects awaiting loan agreements, the Asian Development Bank (ADB) is anticipated to provide nearly half of the total loan, approximately USD14.95 billion. The World Bank has already approved USD3.73 billion, with an additional USD11.12 billion in loan agreements expected with other development partners, including the Asian Infrastructure Investment Bank, China, South Korea, and the New Development Bank.

ERD's latest report also highlights upcoming budget challenges, with a proposed budget of USD3.61 billion aimed at addressing the current economic situation.

ADB's pipeline loan projects include USD4.93 billion allocated for highways, railways, inland depots, and container terminal developments, making it the most heavily funded sector. The government has secured a USD2.6 billion loan from ADB for 12 projects, including the USD5.47 billion Dhaka Metro (Line-5) South Route, which is expected to commence next year.

The 17-kilometre underground metro rail line from Gabtali to Dasherkandi will be primarily financed by ADB and South Korea, with the first USD300 million from ADB expected to be available in October. Additionally, ADB has pledged USD600 million for the first phase of the Dhaka-Chittagong Broad Gauge Rail Line project.

The loan agreement with ADB for the USD250 million inland container depot project at Dhirashram in Gazipur is in its final stages. This railway depot will connect Chittagong and Matarbari ports with the capital, Dhaka, via rail.

International Day for Women in Maritime 2024 Highlights Gender Equality and Future Safety

On 18th May, the maritime industry celebrated the International Day for Women in Maritime, an annual event established by the International Maritime Organisation (IMO) in 2021. This year's theme, "Safe Horizons: Women Shaping the Future of Maritime Safety," highlighted the crucial role of women in shaping a safer, more sustainable maritime future.

Despite efforts to promote gender equality, women account for less than 2% of the global seafaring workforce, as revealed by the IMO. Secretary-General Arsenio Dominguez emphasised the need for education, innovation, and sustainability to close this gap and empower women in the industry.

Leanne Loan, AMSA Executive Director of Policy and Regulation, honoured the achievements of women in shipping and stressed the importance of diversity and female leadership in creating an inclusive maritime sector. The IMO's Women in Maritime Program, established in 1988, continues to support women through training, visibility, and recognition.

Other organisations marked the day by focusing on education and skills development. The UN Office of Drugs and Crime, in collaboration with the Sri Lankan Navy, conducted the first IPC Navigation Training for female sailors in Southeast Asia, preparing them for leadership roles.

The IMO also encouraged the industry to embrace digitalisation, automation, and greener technologies to meet the UN's Sustainable Development Goals, especially Goal 5 on gender equality.

Ocean Literacy World Conference Launched in Venice

On 7 and 8 June, Venice hosted the inaugural Ocean Literacy World Conference, organised by UNESCO in collaboration with the Prada Group, marking World Ocean Day. The event, held at Cà Giustinian, brought together 150 delegates from UNESCO member states and experts in ocean literacy to discuss ocean education and sustainability.

The conference featured SEA BEYOND, an educational programme launched in 2019 by Prada and UNESCO to raise awareness about the ocean's health and preservation. Francesca Santoro, Senior Programme Officer at UNESCO, highlighted the importance of engaging everyone in ocean protection efforts, emphasising that the High Seas Treaty now needs practical implementation.

The event saw the unveiling of the "Venice Declaration for Ocean Literacy," a collective document calling on governments to integrate ocean education into school curricula, aligning with Sustainable Development Goal 14.

Lorenzo Bertelli, Prada Group Head of Corporate Social Responsibility, stated that SEA BEYOND's commitment to ocean education had reached a political level, urging governments to prepare future decision-makers.

The conference concluded with workshops and a documentary screening, open to the public, along with presentations of SEA BEYOND initiatives to engage young people in marine conservation and sustainability practices.

Centre of Excellence for Oceanography and Blue Economy Launched in Antigua

The Centre of Excellence for Oceanography and the Blue Economy (COBE) was officially launched yesterday at the 4th Small Islands Developing States (SIDS4) conference in St John's, Antigua. COBE is a collaborative effort between the Government of Antigua and Barbuda, the University of the West Indies, the Commonwealth Secretariat, and the Association of Commonwealth Universities.

As small island developing states (SIDS) seek to harness the economic potential of their marine environments, the Centre will provide crucial support for research, innovation, and capacity building. COBE will focus on areas such as marine renewable energy, coral reef restoration, and maritime law, contributing to the transition to a sustainable 'blue economy' in the Caribbean.

Honourable Minister Samantha Marshall emphasised the importance of homegrown solutions for managing marine resources amidst climate change, while COBE Director Dr Branson Belle highlighted the Centre's potential to foster regional collaboration and education. Located at the University of the West Indies' Five Islands Campus, COBE will draw from the university's research expertise and Commonwealth networks.

Dr Nicholas Hardman-Mountford of the Commonwealth Secretariat praised Antigua and Barbuda's leadership, noting that COBE will build regional capacity in sustainable ocean industries and support the wider Commonwealth Blue Charter agenda.

Contract for New Ocean Research Vessel in India

Garden Reach Shipbuilders and Engineers (GRSE) Ltd of India has achieved a major milestone by signing a contract worth Rs 840 crore with the National Centre for Polar and Ocean Research (NCPOR) under the Ministry of Earth Sciences. The agreement, signed on 16th July 2024 in Goa, marks a significant step in advancing India's Atmanirbhar Bharat initiative.

The new ocean research vessel (ORV) will be 89.50 meters long, with a gross tonnage of 5,900 tons, and capable of operating at depths of up to 6,000 meters. Designed for a variety of scientific missions, the ORV will support geophysical surveys, biological sampling, and seabed exploration. It will also be equipped to launch and retrieve submersibles, such as Autonomous Underwater Vehicles (AUVs) and Remotely Operated Vehicles (ROVs).

GRSE's extensive experience in shipbuilding, including previous projects like the Marine Acoustic Research Vessel INS Sagardhwani and INS Sandhayak, positions it as a leader in specialised vessel manufacturing. The new ORV will enhance India's maritime research capabilities, contributing to ocean exploration and scientific advancements.

This contract reflects GRSE's growing prominence in the maritime sector, supporting both national research and defence infrastructure.

OceanX Launches Groundbreaking Exploration Mission in Indonesia

On 8th May 2024, global ocean exploration nonprofit OceanX, in collaboration with Indonesia's Coordinating Ministry of Maritime Affairs and Investment (CMMAI) and the National Research and Innovation Agency (BRIN), officially launched the "Indonesia Mission 2024." This landmark expedition is part of a multi-year commitment to exploring the biodiverse and threatened waters of Southeast Asia.

The mission, taking place aboard OceanXplorer, the world's most advanced exploration vessel, will run until 25th August. It aims to deepen understanding of Indonesia's marine ecosystems and their crucial role in sustainability, fisheries, and disaster mitigation.

Indonesia's Coordinating Minister Luhut Binsar Pandjaitan expressed excitement about potential discoveries, emphasising the mission's importance for developing solutions in areas such as medicine, biotechnology, and tsunami safety.

The expedition will include extensive scientific research, including megathrust zone investigations and fisheries studies. OceanX is also launching educational programmes in partnership with Indonesian universities, aimed at inspiring the next generation of marine scientists and engineers.

Vincent Pieribone, co-CEO of OceanX, noted that the mission's data would support sustainable fishery management, conservation strategies, and disaster prevention. The mission represents a significant step forward in Indonesia's efforts to map and protect its vast and largely unexplored ocean territories.

BSM of Singapore Launches Smart Academy to Train Future Seafarers

Bernhard Schulte Shipmanagement (BSM), Singapore has launched the BSM Smart Academy, a new educational programme aimed at addressing the growing shortage of skilled seafarers. Developed in collaboration with selected maritime universities worldwide, the programme aims to bridge the gap between academic knowledge and practical training.

With the global merchant fleet facing a shortage of thousands of officers in the coming years, BSM's proactive approach seeks to train highly skilled seafarers by engaging them early in their education. BSM Smart Academy will allow nautical, technical, and electrical undergraduates from participating universities to join as BSM cadets after their first year, gaining both academic and practical knowledge aligned with current industry requirements.

Eva Rodriguez, Director of HR Marine at BSM, highlighted the importance of the initiative, stating, "We enhance the education of future seafarers by engaging with them at an earlier stage."

The programme offers comprehensive training in realistic work environments, both onshore and onboard, focusing on developing the skills needed for the increasingly digitalised maritime sector. BSM aims to recruit up to 100 students in the first year and gradually expand its global partner network.

Rodriguez emphasised the importance of seafarer education, adding, "Seafarer education is costly. However, no education is even more costly."

Ripple and Marine Learning Systems Merge to Form Ripple Operations

Maritime software brands Ripple and Marine Learning Systems have merged to create Ripple Operations, a unified brand focused on crew training and marine operations. Both firms were acquired by technology holding company Bleecker Street Group in 2023 and are now combining forces to offer comprehensive human capital management, crew operations, training, and learning solutions for maritime operators.

Ripple Operations will support hundreds of thousands of mariners and operators across various industries, including ferry, cruise, offshore, fishery, and tug, tow, and barge sectors. Among its notable clients are the world's largest cruise line and North America's largest ferry system.

The merger aims to expand the company's product portfolio, enhance customer support, and drive innovation. Chad Mitchell, Bleecker Street Group Founder and Ripple Operations Executive Chairman, expressed enthusiasm for the merger, stating, "This represents a significant milestone in our mission to empower global maritime organisations with the tools and technologies they need to succeed in today's dynamic environment."

The newly formed Ripple Operations promises to bring greater value to its customers by continuing to innovate and support the maritime industry through its enhanced offerings.

New UK Regulations Ban Harmful Marine Paints to Protect Ocean Ecosystems

New UK legislation, coming into effect on 10 May 2024, will prohibit the use of cybutryne in marine paints, which has been proven harmful to marine life and ecosystems. The regulation applies to all UK-flagged ships globally and to foreign vessels in UK-controlled waters. This move aims to prevent pollution from such substances, supporting international efforts to protect marine environments.

The ban is part of the Merchant Shipping (Anti-Fouling Systems) Regulations 2024, adopted by the Maritime and Coastguard Agency (MCA) in alignment with the International Maritime Organization's (IMO) amended convention. The regulations also uphold the existing prohibition on organotin compounds, another harmful chemical.

MCA Chief Executive Virginia McVea stated, "We know these substances are proven to have harmful ecological effects, so this action is important to protect our environment."

The legislation consolidates previous rules into one framework, making it easier to update in the future. It revokes earlier regulations and implements the latest version of the International Convention on the Control of Harmful Anti-fouling Systems on Ships.

This step reaffirms the UK's commitment to safeguarding marine ecosystems, with cybutryne posing a significant threat to biodiversity and the food chain.

New Study Highlights Severe Impact of Deep-Sea Mining on Marine Life

A recent study by researchers from Wageningen University & Research and the University of Bergen, published in *Deep-Sea Research Part I*, has revealed that deep-sea mining particles can have devastating effects on deep-sea fauna. The study focused on the common deep-sea sponge *Geodia barretti* and its associated brittle star species, exposing them to particles from seafloor massive sulfide (SMS) deposits, which are targeted for mining due to their valuable metal content.

Results showed a tenfold increase in tissue necrosis in sponges following exposure to these mining plumes. All brittle stars perished within ten days, likely due to toxic metal exposure. The study also found significantly higher concentrations of iron and copper in the sponges, highlighting the accumulation of suspended mining particles in their tissues.

Research leader Erik Wurz stressed the importance of the findings, describing them as a "wake-up call" for the potential ecological risks of deep-sea mining. The study emphasises the need for comprehensive environmental assessments and sustainable management practices to protect vulnerable deep-sea ecosystems.

With large areas of the North Atlantic Ocean hosting sponge-dominated ecosystems, this research underscores the urgency of addressing the adverse impacts of mining on marine biodiversity.

Soil Salinity Assessment

through Remote Sensing and GIS

M. R. Ashikur

Background

The phenomenon known as “Soil Salinity” occurs when soluble salts enrich the soil, resulting in the formation of Salt-affected Soil (SAS). Significant land areas around the world have lost value and productivity due to the existence of salty soil conditions. One common cause of land desertification and soil deterioration is the phenomenon of soil salinisation. The phenomenon being discussed is an adverse effect of soil salt displacement, brought about by a confluence of natural factors including variations in surface morphologies, meteorological events, and hydrological features. The occurrence of salt-related issues largely stems from processes such as rock and mineral weathering, intrusion of seawater, active aeolian processes, increasing water tables, and intense evaporation. The phenomenon of soil salinisation is a significant environmental risk that has wide-ranging implications for global agricultural output and food security. The escalating levels can be attributed to a range of natural and anthropogenic reasons, including suboptimal irrigation practices, overuse of fertilisers, and alterations in land use patterns.

Bangladesh’s entire salinity-affected land area has grown to 105.6 million hectares and is still expanding, from 83.3 million hectares in 1973 to 102 million hectares in 2000. In this country, salinity has risen by approximately 26% over the past 35 years. In addition, coastal

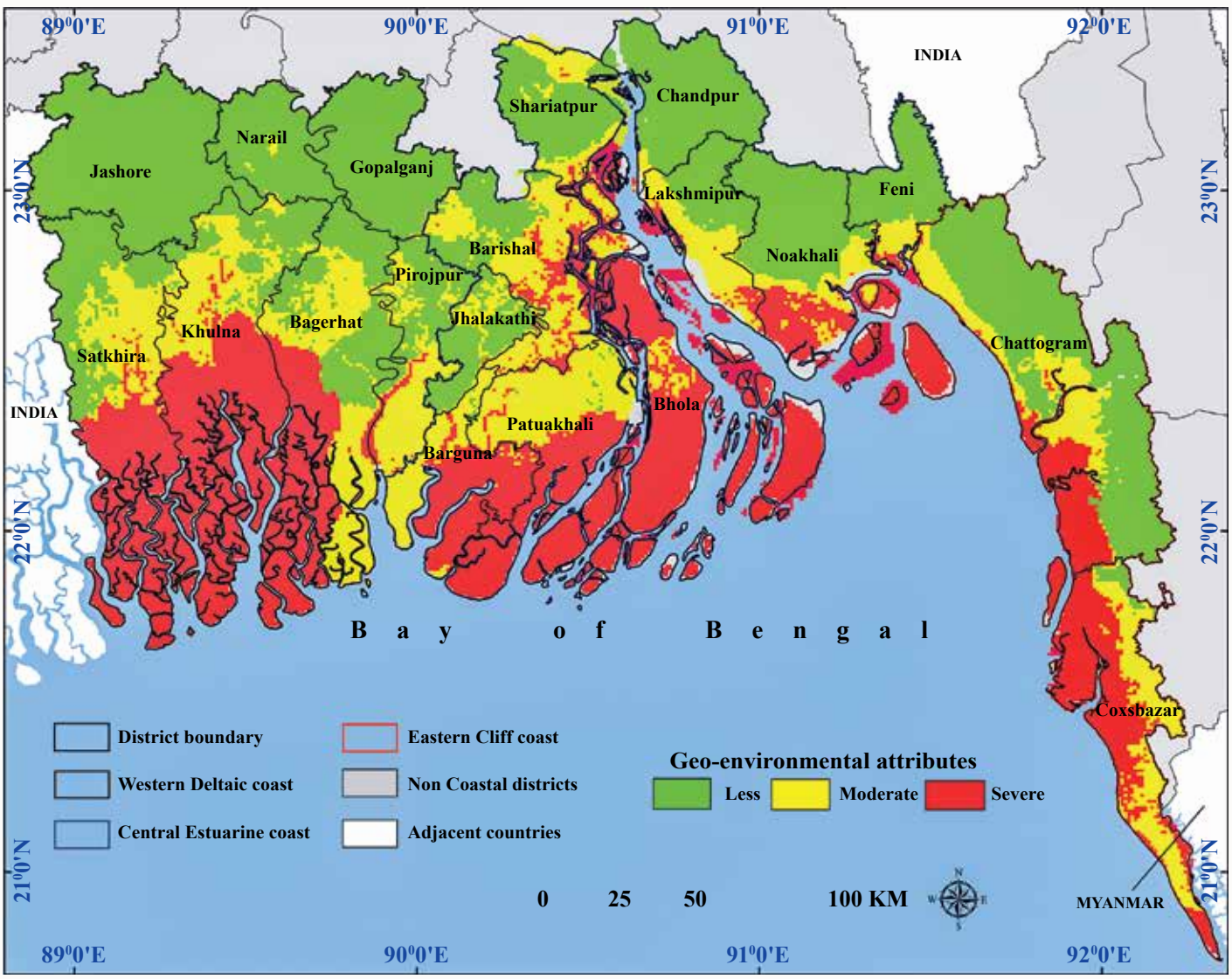

Fig. 1: Geo-environmental attribute map of Bangladesh coastal area (Morshed et al., 2022).

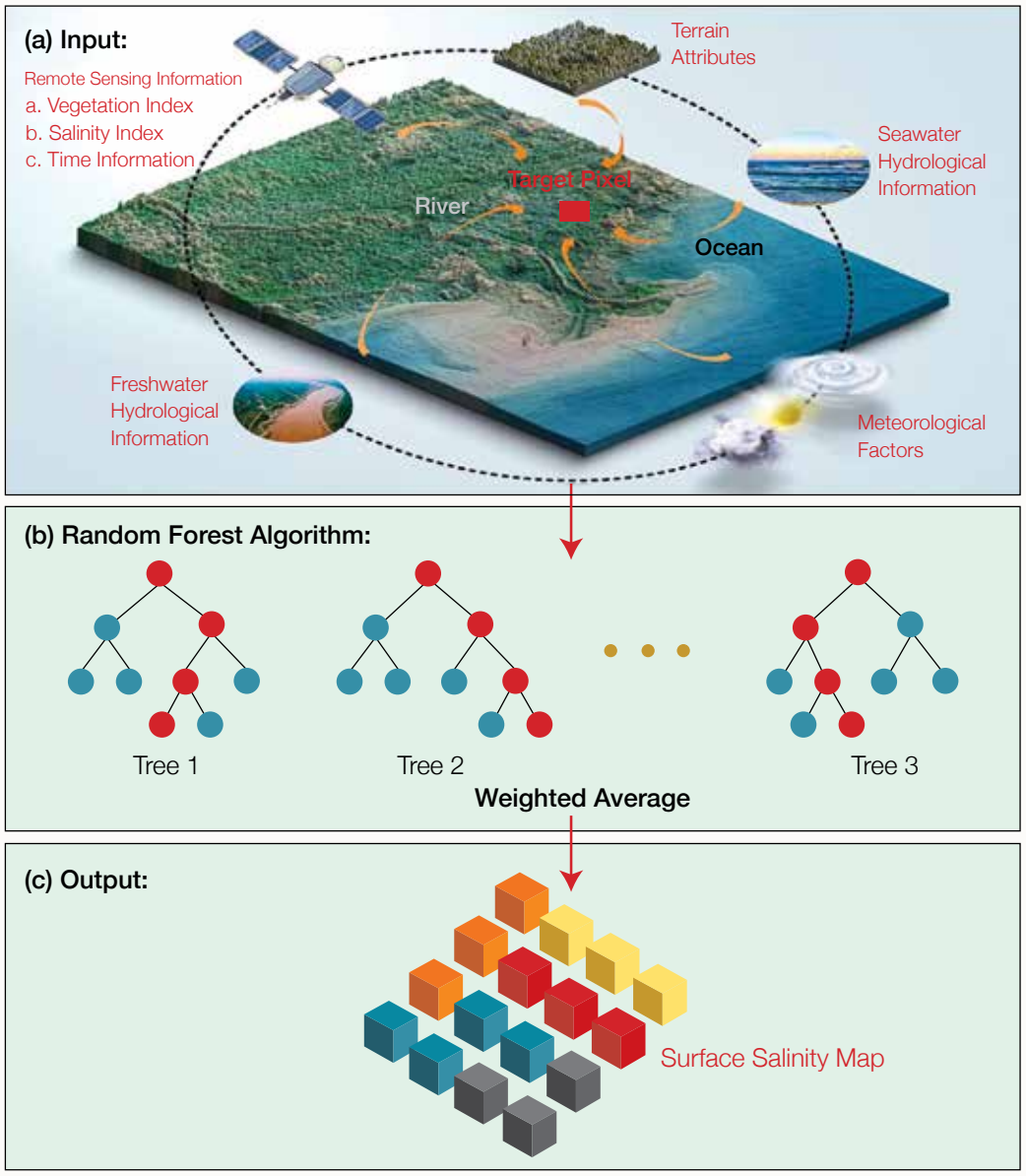

Fig. 2: Structure and specific schematics of soil salinity algorithm matrix (Sui et al., 2022).

areas are experiencing an increase in inland salt intrusion. A total of 1.056 million hectares, or roughly 1.689 million acres, of coastal land are affected by salt in the soil. These areas use far less agricultural land than the country as a whole for cropping intensity because of salinity caused by an excess of soluble salts.

Bangladesh Geomorphological Condition

Bangladesh's coastal regions are predominantly shaped by the Bay of Bengal (BoB) and the Ganges-Brahmaputra-Meghna (GBM) river system in terms of hydrology and geomorphology. There are 35 million people living in the coastal region, making up about 29% of the nation's overall population. More than 30% of Bangladesh's arable land is found to be in its coastal regions. Nonetheless, salt significantly reduces agricultural output in these regions. Severe soil erosion is a feature of Bangladesh's coastal region. Crop growth is severely hampered by the high salinity of the water during the dry season. The extent of saline-affected land in the coastal region of Bangladesh observed a significant rise from 833,450 hectares to 1,056,190 hectares between the years 1973 and 2009. This is 26.7% growth over a span of 36 years. Furthermore, this area is projected to expand at a rate of 146 square kilometres per year.

Bangladesh Coastal Region Responses of the Soil Salinity

The coastal region of Bangladesh has a distinct brackish water ecosystem since it depends on sweet water from upstream, and the quality of the sand soil is closely linked to the tidal effects. Around seventy islands, accumulating land, beaches, a peninsula, rural and urban populations, industrial zones, ports, mangroves, tidal flats, estuaries, seagrass, and a broad variety of other natural and economic systems may be found throughout the 710 km coastline stretch. Real-time monitoring of land-soil incursion is made possible by the application of RS and GIS technologies, which provide valuable information about land usage and soil salinity. The salinity of the soil is determined by measuring the total dissolved solids (TDS) in the soil solution, EC, and other factors. In Asia's coastal wetlands, the tide changes that cause salt intrusion often impede agricultural development. In arid and semi-arid countries, soil salinisation plays a significant role in land degradation, which hinders the sustainable growth of agriculture and food security. Bangladesh is a coastline country; therefore, the negative effects of saltwater intrusion are apparent. Salinity mostly impacts the soil and water in coastal locations.

Spatiotemporal Variation of Soil Salinity in the Coastal Region

In Bangladesh's coastal regions, the soil salinity fluctuates greatly with the seasons. A significant issue in the field of study is salinity, which has an adverse effect on the environment, food production, and flora, and eventually prevents sustainable growth. Soil salinity can be temporally monitored and mapped using both satellite imagery and field measurements with the aid of RS techniques. A low-demand method for mapping soil salinity that can show the spatial distribution of environmental risks and saltiness has been developed using GIS techniques. Furthermore, comparing geographic salinity data with field research is required to enhance satellite imagery's capacity to precisely map and track salinity intrusion. In the last twenty years, RS imagery has demonstrated that it is possible to accurately track

salinity variations from surface characteristics at different scales and in real time. A number of earlier investigations have demonstrated the potential of optical sensors, such as those operating in the short-wave infrared (SWIR) or vis-NIR spectral bands, to sense and detect soil surface salinity. At the regional and global levels, the integration of remotely sensed data, laboratory analysis, ground sample collection, and sophisticated quantitative prediction models greatly facilitates the mapping and monitoring of soil salinity and other environmental concerns Therefore, integrating satellite RS data with other sources of data, such as EC meter, unmanned aerial vehicles (UAVs), ground imaging hyperspectral, and in-situ measurements, can enhance the accuracy and resolution of soil salinity estimation and mapping.

Soil Salinity Condition Retrieved from Satellite Images

Soil salinity is a sign of salt buildup on the planet or in the immediate vicinity. The components of satellite RS of salinity-affected land are identified by decision support systems using digital image processing. Depending on the type of satellite sensor used, satellite images offer a substantial quantity of data that may be processed, analysed, and stored to help understand different vegetation indices. Sustainable farming techniques require that the saline-affected areas be monitored, mapped, and changes are tracked. Many researchers have shown that RS is a reliable way to measure soil salinity in arid areas. Specifically in coastal and marine environments, the Salinity index, a RS indicator, is used to determine the salinity levels. GIS can be used to identify regions with certain salinity ranges, define salinity gradients, and examine spatial patterns and trends using SI data. A potential strategy for comprehending and managing soil salinity has recently emerged. Decision-makers can identify locations with high salinity, low salinity, or places experiencing salinity variations over time by viewing the salinity distribution on maps. Understanding the dynamics of salinity patterns and their regional variability is aided by these maps. Numerous research articles have used RS and GIS-related techniques to assess, map, and forecast soil salinity.

Vegetation Condition Retrieved from Remote Sensing Image

In order to manage land, monitor the environment, and preserve biodiversity, vegetation is essential. One popular RS method for evaluating the health and vitality of vegetation is the NDVI. GIS is a perfect tool for monitoring and analysing vegetation because it offers a strong platform for integrating and analysing spatial data. One of the possible dangers to agriculture and the coastal ecology is the salt of the soil, which might impede the nation's future food security. It is possible that traditional field-based soil salinity monitoring across large areas is not time-or money-efficient. Using many indices, including the Enhanced Vegetation Index (EVI), Soil Adjusted Vegetation Index (SAVI), and the NDVI, satellite RS is providing an effective means to track the salinity of soil.

Soil Salinisation Detecting through RS Technology

Determining the salinity state of soils in an area is greatly aided by the determination of soil salinity using satellite data. RS techniques can be a faster, less expensive, and more effective way to map and track changes in soil salinity across time and space than traditional approaches. Consequently, the link between spectral characteristics of saline soils and salt content has been the subject of decades' worth of RS research. Multispectral sensors, including the Landsat, SPOT, ASTER, IKONOS, MODIS, and IRS series, have provided several choices for mapping and tracking soil salinity since 1990. When evaluating SAS on a time, spatial, repetitive, and resolution scale, there are benefits to employing RS data for detection and monitoring. Additionally, by emphasising soil salinisation, this technique may successfully stop the future deterioration of SAS brought on by human activity. With these benefits, RS is a more viable choice for assessing soil salinity than traditional techniques, which have several drawbacks. The availability of satellite data and the development of advanced sensors with better spectral and spatial resolutions have made this surge possible.

Investigating the Scope and Scale of Accessible Salinity Data

Although RS has emerged as a useful method for assessing salinisation, the magnitude of the inquiry and the availability of data are key factors in its effective application. Numerous research works have used microwave, multispectral, hyperspectral, and thermal sensors to measure the amount of salt. The range and applicability of the study are greatly impacted by the different spectral, spatial, radiometric, and temporal resolution characteristics of these sensors. Thus far, these sensors have demonstrated their ability to detect patterns at spatiotemporal scales, with revisit times varying from one day to two weeks and a spatial resolution of a few centimetres to several hundred meters. As a result, the technical attributes of the sensor and the availability of data are crucial when choosing a RS system for salinisation evaluation. As part of the European Space Agency's (ESA) sponsored Copernicus program, Sentinel missions-namely, Sentinel-1 and Sentinel-2 have lately taken centre stage in the European imaging systems. The Copernicus program is an Earth observation effort that provides free information services for the benefit of the European community while researching the Earth's surface and surroundings. Sentinel products, with their high spatial resolution (10 to 60 m) and quick revisit times (five days for Sentinel-2 and six to twelve days for Sentinel-1), have become a vital source of information for various Earth observation research projects, such as salinisation risk management.

Concluding Remarks

Soil salinity can be mapped and monitored over time using satellite imagery and RS techniques in addition to on-site measurements. Using GIS techniques, mapping the salinity of the soil has become a somewhat effortless process. This method efficiently illustrates the regional variations in soil salinity and pinpoints the related environmental risks of salinisation. RS data has come to be a highly effective tool in comparison to traditional methods for acquiring long-term imagery of environmental and natural resources. This technology enables the monitoring and management of these resources at various geographical scales. In addition, since the 1960s, RS techniques have been widely used to assess the salinity of soil. Besides, RS data offer a rapid turnaround time and a more affordable method than conventional procedures.

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