Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

The role of Marine Spatial Planning (MSP) for the development of Chittagong Port, Bangladesh.

Shohida Aktar 1, Abu Taiyeb Md. Alimuzzaman 2, Mohammad Abdullah Abu Sayed 3

1.Lecturer , Department of Port and Shipping Management
Bangabandhu Sheikh Mujibur Rahman Maritime University, Bangladesh
shohida.aktar49@gmail.com

2.Master Mariner(MCA,UK)
Senior Nautical Instructor
Bangladesh Marine Academy, Sylhet
atm.alimuzzaman@gmail.com

3.Master Mariner(MCA,UK)
PhD Researcher University Nova Lisbon , Portugal
Maritime Supply Chain Management
maasayed74@gmail.com

Abstract

Port development is crucial for Bangladesh, given that the country's dependence on maritime trade accounts for 33% of its total trade. The backbone of the country's economy is the prime port of Chittagong, which manages over 92% of all seaborne trade. However, this port has numerous disputes with different maritime sectors within its port boundaries, and terrestrial pollution has an adverse impact on port activities. In recent times, numerous coastal nations have employed Marine Spatial Planning (MSP) to foster the growth of sectors such as port and shipping, tourism, renewable energy, fisheries, and more. MSP appears as an optimal tool to minimize stakeholder disputes and improve the all-encompassing use of resources via collaborative management techniques. The focus of the article was to identify the major problems facing the Chittagong port in relation to MSP and investigate the role of MSP in addressing those problems. Information from primary and secondary sources was combined in the study using a qualitative methodology. A total of twelve semi-structured interviews were carried out in a variety of maritime sectors in order to collect primary data. The findings of this research could include conflict resolution, the involvement of many maritime stakeholders, economic benefits through the reduction of dredging cost and environmental sustainability of port as well as the ocean.

Keywords: Marine Spatial Planning, conflict resolution, port development, Chittagong port.

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

1. Introduction

Port development is crucial to any country when country's dependency on the port sector is highly integrated. Bangladesh is a nation with a significant maritime presence, as evidenced by the fact that 80% of its trade is facilitated through its seaports. Additionally, the country's dependence on maritime trade registers at 33% (ESCAP, 2020). Chittagong Port assumes a central role by serving as the primary entry point for global trade, propelling economic growth, fostering local employment, ensuring supply chain cohesion, and overseeing a substantial 92% of the nation's trade transactions.

Serving as a significant maritime center, the Chittagong port encounters various conflicts with other sectors in the maritime realm. The port area supports a variety of maritime activities in addition to shipping, such as fishing, surveys, exploration for oil and gas, military and naval exercise, coast guard and naval vessel movement, towing of ships, refuelling services for anchored ships, lighterage operations in outer anchorages of port, and the dismantling and transportation of outdated vessels to Sitakunda for scrapping. (Aktar et al., 2022).

Port is a place for land-sea interaction which connects different modes of transportations to foster the country's trade. Every year, over 4000 ships arrive at Chittagong port but the existing Ship's routing system doesn't meet the demand of maritime traffic using Ctg port as no specific/designated route has been established & charted for merchant ship/Navy ship and fishing vessels and inland vessels approaching to/departing from Ctg port.

Chittagong port is situated in the estuary of Karnafully river and this river has concatenated with a lot of canals, tributaries and small rivers from which it receives a large amount of waste such as solid waste, sewage, contaminated water etc (Hossain et al., 2005). There exist around a thousand industrial zones in different locations like Kalurghat, Nashirabad, Sagarika, and Anawara industrial areas. These sites also accommodate activities such as oil refineries, depots for oil companies, shipbreaking, etc., all positioned along the Karnafully River's shoreline. The untreated and unregulated municipal waste originating from various sources decreases the navigability of Chittagong port, leading to higher dredging expenses.

Development of Chittagong port can be done through many of the aspects viz. technological advancement, infrastructure improvement, optimization of supply chain and logistics, and strengthening connections to the hinterland etc. but this paper will highlight Chittagong port as a major blue economy sector and explore the relationship between the prominent tools, MSP in proficiently managing various maritime sectors. MSP is successful in conflict resolution and engaging several stakeholders throughout the planning process. In many developed and developing countries, MSP has been used for the development of the port & shipping sector, tourism, renewable energy, fisheries and other sectors.

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

A commonly circulated interpretation presented by the IOC-UNESCO, "Marine spatial planning is a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that usually have been specified through a political process"(Douvere and Ehler, 2009). MSP includes engaging stakeholders in the initial phases of decision-making (Gopnik et al. 2012). Nonetheless, MSP represents a comprehensive strategy that diminishes conflicts among various stakeholders (both human-human and human-coastal/ocean environment interactions), thereby exposing and addressing conflicts and synergies among different users to facilitate effective problem-solving (Douvere 2008). So, MSP is a long term public process that preserves ocean biodiversity and at the same time manages economic activities of the ocean.

Tools for coastal and sea management, like Integrated Coastal Zone Management (ICZM), Integrated Coastal and Ocean Management (ICOM) and Marine Protected Area (MPA) have been suggested and implemented in Bangladesh, yielding varied outcomes, often focusing solely on individual sectors or adopting a land-centered perspective limited to the waterfront. Recently, an increasing number of coastal and maritime nations have started implementing Maritime Spatial Planning (MSP) as a tool for governing coastal and oceanic areas, with the aim of effectively handling conflicts between different user groups and addressing conflicts arising between user activities and environmental considerations (Douvere, 2008). MSP is now being implemented in various levels by about 102 countries globally (EU MSP Platform, 2022).

MSP can be a great tool to solve sectoral conflict (such as with the fixed installation, fisheries, coastal and marine tourism, military exercise and so on) and preserve the port and ocean environment. Zoning is a toolkit of MSP which helps to allocate suitable areas for different ocean uses to reduce conflict between them. MSP does not remove existing management framework rather it can link with ICZM, ICOM and also take into account the LSI (Land-Sea Interactions). Although Bangladesh has pledged to create MSP for its maritime region, the country is still in the early phases of creating a framework for the sustainable use of natural marine resources and the planning and management of maritime activities (Hussain et al., 2018).

Considering the context provided earlier, this study aims at finding out the major problems of Chittagong Port in the context of MSP and exploring the role of MSP in addressing the barriers to the development of Chittagong Port.

2. Methodology

Utilizing a qualitative approach, researchers conducted interviews to answer the research question and obtain a deep understanding of the problem. In order to complete this research work, both secondary and primary information were used. A variety of sources, including Port

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

Yearbooks, journals, essays, dissertations, shipping statistics, and relevant published materials, were used to gather the secondary data for this study. Additionally, an analysis was conducted on official documents, laws, and amendments retrieved from the Chittagong port of Bangladesh's website. In addition, relevant information was reviewed on the websites of international agencies including the International Oceanographic Commission (IOC) and the International Maritime Organization (IMO).

To gather primary data, a total of twelve semi-structured interviews were carried out in eight different sectors, encompassing government officials, researchers, and businessmen. These interviews involved experts in maritime fields, aiming for focused data analysis while tailoring questions to individual expertise and maintaining core issues. Following the interview transcription process, coding of the transcripts was performed to facilitate data analysis, involving the identification of relevant text features pertaining to the study question or objectives (John et al., 2014). Every transcript of an interview was given several codes, which were subsequently combined into broad themes that matched the study question. All of the coded information was collected by Nvivo software under a specific theme, allowing for the compilation of various respondents' viewpoints within each theme, ultimately culminating in the synthesis of broader conceptual insights through the combination of all themes.

In conducting secondary information analysis, the approach of content analysis was utilized to facilitate the exploration and interpretation of underlying meanings within textual materials, articles, and visual elements.

3. Analysis of Interview and Discussions

3.1 Major problems of Chittagong Port in the context of MSP

I. No recommended shipping route/ Traffic Separation Scheme:

Any system comprising one or more routes or routeing procedures designed to lower the danger of casualties is referred to as a ships' routing system; it includes traffic separation schemes, two-way routes, recommended tracks, areas to be avoided, inshore traffic zones, roundabouts, precautionary areas and deep water routes.
Ship routeing systems contribute to improving maritime safety, providing safe and effective navigation, and protecting the marine environment, according to SOLAS (International Convention for the Safety of Life at Sea).

Following pre-established shipping routes was originally introduced in 1898 and thereafter adopted by shipping companies who operate passenger ships in the North Atlantic area, mostly due to safety concerns. These safety-oriented principles were later integrated into the initial SOLAS Convention.

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

Since traffic separation schemes and other ship routing systems have been implemented in the majority of the world's crowded shipping locations, the total amount of groundings and collisions has frequently decreased considerably in recent years. The objective of ships' routing system is to "improve the safety of navigation in converging areas and in areas where the density of traffic is great or where freedom of movement of shipping is inhibited by restricted sea room, the existence of obstructions to navigation, limited depths of unfavourable meteorological conditions" (IMO, 2002).

It is recognized that the International Maritime Organization (IMO) is the only worldwide organization tasked with creating guidelines, criteria, and regulations of a worldwide nature concerning ships' routeing systems. Contrating Governments that are parties to the agreement must submit applications for the implementation of ships' routeing systems to IMO. The IMO will collect and disseminate pertinent data regarding any ship routing systems that have been approved to the Contrating Governments.

The IMO's Sub-Committee on Navigation, Communications and Search and Rescue (NCSR), will review any proposed routeing measures and recommend implementation of the measures to governments wishing to create new routing systems or modify current ones. After that, the MSC receives the recommendation for adoption.

Chittagong port is the busiest seaport of Bangladesh. Traffic movements around the port have been increased significantly within a few years **(see below figure)**.

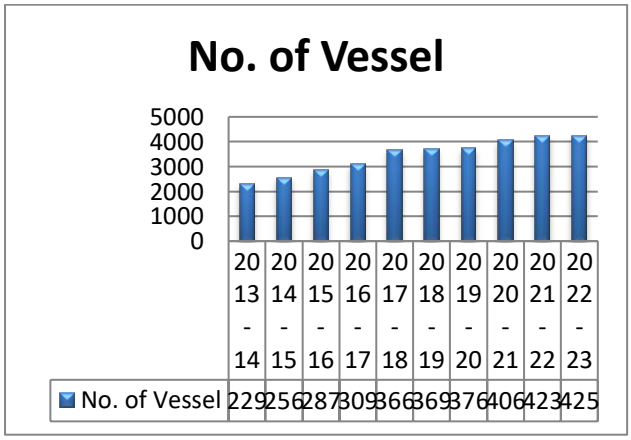

Figure 01 : Vessel handling statistics of Chittagong Port (CPA, 2023).

All the traffic from High seas of the East and of the west is converging towards Chittagong, including inland vessels, ferries from the landward side and riverports of the country. The traffic density increases in great volume while approaching the port as now most of the terminals are situated within Karnafully channel. The existing routing system for Chittagong

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

port covers from Pilot boarding ground (which is within the anchorage) to the terminal (see

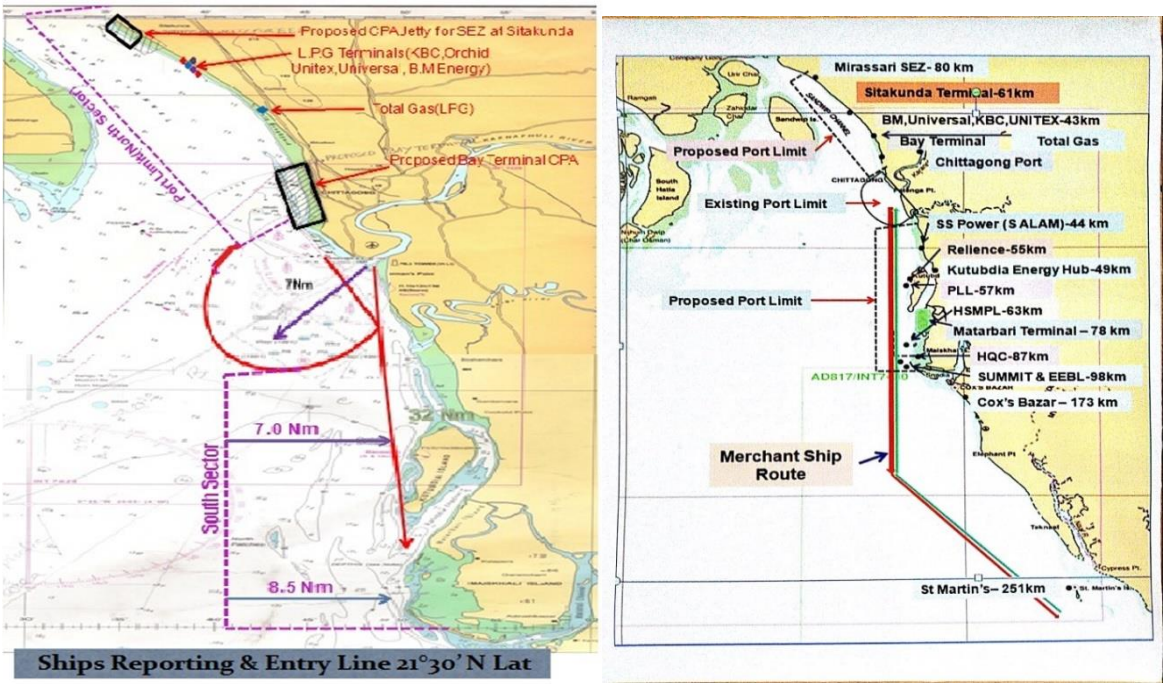

Figure 02: Existing and New Port Limit (CPA, 2019).

Figure 02). Recently the port has expanded in the operational area from Kutubdia (Eastern Side) nearly to Sandeep Channel (Western side). Within this extended port limit construction of Matarbari deep seaport, Bay terminal are in progress. Simultaneously, the Patenga Container Terminal has reached a state of readiness for active operations and is anticipated to commence functioning within the current year. The traffic density will be multiplied when all these become fully operational. Furthermore, numerous additional maritime operations exist apart from shipping. These encompass fishing, exploration of oil and gas, conducting surveys, engaging in military and naval exercises along with firing drills, maneuvering naval and coast guard vessels and convoys, facilitating the transfer and refueling of anchored ships, executing lighterage procedures in external anchorages, dismantling and relocating aging ships to Sitakunda for scrapping (Aktar et al., 2022). But the existing routing system doesn't cover the full area of the port limit. The increased number of traffic and above-mentioned activities pose a potential risk of collision, grounding and pollution which has made it obvious to amend the existing routing system.

Several collisions have occurred between merchant vessels and fisheries sectors upon their arrival at the Chittagong port. This is because there isn't a Traffic Separation Scheme (TSS) or defined shipping route that would effectively divide these two prominent sectors.

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

II. Conflict of Chittagong Port with other maritime sectors:

Fisheries sector: There are several conflicts involving the Chittagong Port, both directly and indirectly, with other sectors within the maritime domain. According to the respondents, Chittagong port mostly faces conflict with fisheries sector (Industrial and Artisanal fisheries). Three categories of ship visits are managed by Chittagong Port: merchant, coastal, and inland vessels. The arrival of foreign ships has been steadily rising, with 4253 foreign ships visiting the port in 2022-23. This surge in ship traffic poses a potential conflict between the port and fisheries sectors due to the absence of designated shipping routes. Navigational risks arise from fishing vessels and nets, notably in the St. Martin-Coxsbazar-Maheshkhali-Kutubdia route, as demonstrated by a previous accident resulting in the loss of a fishing vessel and a fisherman's life near Elephant Point. In 2019, a fishing boat carrying 24 individuals overturned close to St. Martin Island following a night-time collision with a cargo ship (Aktar et al., 2022). Fishing gear poses a major concern for merchant vessels at Chittagong Port, often causing propeller fouling and hampering manoeuvrability due to unmarked nets and equipment. This leads to speed reductions and potential drifting, especially problematic in the strong tidal stream. Ship captains resort to dropping anchors midway to prevent accidents, pollution, and grounding, resulting in financial losses, particularly for time-chartered vessels. Although efforts by the Bangladesh Coast Guard have somewhat improved the situation, challenges persist due to insufficient manpower and the presence of unregistered artisanal fishing boats in the estuary, impacting the port's reputation.

Offshore Oil and Gas Extraction: Currently, Bangladesh holds 26 offshore blocks in open waters and 22 onshore blocks. Among these, 11 offshore blocks are situated in shallow waters, while 15 are positioned in deeper waters. The Sangu gas field's production has been halted since October 1, 2013 and it is currently in a state of suspension, awaiting decommissioning (Petrobangla, 2020). ONGC Videsh and Oil India Ltd have been jointly awarded production-sharing contracts (PSCs) by the government for two shallow sea blocks (SS-04 and SS-09), where they are engaged in collaborative exploration activities. The majority of respondents concurred that Chittagong Port and the offshore gas field do not have a conflict of interest.

Naval exercise: The proximity of the Naval Base and jetty within Chittagong Port raises concerns, the increasing activity and number of vessels in the naval fleet, including submarines, have put pressure on the port's operations. During naval exercises, the density of coastal traffic rises, and the movement of submarines poses a significant challenge to commercial ship traffic, affecting both the port's activity and its financial viability. The coexistence of a naval base and commercial port in Chittagong has led to a minimum of 7 collisions between cargo ships and naval bases in the last decade, raising concerns about potential damage to valuable Navy assets like submarines and highlighting the unsuitability of berthing submarines in a commercial port.

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

Maritime Tourism: Bangladesh has two cruise vessels, M.V. Bay One and M.V. Karnaphuli Express, serving the Chittagong- Cox's Bazar- St. Martin route without using Chittagong port. Tourist attractions within the port area, such as Patenga and Parki beaches, are underdeveloped. Water activities are proposed to attract more visitors. The nascent tourism industry within and outside the port presents no conflict currently.

Nature and Biodiversity Conservation: Chittagong port, located near the Karnafully River estuary, encompasses both riverine and coastal areas, featuring significant biodiversity including fishing lands like 'South Patches' and the 'Marine Protected Area' of St. Martin Island. However, merchant vessel movements through these areas pose a threat to biodiversity and lead to marine pollution, while the Chittagong Port Authority faces challenges in enforcing environmental regulations due to limitations in patrolling and logistics.

Maritime Transportation (Sampan, small barge): The CPA respondent highlighted that uncertified small inland vessel (20-30 meters in length) lacking tidal knowledge and Karnafully endorsement, frequently enter the channel and resulting in collisions with merchant ships leaving or entering the port as they attempt to avoid these unexpected vessels.

Smaller unregulated local boats carrying 15-20 people frequently cause hindrance for foreign vessel pilots navigating the port as they approach foreign vessels alongside outgoing traffic, necessitating careful maneuvers to prevent collisions and leading to mental stress for the pilots.

3.1.3 Terrestrial Waste disposal into the port water:

Chittagong port, country's key port and crucial economic center of the country is situated in the estuary of Karnafully river. This river is blessed with a variety of biodiversity and has been used for many purposes such as port and shipping operations, fishing operations, docks, the industrial use of river water etc. (Siddique and Aktar, 2012). This river is connected to numerous canals, tributaries, and small rivers, from which it receives a substantial amount of waste, including sewage, contaminated water, and solid trash (Hossain et al., 2005).

There are thousands of industrial areas in numerous industrial sites such as Kalurghat, Nashirabad, Sagarika and Anawara industrial zone as well as oil refinery, oil companies depot, shipbreaking activities, etc located on the bank of river Karnafully. The city of Chattogram, home to about 6.0 million residents, lacks an adequate sewage treatment plant, causing 2500 tonnes of municipal waste to be dumped directly in open landfills which eventually carried through 37 canals into the river. Municipal waste is normally construction debris, street sweeping, commercial, industrial, residential, and sanitary leftovers (sewage), among others.

Respondent from Port Authority mentioned that the major difficulties of Karnafully river are that a large amount of municipal waste is directly discharged into the river through 37

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

kcals/channels which includes polythene, net, tyre and tubes, animal skin, leather and other waste. Chittagong port faces significant challenges in preserving river navigability attributed to municipal waste (thick layred polythene) and sediment buildup, necessitating consistent maintenance dredging throughout the year incurring substantial expenses.

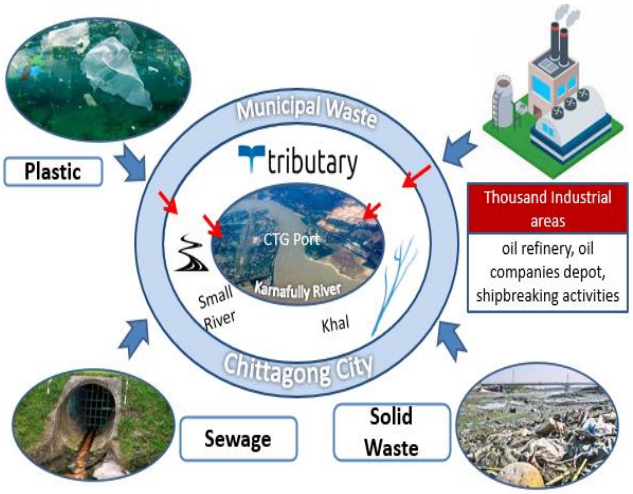

Figure 03: Discharge of terrestrial waste into Karnafully river.

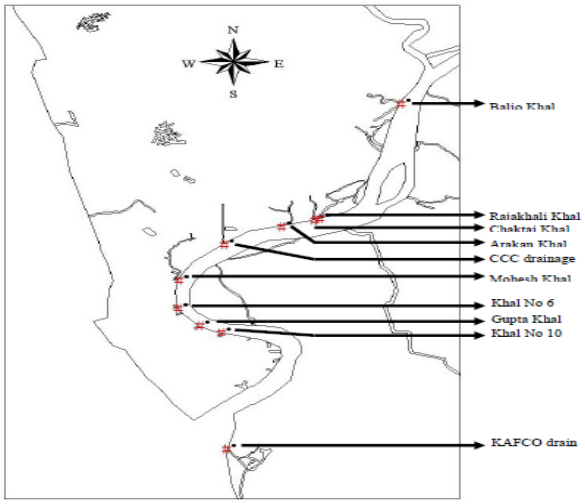

Figure 04: Major Khals on the Karnafully River (Hossain et al., 2005)**.**

High official from Port authority emphasized that mainly they use Grab dredger in the river channel because here mostly found polythene, plastic, net, tyer, timber which is not easily picked up through cutter suction dredger because this type of polythene waste tangled when they become soft and muddy. Due to increased municipal waste dumping, they have to run cutter suction dredgers at least 20days/month on the jetty side to increase the draught of the river which increases the annual dredging cost of the port. The quantity of waste grew to 5.1

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

million cubic meters from a total of 4 million cubic meters in 2018, the year they commenced their activities. Port Capital dredging commenced first in 2011 but the project progress was frequently disrupted due to the existence of layers of polyethylene and discarded tires ranging from 2-10 meters. As a result of these factors, the project expenses have also witnessed an escalation in few phases from 258 crore to 302 crore taka until 2023.

The project entails two main costs for CPA: covering dredging expenses (maintenance, capital) and managing dredged material disposal. Due to space constraints caused by various riverbank activities (shipyard, Ghat, Dry Dock, Institution etc.), the disposal of less valuable dredged materials, like garbage, requires transportation (truck) to the Chittagong City Corporation Yard, incurring extra costs.

3.2 Role of MSP for the development of Chittagong port

3.2.1 MSP for conflict resolution

MSP has been widely used to integrate diverse management strategies in an effort to avoid or lessen conflicts between different user groups (Saha and Alam, 2018). Facilitating consistent stakeholder involvement, despite its difficulties, is essential for the successful implementation of MSP. The integration of stakeholders from the beginning of this procedure can be accomplished through holding frequent gatherings, conversations, and symposiums (Gopnik et al., 2012).

Chittagong port has no recommended shipping route or TSS outside the pilot boarding ground/anchorage. This leads to an incomplete coverage of the port's entire boundary, causing recurrent conflictual issues with fisheries sector. BMA respondent mentioned that the designated shipping route needs to be set up for smooth port operations. The Chittagong port traffic routing systems may incorporate the following elements: traffic lane, separation zone or line, roundabout, inshore traffic zone, suggested route, deep-water route, area to be avoided, precautionary area, etc.

Survey participants hold the view that resolving this dispute can be achieved by segregating fishing and shipping areas by categorizing areas for specific purposes, such as designating zones exclusively for industrial fishing where artisanal fishing is restricted, establishing another zone for artisanal fishing, and creating a separate zone for shipping where fishing activities are forbidden (Aktar et al., 2022). One of MSP's tool kits, zoning helps to reconcile various users by separating appropriate and inappropriate uses of the ocean and keeping them parallel for sustainable ocean uses (Fletcher et al. 2013).

In Bangladesh, it is possible for the government to segment maritime zones into key sectors (such as shipping lanes, ship anchorage, and sand extraction), reserved regions (demanding

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

specific permits), and restricted areas (including MPAs, ECAs, and ecologically significant fishing parks like Hilsa areas) (Saha and Alam, 2018). The scholarly article also puts forward the idea that conflict resolution among various stakeholders can be addressed through tactics such as negotiations, integration, regular meetings, and shifts in mindset (Mannan et al., 2020). Respondents suggested addressing conflicts caused by maritime transportation, specifically with small inland barges and port activity, through training and skill development of the personnel.

3.2.1 Reduce land-based pollution into the port:

Drawing from the perspectives of both survey participants and scholarly sources, it is evident that terrestrial waste is polluting the Karnafully River. A respondent highlighted that roughly 25,000 tons of municipal waste are discharged directly into the Karnafully River through 37 channels, substantially impacting Chittagong port and elevating dredging expenses.

General Framework for LSI developed by EC DG MARE describes "LSI as a complex phenomenon that involves both natural processes across the land-sea interface, as well as the impact of socio-economic human activities that take place in the coastal zone"(European Commission, 2018).

Though MSP is a seaward process instead of the land centric view, it doesn't directly address terrestrial issues. But MSP should consider terrestrial issues through another management process. European Union took Land-Sea Interactions (LSI) into the MSP process for the successful delivery of MSP and suggests the integration of LSI into MSP through ICZM or other formal or informal policy (EU Directive, 2014). Bangladesh is still at the initial level of MSP but it can take LSI into the MSP for getting a successful outcome. Recently Most of the MSP implementing countries such as Spain, France, Malta, Italy, Slovenia, Greece integrated LSI after getting experiences from the past and found a positive outcome for ocean management (EU MSP Platform, 2018).

By engaging with Water Supply and Sewerage Authority (WASA), the port can work towards improving wastewater treatment and reducing the release of pollutants into the surrounding waters the because WASA plays a significant role in managing water resources and sewage systems in Chittagong. Additionally, involving the Chittagong City Corporation is crucial, as it oversees various aspects of urban planning and waste management in the city. Collaborative efforts with the city corporation can lead to better waste disposal practices, minimizing the influx of solid waste and contaminants into the port's waters.

The potential outcome from LSI may include sustainability port environment as well as the ocean, economic benefits through the reduction of dredging cost as LSI reduces the terrestrial impact on the coast and ocean.

Power System Technology
ISSN:1000-3673
Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

4. Conclusions

Chittagong Port in Bangladesh, a vital pillar of the nation's economy, faces numerous challenges stemming from conflicts with various maritime sectors within its jurisdiction and terrestrial pollution in the form of municipal waste. These challenges have significant implications for the efficiency, safety, and sustainability of port operations. The absence of designated shipping routes or Traffic Separation Schemes (TSS) poses a recurring conflict between the port and the fisheries sector, leading to navigational risks and collisions. Moreover, conflicts arise with other maritime sectors such as offshore gas and oil exploration, naval exercises, marine tourism, and nature conservation efforts. These conflicts not only hinder the port's smooth operations but also pose risks to the environment and safety of vessels.

Furthermore, the discharge of significant amounts of terrestrial waste directly into the Karnafully River, which flows through the port's vicinity, increases the need for frequent and costly dredging operations. This poses issues with the environment in addition to having an impact on the port's financial sustainability.

Utilizing MSP appears to be a timely and effective way to address these problems and encourage Chittagong Port's sustainable growth. By designating shipping routes, traffic separation zones, and fishing areas, MSP can assist diverse stakeholders in resolving disputes while lowering the possibility of collisions and improving safety. In order to lessen land-based pollution entering the port, it can also integrate land-sea interactions (LSI) by taking into account the effects of terrestrial activity on the coastal and oceanic environment.

Although Bangladesh has only started to adopt MSP, it is important to acknowledge the potential advantages of MSP in terms of protecting the environment of the port, lowering the cost of dredging, and safeguarding the sustainable use of marine and coastal resources. To effectively implement MSP and address the issues Chittagong Port is facing, it is crucial to involve stakeholders from a variety of sectors, including enterprises, researchers, and governmental organizations.

References:

1. Aktar S, Alimuzzaman A. T. M., Mannan S, Sakib N (2022) “Initiating Marine Spatial Planning (MSP) Process: Resolving conflicts between Chittagong Port and other maritime sectors of Bangladesh, Bangladesh Maritime Journal, Volume 6 Issue 1, January 2022.
2. CPA (2023) Accessed september 05, 2021. http://www.cpa.gov.bd/.
3. Douvere F (2008) The importance of Marine Spatial Planning in advancing ecosystem-based sea use management.” *Marine Policy* 32(5):762–71. doi: 10.1016/j.marpol.2008.03.021.
4. Douvere F, Charles N. E (2009) New perspectives on sea use management: Initial findings from European experience with Marine Spatial Planning.” *Journal of Environmental Management* 90(1):77–88. doi: 10.1016/j.jenvman.2008.07.004.

Power System Technology
ISSN:1000-3673

Received: 16-01-2024 Revised: 12-02-2024 Accepted: 07-03-2024

5. (EU Directive, 2014) https://www.eea.europa.eu/policy-documents/directive-2014-89-eu-maritime.
6. ESCAP (2020) Sustainable Port Development and Improving Port Productivity in ESCAP Member Countries | United Nations ESCAP. https://www.unescap.org/resources/sustainable-port-development-and-improving-port-productivity-escap-member-countries.
7. EU MSP Platform (2022). http://msp.ioc-unesco.org/world-applications/status_of_msp/.
8. Fletcher S, Emma M, Kenneth C. B, Ness S, Karen M (2013) Effective practice in Marine Spatial Planning: a participatory evaluation of experience in Southern England." *Marine Policy* 39:341–48. doi: 10.1016/j.marpol.2012.09.003.
9. Gopnik M, Clare F, Laura C, Kate M, Linwood P, Larry C (2012) Coming to the Table: Early Stakeholder Engagement in Marine Spatial Planning." *Marine Policy* 36(5):1139–49. doi: 10.1016/j.marpol.2012.02.012.
10. Hossain M. S, Islam M, Chowdhury M (2005) Shore Based Pollution Sources of the Karnafully River and the Effects of Oil-Grease on the Riverine Environment. *The Journal of Geo-Environment* 5 (December 30, 2005).
11. Hussain, M. G, Failler P, Karim A. A, Alam M. K (2018) Major opportunities of blue economy development in Bangladesh. *Journal of the Indian Ocean Region* 14(1):88–99. doi: 10.1080/19480881.2017.1368250.
12. IMO (2002) International Convention for the Safety of Life at Sea (SOLAS), Chapter V Safety of Navigation, Regulation 19, Tech. rep.
13. John, Freya A. V. St, Aidan M. Keane, Julia P. G. Jones, and E. J. Milner-Gulland. 2014. "FORUM: Robust Study Design Is as Important on the Social as It Is on the Ecological Side of Applied Ecological Research." *Journal of Applied Ecology* 51(6):1479–85. doi: https://doi.org/10.1111/1365-2664.12352.
14. Mannan S, Nilsson H, Johansson T, Schofield C (2020) Enabling stakeholder participation in Marine Spatial Planning: the Bangladesh experience." *Journal of the Indian Ocean Region* 0(0):1–24. doi: 10.1080/19480881.2020.1825200.
15. (Petrobangla, 2020) http://www.petrobangla.org.bd/
16. Saha K, Alam A (2018) Planning for blue economy: prospects of Maritime Spatial Planning in Bangladesh. *AIUB Journal of Science and Engineering (AJSE)*, *17*(2), 59 - 66. Retrieved from http://45.64.132.67/index.php/ajse/article/view/10
17. Siddique, M. a. M., Aktar M (2012) Heavy Metals in Salt Marsh Sediments of Porteresia Bed along the Karnafully River Coast, Chittagong. Soil and Water Research 7 (2012), no. No. 3 (July 10, 2012): 117–23. https://doi.org/10.17221/7/2012-SWR.