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Review Article

Marine Spatial Planning in Bangladesh: A Review

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ABSTRACT

Bangladesh acquired a large maritime area(1,18,813 km2) which is almost the same as its land area; therefore, this vast marine area provoked Bangladesh to use its maritime resources in a sustainable way called this term "Blue Economy". For implementing "Blue Economy" in the marine area a proper ocean management tool is required; unfortunately, Bangladesh is in the early stage of managing its maritime resources. However, Marine Spatial Planning(MSP) is a very popular multidimensional tool for ocean management. Its integrated approach helps to resolve issues between the ocean users and it can secure ecological, economic and social advantages. There are four prerequisites for implementing MSP; among them, Bangladesh satisfies one; therefore other prerequisites should be satisfied as early as possible. The present legal framework is not enough for implementing MSP in Bangladesh though some legal framework is useful therefore, strong legislative protection and framework and integrated policy along with establishing a special authority for MSP are urgent. Stakeholder engagement in policymaking and arranging ocean literacy and regular meeting for them is badly needed to implement MSP in Bangladesh. Short term and long term monitoring can be implemented for monitoring ecosystem components in Bangladesh's maritime area. Marine Spatial Planning and Blue Economy related previous papers(2011-2020) has been reviewed in this study to give perfect guidelines for policy-makers, researchers and concerned individuals to know about the prospects, challenges and mitigation measures of MSP implementation in Bangladesh. This paper will be an important information hub about MSP in Bangladesh.

Keywords: Marine Spatial Planning; Ocean Management; Competent Authority Stakeholders; legislative framework; Ecosystem Monitoring Blue Economy; Bangladesh

INTRODUCTION

Bangladesh is a coastal country with a huge population (approx. 18 crores) density according to its land area and it consists of a 710 km coastline where 35 million people are lived in the coastal area, and 1 million people are dependent on the fisheries sector for their livelihood. However, due to the scarcity of proper knowledge about the sustainable use of ocean resources, the marine ecosystem is in danger. In recent years, the use of the ocean has increased, putting enormous anthropogenic pressure on the ecology [1] that is alarming. The maritime settlements have given Bangladesh entitlement on 118,813 km2 in the Bay of Bengal comprising her territorial sea where the shallow shelf sea and continental shelf account for roughly 20% and 35% of the total, with the remaining (45%) situated in deeper waters [2] but Bangladesh, as a coastal country, is still in the early stages of managing its maritime resources[3] though these vast maritime area influences for thinking about "Blue Economy" which is better stewardship of blue resources. Withal, the depletion of living resources [4], marine pollution [5], and dangers to the marine ecology [3] will all be difficulties for Bangladesh as a result of the implementation of these blue economy activities. The blue economy itself has many challenges [6] and Bangladesh's current ocean resource management trends are insufficient to meet these concerns [7]. So, it is mandatory to have a better ocean management tool for Bangladesh that can be used for better utilization and benefit from the maritime area without harming the marine environment. Ecosystem-Based

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Management (EBM) is a critical tool for managing development activities in coastal and marine areas [8]; which emphasizes the importance of maintaining or improving marine ecological structure and function, as well as the societal advantages that healthy seas deliver [9]. There are many ways to conduct ecosystem-based management (EBM); some of them are Integrated Coastal Zone Management (ICZM), Marine Spatial Planning (MSP), Marine Protected Areas (MPA), and activities supporting carbon sequestration approach [10].Among them MSP has evolved into a critical appliance for identifying and utilizing marine areas, as well as developing plans for long-term ocean governance [4].

UNESCO-IOC defines that "Marine spatial planning (MSP) 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 are usually specified through a political process"[11]. According to [12], MSP is a tool to improve decision-making and give an ecosystem-based approach to regulating human activities in the marine environment. MSP implementation will help to strengthen planning and management systems for safeguarding the health and services of marine ecosystems, with a focus on striking a balance between economic development and environmental conservation [13]. Besides, MSP is a useful appliance for multidimensional use management since it brings together different sectors to define goals and implement plans [14] and it has evolved into a management tool for resolving issues between ocean users [15] and it can impact the location, timing, and method of human interventions[16]. Moreover, MSP may connect sectors to sectors, people to places, and development to biodiversity, according to evaluations of existing MSP examples around the world [17].MSP is a critical tool for establishing a holistic, long-term, and sustainable framework for social, territorial, and economic development[18] and it is a dynamic process that may adapt to changing environmental and policy conditions in the maritime environment[19]. MSP is based on Integrated management, which recognizes the complete range of interactions within an ecosystem, including human uses, rather than focusing on particular concerns, species, or ecosystem services [20]. Furthermore, MSP's finest characteristic is its integrated approach, which allows planners to take into account varied ocean users as well as environmental implications on ocean regions [21], and it has been implemented in 20 nations so far, and by 2030, at least one-third of the world's EEZ will have government-approved MSP [22].

Ocean governance willingness is at the apex by the government of Bangladesh that is proved by the statement of Prime Minister Sheikh Hasina that is "Bluewater is a heritage for our people; we are committed to conserving and protecting our Bay, as a time-honoured responsibility" [3]. For managing the maritime area, MSP is a crucial tool [23] and for Bangladesh, it is also true[1]. Bangladesh may adopt MSP as a tool to manage its resources and achieve long-term blue growth [24]. The creation, correct design, and implementation of Marine Spatial Planning (MSP) are critical for Bangladesh to manage and utilise blue economy resources through a place-based integrated plan among diverse entities of a coastal state for long-term usage and development [5]. MSP was originally intended to be used by the Bangladesh government to create Marine Protected Areas (MPAs), but it is currently being considered as a tool to administer MPAs and Emission Control Areas(ECAs)[25]. The time has come to develop an efficient MSP policy and strategy at the national level, with the help of an authorized body under the PM's office for sector-by-sector development of the Bay of Bengal's blue economy [24]. Bangladesh's 7th five-year plan [25] expressed a desire to implement MSP in its maritime domain, which includes the exclusive economic zone, territorial water, and continental shelf [26] and in the 8th five-year plan Bangladesh also emphasizes Blue Economy development [2]. The present legal framework for marine environmental conservation in Bangladesh has many flaws and does not embrace the ecosystem approach or MSP [27]. Defining stakeholders and their conflicts, their engagement in the process, and identifying an authority for their early engagement in the process are just a few of the problems that come with starting the MSP process [24]. [28] Stated that for a developing nation like Bangladesh, MSP is a new idea, thus only a few individuals are aware of it. Some research has been done previously about MSP implementation in Bangladesh but the information is scattered therefore this review paper gathered all information in a place. However, this research will be an important information hub for policy-makers, researchers and concerned individuals to know about the prospects, challenges and mitigation measures of Marine Spatial Planning (MSP) implementation in Bangladesh. The main objective of this paper is to give a lucid idea of overall MSP as well as its function in Bangladesh to date.

MATERIALS AND METHODS

Previous papers on Marine Spatial Planning and Blue Economy during 2011-2020 has been reviewed to carry out this study. These papers are collected from Google Scholar, ResearchGate, Science Direct and Keyword-based web search. These all papers are qualitative research work based on the primary and secondary data and this research only used the secondary data from the literature review.

CHARACTERISTICS AND BENEFITS OF MSP

MSP is a science-based, future-oriented technique that demands a thorough understanding of physical, biogeochemical, and ecological patterns and processes in the ocean, as well as human interactions and it has recently gained traction as a novel method to long-term marine resource management that integrates economic, environmental, and social concerns into a single management platform [18]. To conserve natural ecosystems and breeding grounds, MSP puts limits based not just on space but also on time [4]. The development of MSP might help fulfil the goals of safeguarding the maritime environment, regulating and mitigating environmental pollution, and conserving biodiversity [27]. Terrestrial Spatial Planning (TSP) is MSP's land based cousin [29].The characteristics of MSP is given in (Fig. 01).

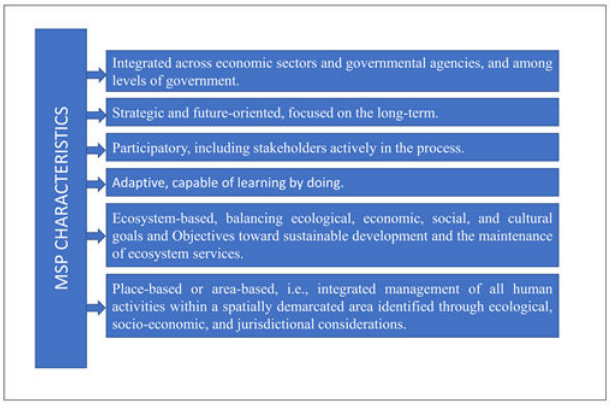

Figure 01: MSP Characteristics (Information source [30].

The purpose of MSP is to secure ecological, economic and social advantages through Ecosystem-based management [31]. According to a review of current MSP examples, distinct gains in the economic, ecological, and administrative sectors have been recognized a few years following MSP implementation [32]. (Fig. 02) shows the MSP benefits which depict that MSP is the best approach for ocean resource management.

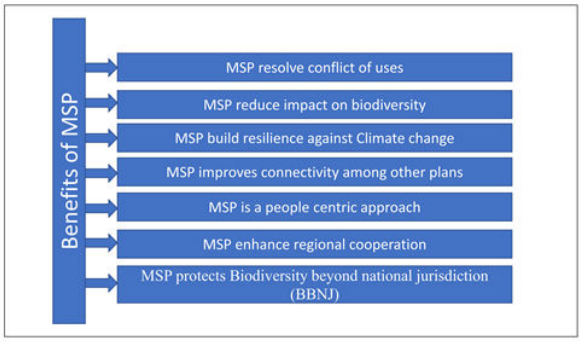

Figure 02: MSP Benefits (Information source [18] and [33].

APPROACH TO MSP

Pre-planning, planning and implementation are the three planning phases in most MSPs [18]. Several attempts have been made to define methodological standards for MSP [18], and the most prominent guideline, 'Marine Spatial Planning: A Step-by-Step Approach to Ecosystem-based Management' was released by the Intergovernmental Oceanographic Commission of UNESCO [34]. IOC (UNESCO) provides a methodological framework for the MSP process, which includes ten steps that can be applied to any geographic environment [18]. Besides, there are many other EU pilot projects, such as Balt Sea Plan, Plan Coast, and Shape, which also give a methodology for building MSP in various scenarios [35]. The ten steps (Fig. 03) is a perfect prescription for implementing MSP. According to [5], It is necessary to have current knowledge on diverse maritime phenomena, marine resources, their utilization and users, managers and agencies, their interactions and responses to varied consumption patterns, seasonality and rough forecasts of future usage of these resources, potential users, and projected changes in management practices, besides It may also require some historical data, such as which resources were extinct and under what conditions, and so on aside from a group of professionals who can create and execute the MSP framework and analytics to adopt MSP.

Figure 03: Ten Steps to Adopt Marine Spatial Planning (Information source [5].

Different governmental organizations, NGOs, universities, and research institutions may collect the essential data and information, which is also shared across scientific publications. Much of this information may already be available; however, some may need to be created, and others may never be economically or technically possible to examine [5].

POTENTIALS OF MSP IN BANGLADESH

Bangladesh is one of the world's fastest developing countries and over the last ten years, the country's GDP has increased by more than 7%[36]. The coastal zone of Bangladesh covers 710 kilometres of shoreline and 47,201(km2) of land, accounting for 32% of the country's total landmass. Bangladesh's coastal estuaries and marine areas are home to a diverse range of flora and fauna and the coastline contains unique biological features such as the world's longest sea beach and the world's largest single block mangrove forest, Sundarban[18]. According to [26] Bangladesh's shoreline is part of the vast Bay of Bengal marine ecosystem, which is rich in species; additionally, artisanal and commercial fishing, shipping, oil and gas exploration, submarine cable, shipbreaking, and tourism are all the scope of blue economic development. As Bangladesh is a coastal developing country, its maritime area is engaged with fishing, shipping, oil and gas exploration, shipbuilding, ship recycling, salt production, and many more [28].

Bangladesh has been motivated to explore its ocean resources as a result of two legal settlements delimiting the country's maritime boundaries in the Bay of Bengal [27]. Bangladesh aims to utilize most of its ocean area to sustain its rapid economic expansion [33]. Bangladesh, being a maritime country, is attempting to plan the use of its coastal and marine areas to accomplish blue economy goals that will assist the United Nations (UN) to achieve its sustainable development goals [37]. Bangladesh's future seascape will be shaped by a resourceful

maritime space, a desire to boost the blue economy, and worldwide commitment to achieve SDG14 and Overexploitation, pollution, invasive species, and other environmental consequences of maritime activity must be addressed[18].

For a successful blue economy development in Bangladesh, MSP is a good option as a management tool of blue resources in the Bangladesh EEZ (Fig. 04). In addition to the traditional sectors, new sectors are emerging in the ocean areas, each with its own set of goals and objectives where MSP may be able to assist various industries in achieving their goals in a long-term manner [33]. Bangladesh is attempting to implement MSP in its maritime territory after all prior efforts failure, including ICZM and ICOM [24]. While the MSP has yet to be completed, the Bangladeshi government recently released a background document titled "Strategy for Ocean and River Resource Management" for the seventh five-year plan (2016-2020) to promote inclusive development and progress in the maritime areas [38]. Bangladesh should manage it all maritime resources under a well-structured MSP, if Bangladesh fails to do that, it cannot achieve SDG, proper utilization of blue resource, and the coastal and marine environmental protection [3]. Fig.05 shows the busy seascape of Bangladesh.

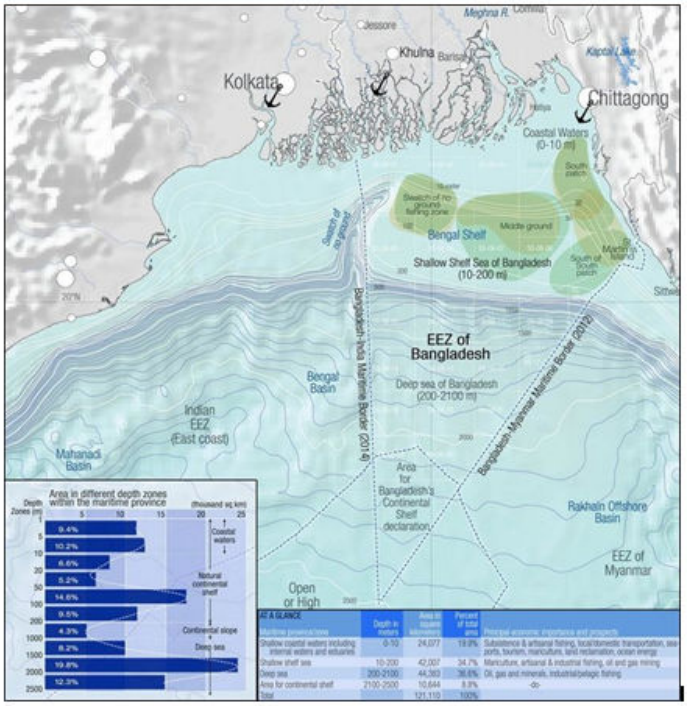

Figure 04: EEZ of Bangladesh [39].

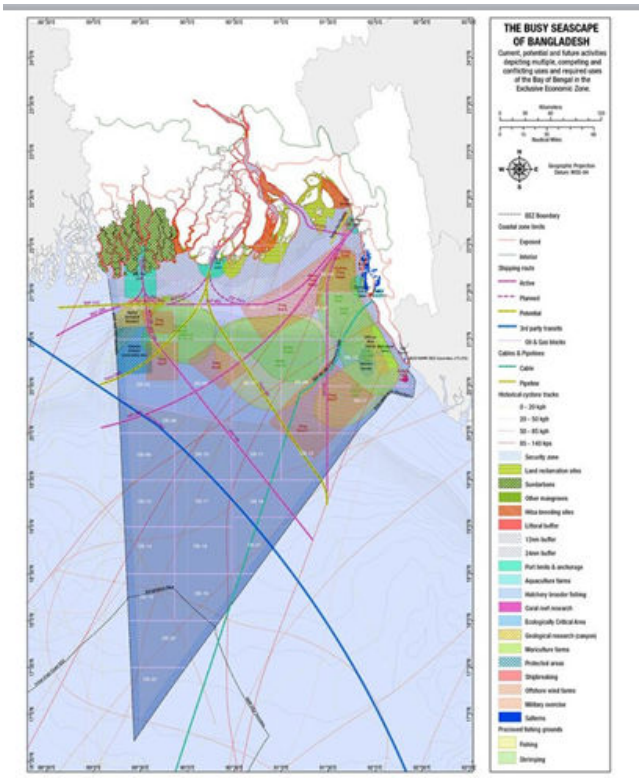

Figure 05: The Busy Seascape of Bangladesh [24].

MSP IMPLEMENTATION PREREQUISITES AND BANGLADESH

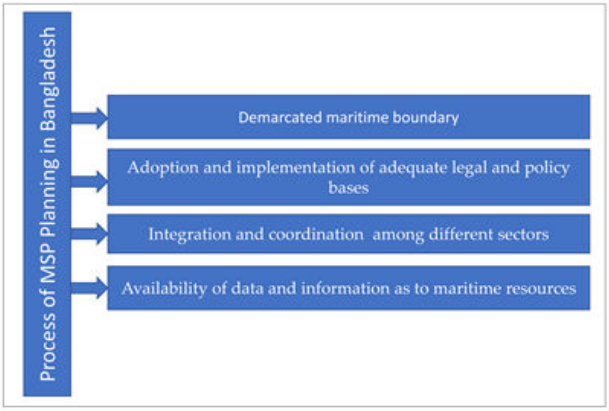

Figure 06: Marine Spatial Planning (MSP) Prerequisites (Information Source [5])

For the first prerequisite, Bangladesh already satisfied the condition by the two recent maritime settlements from Myanmar (2012) and India (2014). In Bangladesh, there are some plans and laws, although they are dispersed and vary by sector or department; and there is no comprehensive strategy or regulation for MSP in the Bay of Bengal [5]. Bangladesh urgently needs an integrated policy and legal framework [3]. Therefore, the second prerequisites are yet to satisfy. Bangladesh has yet to identify the departments responsible for bringing MSP under one umbrella as the concepts of blue economy and marine spatial planning are relatively new; so the third prerequisite is yet to satisfy [5]. Final prerequisites is a must to satisfy as

Bangladesh has scant knowledge about the Bay of Bengal's resources [5]. These four prerequisites must have to satisfy by Bangladesh as early as possible for a perfect MSP and to take the fruits from the blue economy.

LEGAL REGIME FOR MSP IN BANGLADESH

The Territorial Waters and Maritime Zones Act 1974; the Territorial Waters and Maritime Zones Rules 1977; the Environment Conservation Act 1995; the Environment Conservation Rules 1997; and the Biodiversity Act 2017 are all significant legislation concerning the conservation of the maritime environment in Bangladesh. In Bangladesh, the existing legislative framework for marine conservation does not mandate MSP and the existing legislative framework lacks appropriate and coordinated institutional provisions for MSP development; however, numerous rules in present legal systems are crucial to the development of MSP [27].

The Maritime Zones Act requires authorization to explore any ocean resources inside Bangladesh's economic zone and continental shelf where the Maritime Zones Rules specify the specific requirements that must be met for the authorization to be granted; and If the competent authority is convinced that the allowed operations will not pose a harm to marine life resources, authorization is given [27]. This Act mandates the implementation of conservation measures in the zones to safeguard the sea's living resources from indiscriminate exploitation, depletion, or annihilation where Reservation Zones (areas) in the Economic Zone are defined under the Maritime Zones Rules [27]. Zoning is a toolbox for putting the ecosystem concept into practice to achieve a healthy marine environment by separating possibly competing ocean uses [34]; in other words, zoning is a technique for implementing MSP in specified maritime areas [40]. The principal goal of the Environment Act and the Environment Rules is to reduce and regulate pollution in the environment but there are no specific rules for marine conservation in these Act; nevertheless, the laws for environmental conservation can be expanded to include the conservation of the marine environment and the development of MSP [27]. The MSP process' regulatory structures successfully manage polluting activities and risks to marine biodiversity [22]. In Portugal, Poland, and Australia, the Department of Environment and Energy is in charge of MSP implementation [41]; so in Bangladesh, the Department of Environment can be the driving force behind the growth of MSP [27]. There are no provisions in the Biodiversity Act that are specifically related to marine biodiversity conservation; however, it contains several regulations that are pertinent to the protection of marine biodiversity and the development of MSP in Bangladesh [27]. Although the existing institutional structure does not focus on marine biodiversity, these arrangements can be changed to be accountable for marine biodiversity protection. Moreover, the existing legislative framework for marine environmental protection in Bangladesh has several flaws and does not integrate the ecosystem approach or MSP. Bangladesh should modify its current legal framework to include suitable measures for marine protection. The development of MSP in Bangladesh should be delegated to a lead agency [27].

DIFFERENT ENTITIES OF MSP PROCESS IN BANGLADESH

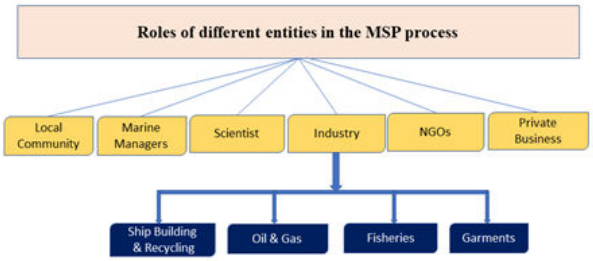

Figure 07: Different Entities in MSP Process (Information Source [42]).

(Fig. 07) shows the most important entities in the MSP process and for a perfect MSP implementation in the Bay of Bengal.

STAKEHOLDER ENGAGEMENT IN MSP IN BANGLADESH

Individuals, people, or organizations who are interested in, participating with, or influenced (positively or adversely) by a specific initiative or activity related to resource usage in some manner are the stakeholders [12]. The MSP process cannot begin without the involvement of stakeholders [31] (Fig. 06). Stakeholder engagement can help to improve the outcomes of maritime spatial planning by allowing for more genuine, well-informed decisions and boosting the effectiveness of management measures [12, 43-47]. MSP has not been designed and executed in Bangladesh in collaboration with diverse stakeholders [48]. The government must identify all stakeholders and conduct a workshop or seminar for them so that they may engage [37] and the government should make an effort to engage these non-public stakeholders in policymaking [26]. Bangladesh needs to understand the potential industries in the blue economy to find stakeholders [28]. According to the MPEMR press release, In 2017, Bangladesh's Ministry of Foreign Affairs recognized 26 blue economy-related industries [33]. Nobody has taken any steps to identify the stakeholders in specific industries after that endeavour. As a result, identifying the parties, their interests, and conflicts in the marine area is a time-sensitive requirement [1]. There is no active body in place to bring all of these parties together [33]. According to [18] it is necessary to engage with stakeholders before making decisions and to update stakeholders when each phase is completed and a legally enforceable, statutory MSP project based on scientific understanding and collaboration with stakeholders can open up a new horizon for Bangladesh's marine landscape. To begin the MSP process in any region, UNESCO advised that stakeholders and conflicts be identified, as well as a responsible authority to manage the MSP [22]. (Fig. 08) shows the stakeholder identification process.

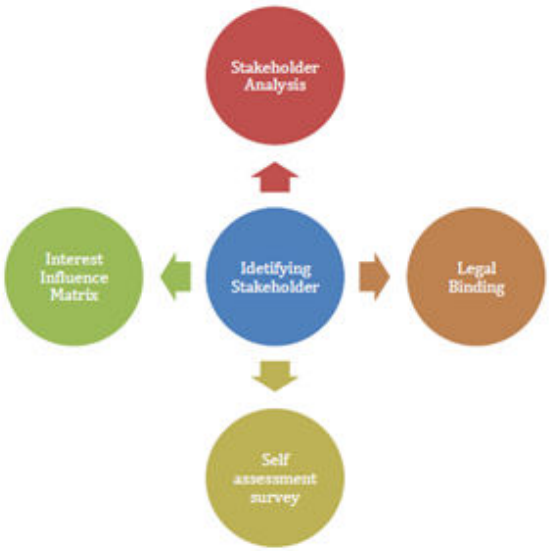

Figure 08: Stakeholder Identification Process [42].

Nobody knows who will do the stakeholder analysis or who the main stakeholders in a particular industry are and miscommunication among stakeholders, disjointed governance, biased decisions, a lack of trust, and misunderstandings about other stakeholders are some of the problems that stakeholders face when participating in the MSP process [24]. Stakeholder analysis is a crucial step to perform early in the MSP process to involve stakeholders [12]. The stakeholder analysis will provide the government with a comprehensive picture of the various stakeholders in the MSP process. Therefore, three groups of stakeholders have been formulated [33] for better understanding (Fig. 09).

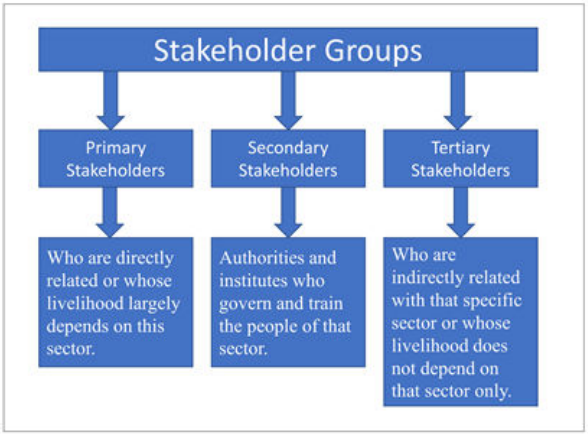

Figure 09: Stakeholders Group of Each Sector [33].

Based on the interview (Fig. 10) data existing stakeholders in different sectors(Table 02) has been identified and by using that information stakeholder analysis(Table 03) and existing stakeholder statistics(Fig. 11) has been reported by [33].

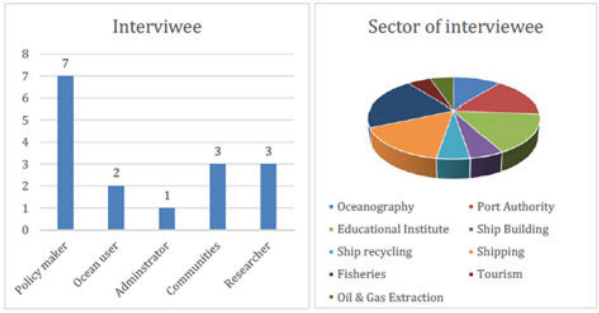

Figure 10: Details of Interviewee [33].

Identifying Stakeholder

Table 01: According to Blue Economy Cell(BEC) Stakeholders identification[42].

Inshore Stakeholder	Offshore Stakeholder
Chittagong Port Authority, Mongla Port Authority, Payra Port Authority.	Owners of International Ship
Owners of the ship breaking yard of Bangladesh.	Owners of Inland Ship
Owners of Shipbuilding, ship repair yards and dry docks of Bangladesh	Owners of fishing vessel
The local authority of 19 District and 48 Upzilla (Sub-district)	Artisanal fisheries community
Forest Department for managing mangrove forest	Sand Extraction(small scale)
Aquaculture firms owners	Dredging and sand extraction(Large Scale)
Buyers of fish at fish landing station	Mercantile marine office
Coastal communities about 34.8 million people	Recreational boating, diving and activities
Hotels and business centers in costal tourism	Ships engaged in costal tourism
Marine related business	Oil and gas exploration company
Fish processing and fisheries related business	Supply vessel for Oil and Gas exploration
Salt Production farmers and businessman	Wind Firms company
Educational Institute	Environment Department
NGOs and Consultant groups	Military and defense activities
Fisheries department	Deep Sea port

LPG and LNG Terminal	Single mooring Buoy Terminal

Table 02: Existing Stakeholders in Different Sectors of Bangladesh[33].

Sector	Primary	Secondary	Tertiary
Fishing	Artisanal fisherman, Industrial fisherman, Recreational fisherman, Fishing vessel Owner, Fish traders, Cold Storage Owner.	MOF, DOF, Marine fisheries academy, IMSF, BORI	Fish consumers, Superstore Owners, C&F agents, Port authorities, Shipbuilders.
Merchant Shipping	Ship-Owner, Seafarer, Ship manning agents, Ship builders port authorities, Dry dock, Ship supplier, Ship manager, Ship breaker, Stevedores	MOS, DOS, BOMMA, BMA, BSMMRU, Private marine academy, NMA	BGMEA, Exporters and Importers.
Shipbuilding	Ship owner, Worker, Ship recycling industries	MOI,MOS,DOS	Plumbers, Electricians.
Seaports	Ship Agent, Stevedores, C & F agents, port repair, Dry Dock, Ship owners, Exporters and Importer	MOS, Port authority, DOS, BGMEA	Seafarer
Ship recycling industries	Shipyard owner, Worker, Ship building industries	MOI,MOS,DOS,DOE	Ship building industries, NGOs
Costal aquaculture and marine culture.	Fisherman, Fish farmers, Fish, Feed suppliers, Fish processing industries	MOF,DOF,IMSF,BORI	Fish consumers, Superstore Owners, C&F agents, port authorities, Shipbuilders.
Oil and gas	Consumers , Industries, Gas exploration industries, Gas exploration workers, engineers	Petro Bangla, MOI, MOE	Ports, shipbuilders, LNG sellers.
Salt production	Sea producers, Salt traders	MOA,BARI,BADC,	Salt consumers superstore Owners.
Costal tourism	Owner of hotels, Motels travel agents, Tour guides, Passenger ferries.	MOT,DOT	MOE, DOE.
Marine surveillance	Coast guard, Port authorities.	MOS,DOS	Shipbuilders, Seafarer.
Human Resource Development	BMA, NMI, BEPTC, BSMMRU, BORI, IMSF	MOS,DOS	Seafarer, Maritime Professionals.

Table 03: Stakeholder Analysis[33].

Stakeholders						
Ministries	**Authorities**	**Department**	**Corporation & Cells**	**Industries**	**Institutes**	**Communities**
Ministry of fisheries & livestock		Department of fisheries	Bangladesh fisheries development corporation	fish patty, fish processing industry, aquaculture industry	Bangladesh fisheries research institute, Bangladesh marine fisheries academy	Artisanal fisherman, industrial fisherman, fishing vessel owner, fishing gear suppliers, cold storage owner, fish exporter & importer
Ministry of shipping	Chittagong port authority, Payra port authority, Mongla port authority	Dept of shippinz	Bangladesh shippinz corporation	ship builders, Chittagong dry dock	Bangladesh marine academy, national maritime training institute, deck & engine	sea fearer, ship owners, ship agents, stevedores, ship repair

				personal training center	
Ministry of Industry			ship recycling industry		shipyard owner
Ministry of power, energy and mineral resources	Sustainable and renewable energy development authority	bureau of mineral development	Bangladesh petroleum corporation, Petro Bangla, blue economy cell	oil & gas exploration companies, sand extraction companies	Oil & gas exploration Engineers, sand extractor
Ministry of civil aviation and tourism		Bangladesh tourism board	Bangladesh tourism corporation	national hotel& tourism training institute	hotel & motel owners, travel agencies, tour guides, owner of passenger ferries
ministry of Environment & forest		Bangladesh climate change trust & dept. of forest		Bangladesh forest research institute	Environmental NGOs
Ministry of planning	Implementation, monitoring & evaluation division	Bangladesh planning commission			ocean planners
Ministry of education		department of secondary & higher education		Bangabandhu Sheikh Muzibur Rahman Maritime University	Researchers, university professors

Ministry of Agriculture		Bangladesh agriculture development corporation	sea salt producing industry	Bangladesh agricultural research institute	Sea salt procedure
Ministry of local government & rural development co-operative	Bangladesh rural development board				
Ministry of foreign affairs	Maritime affairs unit				
Ministry of home affairs	Bangladesh coast guard	Chittagong city corporation, Khulna city corporation			
Ministry of water resource	Bangladesh water development board			Bangladesh river research institute	
Ministry of science & technology				Bangladesh institute of technology, Bangladesh oceanographic research institute	
Ministry of digester management	Department of digester management				
Ministry of land	Land reformation board				

PM Office	Bangladesh economic zones authority		Sustainable development goal cell			
17 ministries	12 authorities	11 department	8 corporation & 2 cells	9 industries	12 institutes	22 communities

Figure 11: Statistics of Existing Stakeholders of Bangladesh [33].

It is clear from the stakeholder analysis (Table 03) that there are a lot of stakeholders that must work together to begin the MSP process. According to MOFA(2018), it is Regrettable that there is no competent authority that can bring all of these parties together[33].

Identifying the Competent Authority for Coordinating the MSP in Bangladesh

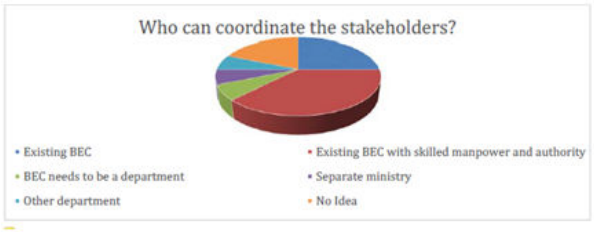

Figure 12: Competent Authority for Coordinating Stakeholder [33].

[33] Stated that the current Blue Economy Cell (BEC), with its competent workforce and authority, is capable of coordinating all stakeholders and engaging them early in the MSP process (Fig. 12).

Way of engaging stakeholders early in the MSP process

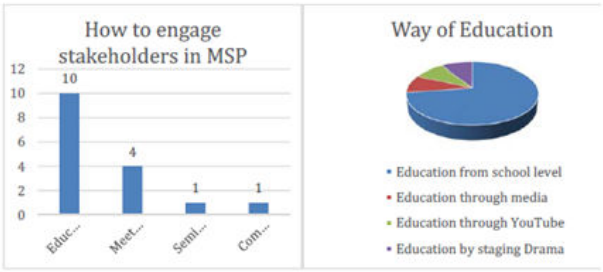

Figure13: Way of Engaging Stakeholders Early in the MSP Process [33].

Education, Ocean Awareness, Dialogues, and Meetings can assist in including stakeholders early on in the process (Fig. 13)

Identify current disputes and methods for resolving them among stakeholders

In the marine sector of Bangladesh, there are two forms of conflict: user-user conflict and user-environment conflict. As a result, to settle all of these issues, the government is attempting to include all stakeholders in the decision-making process [24]. (Table 04) shows the existing major conflicts among stakeholders in Bangladesh which were identified by an interview conducted by [33].

Table 04: Existing Major Conflicts Among Stakeholders [33].

Existing major conflicts among stakeholder.										
Stakeholders	**Industrial Fisheries**	**Artisanal fisheries**	**shipping**	**port**	**shiprecycling**	**oil & gas extraction**	**salt procedure**	**sand extraction**	**tourism**	**Nature & Biodiversity conservation**
Industrial Fisheries		Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Artisana	Yes		Yes	Yes	Yes	Yes	Yes	Yes	No	Yes

l Fish eries										
Ship ping	Yes	Yes		No	No	Yes	yes	Yes	No	No
Port	No	Yes	No		No	No	No	Yes	Yes	No
Ship recy cling	Yes	Yes	No	No		No	No	No	Yes	Yes
Oil & gas extr actio n	Yes	Yes	Yes	No	No		No	Yes	No	Yes
Salt proc edur e	Yes	Yes	Yes	No	No	No		No	No	No
San d extr actio n	Yes	Yes	Yes	Yes	No	Yes	No		No	Yes
Tour ism	yes	yes	no	yes	no	no	no	yes		no
Nat ure & Biod iver sity cons erva tion	yes	yes	no	no	yes	yes	no	yes	no	

Approaches for settling stakeholder conflicts

Most respondents (Fig. 10) believed that regular meetings among stakeholders are the greatest way to decrease disputes, integrate stakeholders, and close the information gap between them because meetings allow stakeholders to voice their perspectives and goals for ocean usage. As a result, they may be able to find a solution to a competing issue[33]. Existing Major Conflicts Among Stakeholder are showed in (Fig. 14).

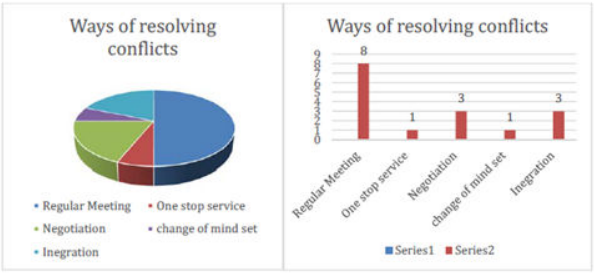

Figure 14: Ways of Resolving Conflicts Among Stakeholders [33]

Because fishing and shipping are the two most important sectors in Bangladesh's marine area, the government must first recognize the problems and conflicts that these two industries face[1]. According to research studies, ocean zoning and the place-based management strategy can decrease stakeholder disputes[49]. However, NGO's, researchers, scientists, local leaders, ethnic groups, labour organizations, sports clubs, and religious groups all have a role to play in the MSP process and they should be consulted early on in the MSP process by the government[38]. Understanding the good outcomes of the MSP process might inspire civil society to participate more actively in the MSP process[50].

DATA MANAGEMENT FOR MSP PROCESS

Available Data in Bangladesh

The Ministry of Foreign Affairs' "Blue Economy Cell" (BEC) provides information on maritime areas and stakeholder involvement and the Institute of Marine Science and Fisheries (IMSF) is gathering and archiving all accessible data in preparation for future usage through geospatial data on various stakeholders and maritime areas is scarce in Bangladesh[42]. Additionally, Fisheries, shipping, maritime environment protection, conservation, and the oil and gas sector are among the top sectors that save and retain their data [3]. (Fig. 15) shows the MSP data management framework.

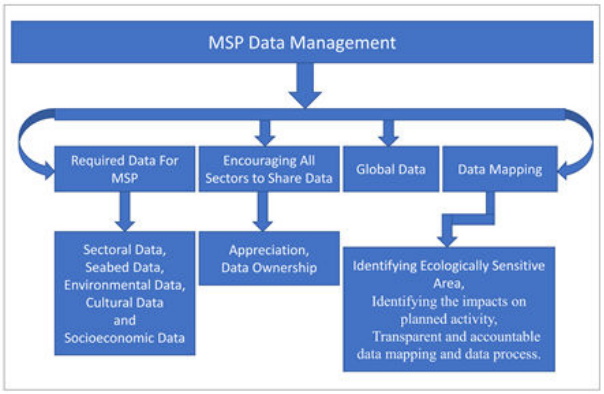

Figure 15: MSP Data Management Framework (Information Source [42].

MONITORING

Different aspects of the environment, such as biodiversity, ocean health, and marine management performance, should be considered by the government during monitoring. However, different tools for monitoring ecosystem components(Table. 05) and besides this, short term and long-term monitoring can be implemented[42].

Table 05: Different Tools for Monitoring Ecosystem Components[51].

Platform (section in manuscript)	Sensor availability	Current issue	Future uses	Limitations
Research vessels(Research vessels)	Acoustics, sample collection, CTD, camera/ light imaging, hydrophone, passive sampler, visual taxonomy	Virtually all monitoring	Continued use for sampling and monitoring. Likely to be used as platform to launch autonomous vehicle and service fixed point observation system.	Expense, availability
Fixed point marine observation system(Fixed point marine observation system)	Some sample collection, CTD, light/ camera imaging, hydrophone, passive sampler	Wave height	Increased network, potential for increased sample collection (water), mounting of biosensors, mounting of plankton microscopy.	Expense of servicing, limited for locations (not in shipping channels)
Other vessel(Voluntary observation Ships and ships of opportunity	Variable availability: acoustics, sample collection CTD, camera/ light imaging hydrophone, ferry box	Fisheries research; sea-bed mapping; Ferry Box	Continued used alongside citizen science for monitoring; Ferry Box.	Requires to good-will, limited to certain sea area (e.g. ferry routes)
Mobile platform(subsurface Floats, Remotely operated and Autonomous Vehicles	Acoustics, CTD, camera/ light imaging, water sample collection(limited)	Argo float fleet; sea-bed map[ping	Large potential for oceanographic measurements acoustic and potential for some sampling.	Power usage 9battery life) must be launched and recovered
Unmanned aerial vehicle(Remotely-Piloted Aircraft)	Camera, GPS	commercial shoreline surveys, not yet used for environment monitoring	Increased range to target greater areas, longer battery power, greater degree of automation, launch from RV	Battery power, legal limits to flight patterns (up to 1 KM from pilot)
Citizen Science(Citizen Science)	Species ID. e DNA sample collection, litter sample collection, catch diaries	Non-indigenous	Large potential to record data and collect samples for Shore based and shallow water studies.	Expertise, data quality, reliability, continuity
Satellite(Satellite)	Camera/ light imaging, data transfer from automated platforms	Water quality(algal bloom)	Increased sensor types, increased resolution and increased coverage	Initial expense, cloud cover reduces capability, only surface measurements
CTD(sensor)	Salinity	RV or other vessel, animal tag, citizen science, mobile or static autonomous platform	As current, perhaps with further miniaturization	Limited variables
Acoustics(Acoustics)	Depth measurements, sea bed mapping	RV, mobile or static autonomous platform	As current	Large data storage required, often requires specialist vessel
Camera/ light imaging(Cameras)	Eutrophication, biodiversity fish stock assessment	RV, citizen science, mobile or static autonomous platform, satellite, UAV	Continued development of resolution and non-visible light	Images may require expert analysis, large data storage required, power use on remote platform

HF Radar [High-Frequency Radar]	Wave height	Onshore Or Offshore Static Platform	As current	Initial expense and upkeep, limited function
Visual taxonomy (high-frequency radar visual taxonomy-Benthic macro fauna, and visual taxonomy-plankton	Fish stock assessment, biodiversity, no-indigenous species	Sample Collection; : RV, citizen science. Analysis: RV or laboratory	Reduced capacity due to reducing expertise	Cost and expertise
Biosensor (Biosensors)	none with in ecosystem monitoring	RV, animal tag, citizen science, mobile or static autonomous platform	Species ID, phytoplankton and zooplankton analysis	Complex, still under development
Molecular biology techniques (Molecular Biology Techniques)	Fish stock ID, non-indigenous species	Sample collection: RV, citizen science, mobile or static autonomous platform, Analysis: RV or laboratory	Possibility of automation of analysis in deployable form, uses of biodiversity	Cost and expertise, molecular databases, large data storage required
Passive sampler (Passive sampler)	Chemical monitoring	Sample collection: RV, Ferry Box, static (autonomous) platform, Analysis: laboratory	Continued development of equipment and methods	Not universally accepted as suitable for analysis of biota
Analytical chemistry	Chemical monitoring, water quality	Sample collection: RV, citizen science, mobile or static autonomous vehicle, Analysis: RV or laboratory	Continued development of equipment and methods	Expensive equipment
Biological effects	Chemical monitoring, Eutrophication	Sample collection: RV	As current	Expensive and laborious sampling
		Analysis: RV or laboratory		
Hydrophone	Underwater noise	Usually static platform, animal tag, RV	Increased sensitivity, miniaturization	

MSP FRAMEWORK FOR BANGLADESH

Table 06: Possible MSP Framework Development in Bangladesh[18].

	TASKS	ACTORS
Defining vision and goal for marine project	Develop vision and goal The relationship between planning goals and the principles	Ministries and state authorities National stakeholders Experts
Evaluation of management effectiveness of MSP PROJECT	Defining the authority for MSP Understanding legislative context Evolution of institutional components	Ministries, state authorities National stakeholders Experts
Analyzing existing marin context	Assessment of ecosystem, ecosystem services Assessment of socio-economic conditions, activities Assessment of socio-culture context	Scientific institutes NGO and social worker Professional Experts
Analyzing existing marin context	Engaging with stakeholders Setting specific objectives Defining current and possible future condition	Local government NGO and social worker Professional Experts
Developing plan, scenario	Identify key issues Developing alternative scenario Developing draft plan	Universities, Institutes Stakeholders Professional Experts
Defining management plans elaborating What, by whom, How, by when	Developing and evaluating management actions	Local government NGOs, Social worker Research Institutes

	Defining potential actor
	Defining indicator and time frame

For the effective implementation of MSP in Bangladesh, it is preferable to utilise current systems rather than establishing new management authorities(Table 06) [18]. However, MSP is a continual process that should be assessed regularly depending on its results. MSP is assessed every 5 years in most situations throughout the world to review the target outcome in a variety of methods and kinds to incorporate stakeholder aspects in the planning process. Additionally, Municipal administration involves comprehensive planning, development, and execution duties at the local or municipal level(Fig. 16)[18].

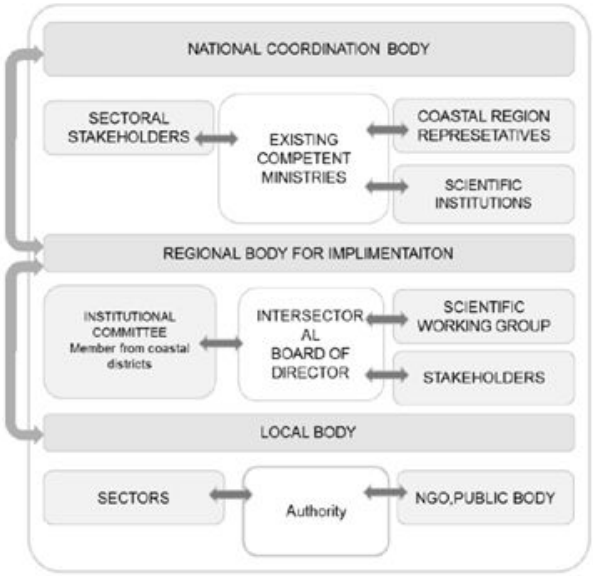

Figure 16: Prospective Implementation Framework for MSP in Bangladesh [18].

CHALLENGES FOR MSP IMPLEMENTATION IN BANGLADESH

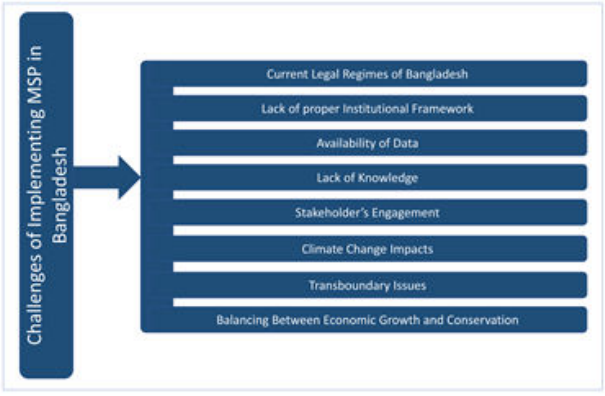

Figure 17: Challenges of Implementing MSP in Bangladesh (Information source [33, 52]).

The challenges (Fig. 17) should be overcome for a perfect MSP implementation in Bangladesh which will help to achieve the blue economy goal of Bangladesh.

RECOMMENDATIONS

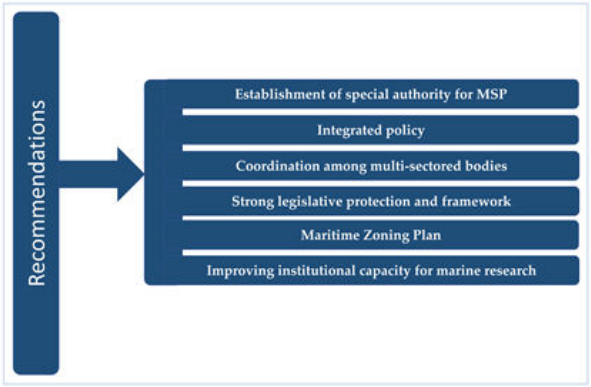

Figure 18: Recommendations for Implementing MSP in Bangladesh (Information source [5,52])

Recommendations (Fig. 18) can be taken to manage Bangladesh's maritime boundary excellently. More research on this sector is needed for a better understanding of the MSP.

CONCLUSION

Bangladesh attained a large maritime boundary from two neighbouring countries recently and that motivates Bangladesh Government to think about the blue economy but to fulfil this blue economy desire a proper ocean management tool is required and Bangladesh is in the early stage of managing its maritime resources. MSP is the best way to ecosystem-based model implantation in the marine spaces. Further, it is a multidimensional use management tool for marine areas which helps to resolve issues between the ocean users and an integrated approach is the best characteristic of it and the objectives of it are to secure ecological, economic and social advantages. Bangladesh satisfied one prerequisite among four to implement MSP in its marine space. Though some present legal framework is crucial for the MSP implementation, it is not enough for implementing MSP in Bangladesh maritime area; therefore, strong legislative protection and framework and integrated policy along with establishing a special authority for MSP is urgent in Bangladesh. Bangladesh government need to identify stakeholders, engage them in policymaking through the seminar, workshop and campaign. Additionally, regular meetings among stakeholders, ocean zoning and place-based management strategy can decrease stakeholders disputes in marine space. For monitoring ecosystem components some tools and short term and long term, monitoring can be implemented. Past studies (2011-2020) on Marine Spatial Planning and Blue Economy has been reviewed and a lucid idea on MSP as well as its function to date in Bangladesh maritime area are given in this study; which will be a crucial guideline for policy-makers, researchers and concerned individuals to know about the prospects, challenges and mitigation measures of MSP implementation in Bangladesh.

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