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MESSAGE FROM THE CHIEF OF NAVAL STAFF

'Bismillahir Rahmanir Rahim'

I am elated to see the 'Navy Journal 2022', the literary excellence of Bangladesh Navy, coming to light with its 8th edition. The readers will have the unique opportunity to delve into the rich tapestry of the development of Bangladesh Navy through the experiences of our brave sailors. As a symbol of national pride and strength, Bangladesh Navy continues to uphold its reputation as a formidable force both regionally and globally.

Keeping pace with the advancing world, our beloved motherland is exceeding its worth everyday, so as Bangladesh Navy is. The guiding principles of visionary leadership of daughter of the father of the nation became the lighthouse for dreaming the unfathomable inspiration to reality. The aspirations of the write ups endeavour pursuing the widened horizon of mental faculty of BN professionals as well as its readers. My warmest felicitation to the brains worked behind the publication of 'Navy Journal 2022'.

With the technological advancement and increased trained manpower, the operational scopes of Bangladesh Navy has flourished manifold. Starting from the core duty to protect the sovereignty, Bangladesh Navy is relentlessly working to uplift the living of the nation, infrastructure and peace building activities, establishing good governance, supporting civil administration during distressed moment and flying the flag in the regions of conflict. In consensus with the foreign policy, Bangladesh Navy is rigorously instating harmony among the regional and international communities. The pages of the journal serve as a chronicle of the Navy's accomplishment, advancements and unwavering commitments to excellence.

Another sacred task of navy is to keep the Sea Lines of Communication unhindered to support national economy. Bangladesh Navy is performing this unambiguous responsibility day and night in the arduous Bay of Bengal. The recent International Fleet Review 2022 at Cox's Bazar embodied the effectiveness of a growing navy in South and South East Asia. The ever ending journey of the ships and the crew forsaking the taste of life at shore will certainly pay dividend in course of time. In this stream "Navy Journal-2022" plays a vital role in disseminating knowledge, sharing experiences and fostering professional development of our beloved navy.

Following the successful guidance and effective leadership of Father of the Nation, Bangabandhu Sheikh Mujibur Rahman, his able daughter Honourable Prime Minister of Bangladesh has pulled up the socio-economic status of the country to an equilibrium height among the adjoining neighbours. With kind gesture of the present government, Bangladesh Navy has reached an acceptable size to cope up with the increased demand of the blue waters. We vow to uphold the dignity of the nation with the cost of our lives as our predecessors did. Here I humbly recall the supreme sacrifice of the heroic Freedom Fighters of 1971 and the fearless life of Naval Commandos.

The only professional magazine of Bangladesh Navy, 'Navy Journal', encompasses writings of our scrupulous researchers to unveil their inner selves and professional excellence. I firmly believe that 'Navy Journal 2022' is going to satisfy the inquisitive mind of its readers about how Bangladesh Navy is stepping forward. I wish all the very best to the writers and persons behind the publication of this journal.

May Allah SWT shower His kindest blessing upon us.

Joy Bangla.

M SHAHEEN IQBAL
Admiral
Chief of Naval Staff

EDITORIAL

The Navy Journal 2022 is a skilled accumulation of articles composed by many officers out of their day to day experiences, knowledge and wisdom. It is pure contentment to be a limb of this journal which emerges from the descriptive scripts full of ideas and thoughts. I believe this would pave the way towards a best media for navy in realizing the literary practices.

The dictions narratives and prudent projections of the writers in-depth thought have enlightened the furtive sprit of individual which emancipate variety of lights into rend of the readers. The indomitable spirits of the write-ups of our leaders have been based on self-motivation, dedication, relentless efforts, professional wisdom and commitment.

Inspite of all out efforts, this publication is not free from errors. We would invite our valued readers for constructive criticism and clearing vague ideas. Hope the finders will accept follies and foibles as well. However, I would join my hands together to unveil the journal editors and staff for their hard works.

The board of editors remains grateful and expresses sincere gratitude to the Chief of Naval Staff for gracious guidance and to the Chief Patron for valuable advice and constant monitoring of publishing the Journal in a befitting manner. We duly acknowledge the whole hearted and spontaneous cooperation and initiatives of all concerned for timely publication of this ‘Navy Journal 2022’. May Allah bestow us with enough strength and serve the nation with zeal and enthusiasm for a better future ahead.

QUEST FOR A REGIONAL MARITIME SECURITY COOPERATION PLATFORM IN SOUTH ASIA

Rear Admiral Mohammad Anwar Hossain, NGP, PCGM, ndc, afwc, psc

Abstract

Due to the complexities of maritime environment and threats, no single state can counter the maritime security threats alone and littoral states need to cooperate in enhancing maritime security through regional, sub-regional and bilateral mechanism. South Asian littoral states maintain bilateral and trilateral maritime cooperation. However, South Asian littorals are yet to form an institutionalized regional maritime security cooperation platform to address the maritime security issues. This led to do a study the existing maritime security cooperation architecture among the South Asian states with a view to find a scope of establishing a regional maritime security cooperation platform for South Asia. The study found that South Asian states need to form an integrated multilateral regional platform for maritime security cooperation which will be beneficial to ensure maritime security in South Asian region. Analyzing the scope of establishing a maritime security cooperation platform under the umbrella of existing regional forum that is SAARC, IORA and BIMSTEC where the South Asian states are members, both IORA and BIMSTEC are found to be suitable regional forum under which a maritime security cooperation platform may be formed for South Asia.

Introduction

Since time immemorial the sea has historically been of great importance as a highway for commerce and resources. Connectivity through sea increased phenomenally with the globalization. Littoral states got benefit from their seas due to authorized areas of jurisdiction by the United Nations Convention on the Law of the Sea (UNCLOS III). The strategic importance of the seas due to its vast resources and interconnectivity also brings ahead the importance of security to the resources as well as to the lawful uses of the seas. To ensure security at seas, Maritime Security Cooperation (MSC) among the littorals got importance.

Due to the nature of the sea and its use around the world, it is not practicable to ensure security by a single state even it is powerful. Littoral states around the world made tremendous efforts for MSC mainly in terms of regional, sub-regional and also bilateral cooperation. The abundant resources there in and in the sub-soil of seas along with ever increasing global trade through seas and the economic value and volume, attract a lot of illegalities like piracy, poaching and illegal and unlawful uses which constitute maritime security threats to the littorals. Consequently, ensuring maritime security against a wide spectrum of threats has become necessary to nations (Bessing, 2016).

Given the benign nature of peacetime maritime cooperation activities the littoral states are more than willing to cooperate with each other to mutually augment their maritime capacities (Upadhyaya, 2018). The geophysical attributes of the sea areas of South Asia (SA) coupled with a high volume of maritime trade has implications for regional security. Challenges are common and also potential change multipliers which could throw up complex challenges in the future, far beyond the capacity of any single littoral state to tackle. Due to the complexities of maritime environment and threats, no single state can counter these threats alone and littoral states need to cooperate in enhancing maritime security through regional, sub-regional and bilateral level. SA littoral states maintain bilateral and trilateral maritime cooperation like India, Sri Lanka and the Maldives have a trilateral cooperation ‘Dosti’. Bangladesh and India conduct CORPAT along the IMBL which facilitates to prevent unlawful activities. However, SA littorals are yet to form a institutionalized regional MSC platform to address the maritime security issues regionally.

In this backdrop, this paper seeks to study the existing MSC architecture among the SA states with a view to find a scope of establishing a regional MSC platform for SA.

Geographical Characteristics and Maritime Environment in South Asia

South Asia region consists of the countries of Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. Topographically, it is dominated by the Indian Plate and defined largely by the Indian Ocean on the

south, and the Himalayas, Karakoram, and Pamir mountains on the north. South Asia covers about 5.2 million km² (2.0 million sq mi), which is 11.71% of the Asian continent or 3.5% of the world's land surface area. The population of South Asia is about 1.94 billion (2020) or about one-fourth of the world's population, making it both the most populous and the most densely populated geographical region in the world (Bank, South Asia, 2022). Maritime SA is surrounded by three water bodies, the Bay of Bengal, the Indian Ocean and the Arabian Sea and has acutely varied climate zones. Afghanistan, Bhutan and Nepal are the three landlocked countries of SA without sea territories.

According to Barry Buzan, South Asia is a classic example of a "regional security complex"; that is, a set of states whose major security perceptions and concerns are so interlinked that their national security problems cannot reasonably be analyzed or resolved apart from one another (Barry Buzan, 1988). The challenges in the region among others include Inter-State Disputes, Armed Race, Extra Regional Interest, Human and Drug Trafficking, IUU Fishing, Natural Disasters, Marine Pollution, presence of Armed Non-State Actors, Terrorism etc. India, as the largest state in SA, with relative economic might and historical and cultural linkages, enjoys significant influence across the region. India's relations with its neighbours are a crucial factor for security and stability in SA. Again, India-Pakistan rivalry has dominated the regional security scenario in SA. During the period of present government, India's relations with its immediate neighbours have received greater focus than ever before with exception to Pakistan which continue to remain troubled and aggravated. Again, India's desire to reinvigorate its relations with its neighbours has been influenced by a growing Chinese influence in the neighbourhood. Thus, the MSC among the SA states are directly related to the relations between India and its SA neighbours and also has an influence of China.

UN Cartographic Map of South Asia

Multilateral Mechanisms for MSC Architechture in SA Region

There is no separate institutionalized regional MSC forum or platform existing presently among the SA states. However, SA littoral states are maintaining maritime engagements in regional and sub-regional level which are discussed in following paragraphs.

The Indian Ocean Rim Association (IORA) is a regional forum consisting of 23 member states bordering the Indian Ocean, ten dialogue partners and one Observer. IORA is tripartite in nature, bringing together representatives of

Government, Business and Academia, for promoting co-operation and closer interaction among them. It is based on the principles of Open Regionalism for strengthening Economic Cooperation particularly on Trade Facilitation and Investment, Promotion as well as Social Development of the region where the main objective is to promote the sustained growth and balanced development of the region and of the Member States, and to create common ground for regional economic co-operation (IORA, Structure, 2022).According to the IORA Charter, the Priority Areas and Cross-Cutting issues are listed below:

Priority Areas: 1. Maritime Safety and Security; 2. Trade and Investment Facilitation; 3. Fisheries Management; 4. Disaster Risk Management; 5. Academic, Science and Technology Cooperation; and 6. Tourism and Cultural Exchanges. The Cross-cutting Issues: 1. Blue Economy; and 2. Women's Economic Empowerment

Indian Ocean Naval Symposium (IONS) is a series of biennial meetings between the navies of littoral states of the Indian Ocean region. It provides a forum to increase maritime security cooperation, discuss regional maritime issues, and promote friendly relationships among the member states. The symposium was first held in 2008 with India as host. The chairmanship and location of the Symposium rotates between the various member states. IONS is a security construct for the Indian Ocean region which is similar to the Western Pacific Naval Symposium. It is a voluntary initiative among the navies and maritime security agencies of the member nations. In addition to the symposiums, numerous other activities like workshops, essay competitions and lectures are also held under the umbrella of the organization. The 25 member nations of the IONS are grouped into four sub-regions. South Asian, East Asian, East African, South East Asian and Australian. IONS has eight states with observer status (IONS, 2022).

Bilateral Maritime Security Cooperation

Though having traditional enmity and lack of formal defence relations, a Memorandum of Understanding (MoU) signed in 2006 between the Indian Coast Guard and the Pakistan Maritime Security Agency (MSA) for exchange of

information on maritime boundary violations by fishermen, intra-agency coordination on maritime search and rescue and marine environment pollution, serves as a significant link between India and Pakistan (Shishir U. , 2018). Under the MoU, the heads of the Indian Coast Guard and Pakistan MSA meet annually and also have established a hotline link for regular exchange of information on non-military maritime issues.

Bangladesh and India have resolved their maritime boundary disputes through the delimitation of maritime boundary in 2014, which is considered a milestone achievement between the two countries. Presently the maritime cooperative engagements are limited to regular training exchanges, staff talks, naval ships visit and senior level interactions between both the navies and coast guards. Coordinated Patrol (CORPAT) by ships of two navies along the International Maritime Boundary Line (IMBL) is another step forward between the two countries in MSC. The fourth edition of the two-day India-Bangladesh CORPAT exercise was conducted from 22 May 2022 in the Bay of Bengal. The exercise aims at strengthening mutual understanding and enhance the interoperability between the navies of India and Bangladesh in countering maritime threats. CORPAT builds up understanding and interoperability between both the navies. It facilitates institution of measures to prevent and suppress unlawful activities such as IUU fishing, maritime terrorism, drug trafficking, armed robbery and piracy. It also helps in enhancing operational synergy by exchanging information to prevent smuggling, illegal immigration and to conduct SAR operations at sea. India assists Bangladesh in developing its maritime research capabilities through an agreement for collaboration between the National Institute of Oceanography in Goa and the University of Dhaka.

There are deep and close bilateral relations between India and Maldives which also include defence and security ties. India's defence cooperation with Maldives was formalized in August 2009 with the signing of a comprehensive Defence and Security Cooperation Agreement (Shishir U. , 2011). India provides regular training to Maldives National Defence Forces, both the maritime forces also conduct exercises and surveillance in the Maldivian Exclusive Economic Zone (EEZ). In October 2011, India signed a trilateral agreement with the

Maldives and Sri Lanka for MSC. Under the agreement the three countries agreed to share information on the movement of shipping through the region under a common software platform developed by India, the Merchant Ship Information System (MSIS). India has also built a system of coastal surveillance radars across the Maldivian archipelago which are networked with the Indian coastal radar system and integrated with India's National Command Control Communication Intelligence Network (N3CIN) at Gurgaon, near New Delhi (Shishir U. , 2018).

India and Sri Lanka maintain bilateral maritime cooperation and both the navies have regular exchanges of training, ship visits, staff talks, information exchange, supply of military hardware such as ships and aircraft, hydrographic assistance and exercises. The Indian and Sri Lankan navies conduct an exclusive bilateral exercise Sri Lanka India Naval Exercise (SLINEX) since 2005. The trilateral annual maritime exercise “Dosti” is also being conducted between Indian Coast Guard, Maldives National Defence Force and Sri Lankan Coast Guard (India, 2014).

Under SAGAR (Security and Growth for All in the Region) vision the Indian Navy has been proactively engaging through bilateral and multilateral exercises, joint exclusive economic zone surveillance, Humanitarian Assistance and Disaster Relief (HADR) operations and economic zone surveillance with countries in Indian Ocean Region to enhance regional maritime security.

All the SA littoral states have bilateral or trilateral maritime cooperation in the field of exchanges in training, ship visits, staff talks including CORPAT with the exception between India and Pakistan.

Overall Assessment of Maritime Cooperation in South Asia

India is the largest country in SA. In terms of maritime capacity as well as capability, other SA states are not comparable to India. India has the largest share of seas and oceans of SA and from the geophysical point of view; India is in centre of SA. On the other hand, as discussed in the previous paragraphs, India is maintaining effective bilateral and trilateral maritime cooperation with SA states with the exception to Pakistan. Present maritime cooperation with India and other SA littoral states are summarized in the following table:

Table 1: An Assessment of MSC among SA States with India

Country	Ship Visit/ Staff Talks/ Trainer	Multilateral Exercise	MoU/ Agreement	**Assessment** of Maritime Cooperation Good/ Average/ Weak
Bangladesh	a. Regular Navy and Coast Guard Ship Visit b. Regular Navy to Navy Staff talks c. Regular Navy and Coast Guard Training. d. Senior Official Visit	a. Navy to Navy Exercise Milan b. Bilateral Coast Guard Exercise c. CORPAT	a. Navy and Coast Guard Training b. Defence export	**Good**
Pakistan	Nil	Nil	MoU between Indian Coast Guard and Pakistan Maritime Security Agency	**Weak**
Maldives	a. Regular Navy and Coast Guard Ship Visit b. Regular Navy to Navy Staff talks c. Regular Navy and Coast Guard Training.	a. Navy to Navy Exercise Milan b. Trilateral Coast Guard Exercise Dosti c. CORPAT	a. Navy and Coast Guard Training b. Defence export c. Trilateral Agreement for Information Sharing	**Good**

(Prepared by author taking relevant information from available sources)

Scope of Establishing a Regional Platform for MSC in SA

It is well understood that a common, inclusive multilateral intergovernmental organization is necessary for effective MSC for the regional littoral states, thus the littoral states of SA also need to establish a common and multilateral intergovernmental organization for MSC in the region. Therefore, it is necessary to explore the scope of forming a MSC forum for SA littoral states. For the purpose of this study, existing three regional Forum (SAARC, IORA and BIMSTEC) were studied considering the SA states participation as member states. Following paragraphs will analyze the existing multilateral intergovernmental organization and try to find out the suitable option to form a separate MSC platform for SA region.

Analyzing the South Asian Association for Regional Cooperation (SAARC) to Establish a Regional MSC Platform in SA

The SAARC was established on 8 December 1985 and was "desirous of promoting peace, stability, amity, and progress in the region through strict adherence to the principle of the United Nations Charter and Non-Alignment"(CHARTER, 2022). According to the Dhaka Declaration issued at the end of the summit, SAARC was "a tangible manifestation of the determination" of the leaders of South Asia "to cooperate regionally, to work together towards finding solutions towards common problems in a spirit of friendship, trust, and mutual understanding and to the creation of an order based on mutual respect, equity and shared benefits". Article III of the Charter articulates that the SAARC Summit that is the Meetings of the heads of state or governments is the supreme authority of SAARC, as stated in, and all decisions at all levels are taken on the basis of unanimity. Due to the rivalry and hostility between India and Pakistan SAARC could not build confidence among the member states and be a platform for regional integration in SA and it will fail to deliver on its commitments and tap into the tremendous potentialities available in the region (Hu, 2021). Both countries are reluctant to compromise on the disputed issues. India will not consider negotiation if it perceives the negotiated settlement reduces her power and influence. In the same way, Pakistan will not cooperate if she feels the terms of negotiation are not to her benefit (Michael, 2018).

SAARC is considered as a regional body for SA placed in a geostrategic location with an opportunity to contribute to the global goal. Economic development, peace, stability, and security are central to the promotion of the common interests of the member states. However, the experience of the last four decades suggests that, under its existing structure, SAARC cannot be the tool of regional integration, as it will continue to be the victim of Indo-Pak rivalry. SAARC is held hostage to the realpolitik of India and Pakistan. Moreover, since its inception, SAARC is yet to discuss any issue related to maritime cooperation and it may not be a suitable regional forum to form or initiate a regional MSC platform for SA.

Analyzing the Indian Ocean Rim Association (IORA) to Establish a Regional MSC Platform for SA

Forming of IORA, its objectives, priority areas related to maritime cooperation in general and MSC in particular has been discussed before in this paper. As analyzed further, it is found that IORA's large membership affords it with the ability to understand perspectives of a wide array of nations in the Indian Ocean Region. Economically and developmentally, IORA brings together some of the world's richest countries like the United Arab Emirates, Singapore, and Australia with some of the poorest, such as Mozambique, and island nations with very low GDPs, such as Seychelles; this creates uneven benefits from participation in IORA projects and can lead to economic competition and resentment among member states (IORA, Structure, 2022). IORA faces competition with other regional and international organizations for member states' attention and investments; in fact, 14 such bodies have IORA member states in their membership (IORA, Structure, 2022).

IORA Action Plan (2017-2021) is the latest initiative of IORA which has focused on Maritime Safety and Security (MSS) as a priority area for promoting MSS in the Indian Ocean region. Short-Term, Mid-Term and Long-Term initiatives were planned with implementation guideline. Accordingly, the IORA Working Group on Maritime Safety and Security (WGMSS) was established in September 2008. It is also important to note that the member states reviewed the

first Work Plan while updating it for the next Work Plan cycle of 2022 to 2026, organizing activities in time lines of Short-Term from 2022 to 2024, Medium-Term from 2022 to 2026 and Long-Term from 2022 to beyond 2026. Analyzing the IORA objectives, priority areas and also the status of IORA Action Plan (2017 – 2021) and the reviewed plan, it is clearly identified that IORA states are giving importance to MSS and member states are also positive in implementation of the Action Plan. Thus, IORA is considered to be a suitable option for a regional MSC platform for SA.

Analyzing the BIMSTEC to Establish a Regional MSC Platform for SA

The Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) is a regional organization that was established on 06 June 1997 with the signing of the Bangkok Declaration. Initially known as BIST-EC (Bangladesh-India-Sri Lanka-Thailand Economic Cooperation), the organization is now known as BIMSTEC and comprises seven member States with the admission of Myanmar on 22 December 1997, and Bhutan and Nepal in February 2004. The member states are Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka and Thailand (BIMSTEC, BIMSTEC History, 2022).

The BIMSTEC CHARTER (BIMSTEC, CHARTER, 2022), Chapter I, Article 1 (Purposes) declares "To maintain peace and stability in the Bay of Bengal region through close collaboration in combating international terrorism, transnational organized crimes as well as natural disasters, climate change and communicable diseases". It is important to note that BIMSTEC formed the Expert Group on MSC and first meeting was held from 5-7 September 2022 to prepare Action Plan (Hossain, 2022). BIMSTEC hold total five summits where five Declarations were made. Studying the Declarations, following important issues related to maritime security cooperation are summarized below where member states agreed to cooperate (BIMSTEC, Summit Declarations, 2022):

(a) To intensify cooperation to promote the sustainable use of the marine resources in the Bay of Bengal through effective management and conservation in close coordination with the already existing frameworks, including the Bay of Bengal Programme-Inter-Governmental Organisation (BOBP-IGO).

(b) To intensify efforts to strengthen cooperation in all areas of activities within the framework of BIMSTEC so as to promote regional cooperation and cohesion.

(c) To call for expediting the ratification for entry into force of the BIMSTEC Convention on Cooperation in Combating International Terrorism, Transnational Organized Crime and Illicit Drug Trafficking.

(d) To strengthen cooperation and coordination among the law enforcement, intelligence and security agencies on counter terrorism and transnational crimes.

(e) To emphasize the importance of blue economy and to cooperate in this sector for the sustainable development in the region and decide to establish an Inter-Governmental Expert Group to develop an action plan on blue economy, keeping in mind the special needs and circumstances of the landlocked member states.

Analyzing the BIMSTEC CHARTER and Summits Declarations, BIMSTEC is considered to be a suitable option for regional MSC platform among the SA states. Though, Pakistan is yet to be a member of BIMSTEC, it has the scope to be member.

Conclusion

The gradual increased dependency on maritime resources and increased blue economic activities have brought maritime security on the priority agenda worldwide. SA littoral states face maritime security threats which affect the littorals of the region equally. The challenges in the region among others include Inter-State Disputes, Armed Race, Extra Regional Interest, Human and Drug Trafficking, IUU Fishing, Natural Disasters, Marine Pollution, presence of Armed Non-State Actors, Terrorism etc. Due to the complexities of maritime environment and threats, no single state can counter the maritime security threats alone and littoral states need to cooperate in enhancing maritime security through regional, sub-regional and bilateral mechanism. SA littorals are yet to form a regional MSC platform to address the maritime security issues.

This led to do a study to find scope of establishing a MSC platform for SA. The study revealed that the unique geophysical attributes of SA region coupled with a high volume of maritime trade have implications for regional security. Further, the vulnerability of the highly populated coastal regions to natural calamities have been exposed in recent years. From the study, it is found that the SA littorals are maintaining bilateral and trilateral maritime cooperation to ensure maritime security in their sea areas. However, no dedicated platform for regional MSC yet to be formed in SA. The study analyzed existing three multilateral intergovernmental organizations namely SAARC, IORA, BIMSTEC where SA littoral states are members and tried to find out the suitable option to form a separate MSC platform for SA region. From the study, it is revealed that in last four decades SAARC could not function effectively under its existing structure and SAARC cannot be the tool of regional integration, as it will continue to be the victim of Indo-Pak rivalry. Moreover, since its inception, SAARC is yet to discuss any issue related to maritime cooperation and it may not be a suitable regional platform to form or initiate a regional MSC forum for SA.

The member States of IORA are of multi-cultural, varied socio-economic and geo-political status and have numerous variations and differences. The landlocked countries of SA are not Member States of IORA. However, analyzing the IORA CHARTER and the IORA Action Plan (2017 – 2021), it is clearly identified that IORA is giving importance to MSS and member states are also positive in implementation of the Action Plan.

The BIMSTEC CHARTER (Purposes) clearly focuses the requirement of security cooperation in general and MSC in particular among the member states. Analyzing the 'Declarations' made in BIMSTEC Summits, it is revealed that BIMSTEC is emphasizing in maritime cooperation by promoting the sustainable use of the marine resources, emphasizing maritime security cooperation through Combating International Terrorism, Transnational Organized Crime and Illicit Drug Trafficking, strengthening cooperation and coordination among the law enforcement, intelligence and security agencies, emphasizing the importance of Blue Economy and developing Plans of Action to carry out their respective mandates. Moreover, as BIMSTEC goes beyond the boundary of SA and extends in SEA, it will rather complement in the regional MSC for SA.

Analyzing the scope of establishing a MSC platform under the umbrella of existing regional forum that is SAARC, IORA and BIMSTEC where the SA states are member, IORA and BIMSTEC are considered to be suitable regional forum under which a MSC platform may be formed for SA. Now, policy makers need to decide the way ahead considering relevant factors.

Recommendations

From the study and analyzing scope of establishing a MSC platform for SA, following are recommended:

(a) An integrated multilateral regional platform for MSC may be formed to ensure maritime security in SA region.

(b) SA states may continue their existing Bilateral and Trilateral cooperation to ensure maritime security at their sea areas.

(c) Analyzing functioning of existing regional forums SAARC, IORA and BIMSTEC where SA states are members; IORA and BIMSTEC may be considered to be suitable forum to form a regional MSC platform among the SA states.

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Biography of the Writer

Rear Admiral Mohammad Anwar Hossain, NGP, PCGM, ndc, afwc, psc was commissioned in the Executive Branch of Bangladesh Navy on 1st January 1988 and has 35 years of outstanding blend of professional and academic career profile. He is a Navigation specialist and qualified Basic Navigation Course from Australia and Navigation and Direction Course from Pakistan. He commanded different types of warships of Bangladesh Navy ranging from Patrol Craft to Guided Missile Frigate. He has in his credit M Phil Degree in Security and Development and has also two Master's Degrees one in Security Studies and another in Defence studies. Rear Admiral Anwar completed Naval Staff Course from Defence Services Command & Staff College, Bangladesh. He is also a graduate of Armed Forces War Course and National Defence Course from National Defence College (NDC) Bangladesh. The Admiral has successfully qualified in Combined Force Maritime Component Commander Course from USA. He served in UN Peace Keeping Mission as Staff Officer of Bde HQ at DR Congo. He also served in UN Maritime Task Force in Lebanon as Commander Task Group and Commanding Officer of Guided Missile Frigate BNS ALI HAIDER. He served as Director of Naval Plans and Director of Naval Aviation at Naval Headquarters. The officer also served in Bangladesh Coast Guard as Deputy Director General, Director Operations and Zonal Commander in different times. He was awarded with Navy Glorious Service Medal (NGP) as recognition of his glorious service and contribution to Bangladesh Navy and President Coast Guard Medal (PCGM) as recognition of his excellent performance in Bangladesh Coast Guard. Rear Admiral Anwar has commanded BN Special Force SWADS Command. He was also the Area Commander of Dhaka Naval Area and Khulna Naval Area. The Admiral is currently appointed as Assistant Chief of Naval Staff (Personnel) in Naval Headquarters. He is happily married to Lubna Anwar and blessed with one son and one daughter. His son is also a second generation navy officer. He is a keen Golfer and loves to read books and listen to music.

PRESENT AND FUTURE PROSPECTS AND CHALLENGES OF BANGLADESH SHIPBUILDING

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Abstract

Around 80% of the world goods and products trade through the sea route. Today's ships and shipbuilding need automation, where skilled workforce is a must. Modern shipbuilding makes considerable use of prefabricated blocks or modules. There is a very close relation between world GDP, global seaborne trade and global merchant fleet. Ship and shipping are always playing a vital role for economic and trading activities in Bangladesh. Few local shipyards have constructed and handed over few dozens of ships to foreign owners. There are few more local shipyards are improving their capability. There are new hope which has been developed to receiving FDI in local shipbuilding from foreign countries. Bangladesh shipbuilding remains at advantageous position in the world in term of cheap labor. However, most of the local shipyards are very reluctant to follow corporate management culture and use modern technology. Local shipyards are still at a vulnerable stage; need to develop international standard in competitive market. Bangladesh has potential to capture 2% of global shipbuilding market (mainly small and medium) with USD 3.5 billion. But, it needs special care, appropriate policy and sustainable strategy.

Key words: *Automation, 4IR, module construction, global market*

Introduction

Marine transport or shipping is considered as backbone of global trade and the industrial supply chain. Around 80% of the world goods and products trade by volume is carried out through the marine route (Lixing Z 2009). Global trade volume and size has increased with a growth rate of around 10% since the last decade. Consumer demand mainly in developing countries are increasing and that increasing the imports volume as well as demand of commercial ships are also increasing. As a result, shipbuilding is always an attractive industry for developing nations (Hossain et al 2017). After World War II (WWII), from

1950s to 1960s, Japan has used shipbuilding as to rebuild her industrial structure. After that South Korea started to make shipbuilding a strategic industry from 1970s to 1980s same as Japan. Interestingly, China also follows the same path and repeating these same policy and strategy with large state-supported investments in shipbuilding in 2010s (Michael D 2010 and Hossain et al, 2010).

The local shipbuilding and the growth rate of inland ships of Bangladesh is quite amazing. The inherent ability and long-term heritage of the people in this region provide a strong base for building ships of international standard. Utilizing this opportunity, few local shipyard have been trying to make international standard ships since 2005. Country's lost glory has begun to revive when two local shipbuilders (ASSL and WMSL) start to export ocean going vessels to foreign countries since 2008 (Hossain et al 2017). Bangladesh has so far exported its product to companies in Germany, Denmark, Finland, New Zealand, Ecuador, Tanzania, Pakistan, Gambia, Nigeria, Uganda, India, Kenya and the UAE. There will be huge impact on maritime industry during incoming 4th Industrial Revolution (4IR) or Industry 4.0 and future ships will be controlled by Artificial Intelligence (AI), IoT, or automated systems. Modern shipbuilding technology and future demand will steadily reduce seafarers in shipping due to unmanned ship and AI. This is a brief inclusive study on Bangladesh shipbuilding industry with the aim of depicting present and future prospects and challenges. The study has been conducted on the basis of both primary and secondary data including useful inputs from key stake-holders of shipbuilding from home and abroad. Therefore, this study will endeavor to evaluate the prospects and challenges of local shipbuilding to develop a sustainable industry.

Trend of Development of Shipbuilding Industry

Conventional shipbuilding was labor intensive and low-tech industry (Hossain et al 2017). 'Early welded steel ships used steels with insufficient fracture toughness, which resulted in some ships suffering catastrophic brittle fracture blocks or modules, where entire multi-deck segments of the hull will be built elsewhere in the yard, transported to the building dock/slipway, and then lifted into place and fabrication process get completed. This is known as block or module construction' (Hossain K A 2017).

The most modern shipyards pre-install equipment, pipes, electrical cables, and all other components within the blocks, to minimize the effort needed to assemble or install components within the hull, once it is welded together. Ship design work, also called naval architecture, usually be conducted using a ship model tank or basin. Again, 4IR or Industry 4.0 will definitely influence the whole maritime sector and new transformation will come in the shipbuilding industry and that will be very crucial (Noordstrand 2018). The main goal of shipbuilding 4.0 is intelligent shipyard which is characterized not only by adaptability, resource efficiency and ergonomics but also close integration among ship owner, shipbuilder, suppliers, the partners and other stake-holder in the business and value processes.

There are ups and downs observed in shipbuilding growth. United Kingdom (UK) was the market leader of global shipbuilding before WW II. After that, Japan become the dominant ship building nation in 1960s and slowly lost its competitive advantage to the promising industrial nation South Korea, as they had the advantages of much cheaper wages, suitable shipbuilding strategy, strong government support and cheaper currency. South Korean shipbuilding overtook Japan's in 2003' (Lixing Z 2009). Again, from 2009, 'during and after global financial crisis China become global shipbuilding leader leaving behind South Korea and Japan by using the same strategy and technique of those two shipbuilding giant' (Hossain K 2018). China utilize global financial crisis to develop their shipbuilding and they initially targeted the medium and small global market of containers, tankers and cargo ships.

Trade is always for population. The trend of global population growth has been shown in the figure 1 (OECD 2011). There is a very close relation between world GDP, global seaborne trade and global merchant fleet and that has been shown in figure 2 (Clarksons Research 2021). 'Global population in July 2010 was around 6.83 billion and it has been estimated that, it will raise to 9.08 billion by 2050' (EIA 2011, OECD 2011). Again, the urban population around the globe has continued to grow faster than the growth of total population. Today more than half of the population is living in urban area. Therefore, the rise in urban population is anticipated to reach around 70% by 2030 (EIA 2011, OECD 2011).

This phenomenon can also have a positive impact on seaborne trade; due to a large urban population not only creates a domestic market for goods and services but also drives the economic growth and innovation. At the same time, the increasing urbanization will also develop strong middle class and boost up higher consumption of goods and services further.

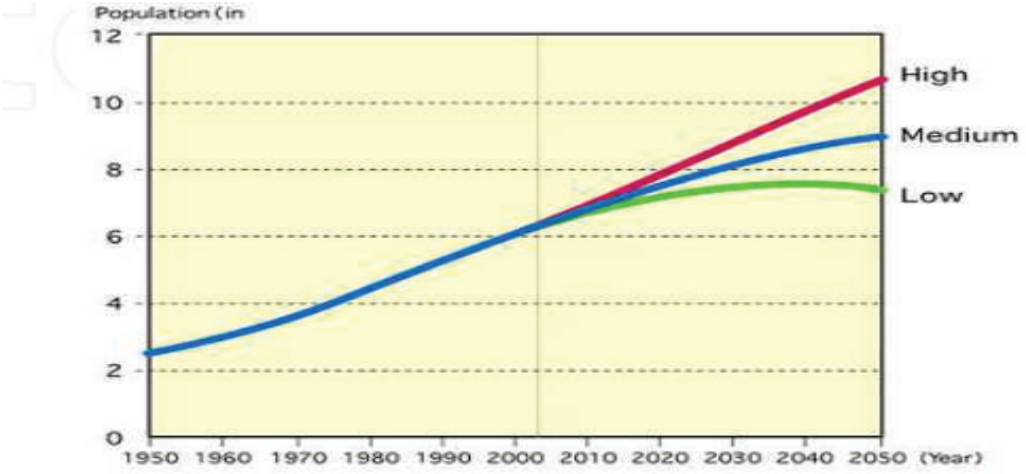

Fig 1: Growth of World population (Source: EIA 2011, OECD 2011)

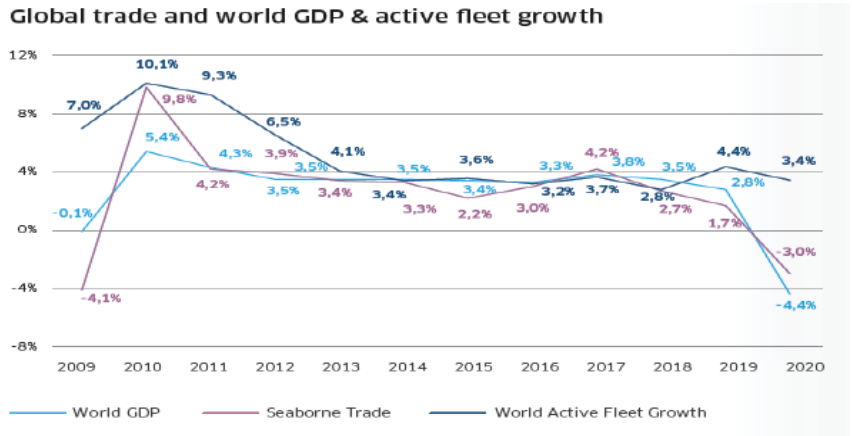

Fig 2: World GDP, Global Seaborne Trade, and Global Active Fleet Growth (Source: OECD Report 2021, UNCTAD Report 2021, Clarksons Research 2021)

Structural Characteristics of Shipbuilding Industry

Economic interconnection of trading partners around the globe is increasing day by day. Shipbuilding and shipping industries are responsible for the production and operation of merchant ships, and shipping considered as the heart of the international trade and commerce. The shipbuilding is a complex and diverse industry by its nature. The shipbuilding industry is characterized by a relatively high heterogeneity of ships due to its wide variation of types or uses. Those are: Bulkers, Tankers, Container-ships, Off-shore vessels, Passenger Ferry, Cruise-ship, Yacht, Warships, etc. 'The range of prices is also varying widely. Cost of a large cruise ships is around USD 1 billion whereas a Handy-size bulk ship costs around USD 25 million' (Clarksons Research, 2015a, 2020a). However, major drivers of shipbuilding market are: growth of seaborne trade, demand and price of EOL ships, diversified use of ships, etc. On the other hand, excess ships supply, inflation, and over capacity of shipyards are the main causes of market imbalances in shipbuilding. Structural characteristics and business nature of the shipbuilding has been shown in table 1 below.

S. No	Subjects or Characteristics	Situation of shipbuilding Industry
1	Production pattern	Unit and specialized production
2	Delivery time	Naturally long (2-3 years)
3	Production factor intensity	Usually labour-intensive industry.
4	Trade ability	Very high and diversified Play large role of ship finance in the exports Multiplier of other business as connected with back-word and foreword linkage
5	Possible change areas in future	Offshore business and it involves high risks Repair and maintenance of ships Steel construction and fabrication business
6	Product heterogeneity	Very high as wide variation of ships types
7	Demand accelerate	Expansion of seaborne trade Replacement of ships Changes of regulations Changes of owner requirement
8	Challenges	Eco-system or environment friendly product Automation and digitalization Impose regulation Design as unit production Overcapacity Trade fluctuation
9	Uses	Versatile EOL ships also have value

Table 1: Structural characteristics and business nature of the shipbuilding Industry

Government Support and Sustainable Shipbuilding

Shipbuilding being primitive business remains as open and competitive global market. Shipbuilding has vast experiences in surviving peaks and slumps of economy; and all past global crisis have hit shipbuilding more severely. The production of shipbuilding is gradually declined like sine curve; primarily due to slow economic growth, market fluctuation, and imbalance between supply and demand of ship. Again, increase in production price may weaken the ship demand. As shipbuilding is highly capital intensive industry, it needs strong government support and political stability for its sustainability. From figure 3, it is clear that, government support and countries own investment is essential for the survival of local shipbuilding amidst global crisis. Countries like Japan, South Korea and China have helped the local shipbuilding by enhanced domestic demand, through investment in R&D, and government subsidies; which attracts global market. So, government support and domestic investment are essential for sustainable growth (Hossain et al 2017).

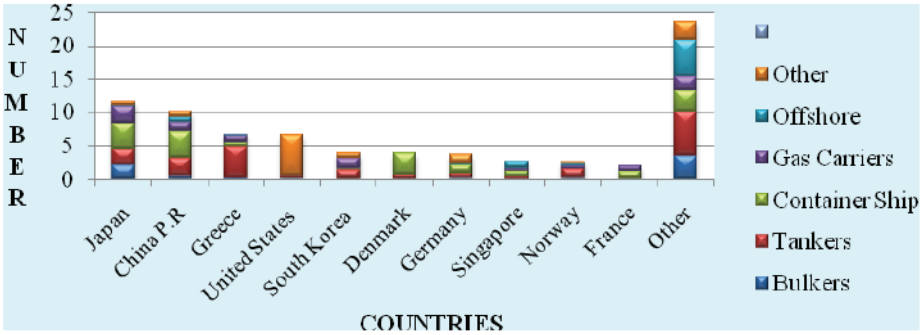

Fig 3: Trend of government investment/support by main ship types from 2010 in 2015

State of Local Shipbuilding

Dockyard and Engineering Work (DEW) Ltd is the oldest shipyard in this region and is providing services to new shipbuilding and repair sectors in this region since its establishment in 1926. The organization was taken over by the government of the then Pakistan from the Royal Indian Marine Service after the division of India. In 1954, the then East Pakistan Industrial Development Corporation (EPIDC) took it over and transformed it into a public limited

company. Subsequently, in the process it has come out with the capability of building and repairing vessels of all types up to 1500 DWT. It has further modernized in 1989 by introducing good machinery and modern shipbuilding technology. This development was achieved to enable the yard to undertake construction of Ro-Ro ferries under a Danish aided project for BIWTC. But DEW failed to keep its reputation and to earn good profit since independence. After declaring sick industry in 2002, it has stopped its activities and finally handed over to Bangladesh Navy on 07 Dec 2006. Since taken over by BN, DEW Ltd has built few dozens of new ships for Bangladesh Navy, Army and Coast Guard, BIWTA, BIWTC, CPA, MPA and other private customers. Presently they are constructing 17 in number class Tug-boats for BIWTA. This shipyard is earning profit and is the highest tax paid industry in the Narayangonj region.

Khulna Shipyard (KSY) Ltd officially started her journey as a shipyard in 1957 was jointly operated by German and British companies Still 1965. Then the management of the yard had been taken over by the then EPIDC. Soon after the liberation, the yard management was placed under Bangladesh Steel Engineering Corporation (BSEC). After 1984 till Bangladesh Navy took over on 03 Oct 1999, this shipyard remained as a sick industry and there was no sign of profit. However, the versatile dock facilities can accommodate a good number of ships at a time for repair or new building. In 1957 Khulna Shipyard started construction of tugs, work-boats and other commercial craft with standard design. The yard has the capacity to build Steel/Aluminum ships up to 90 m length, 700 tons lightweight and 04 meters draft. Very recently KSY has successfully built naval ships like Large Patrol Craft (LPC), Inshore Patrol Vessel (IPV), Hydrographic Survey Vessel, Landing Craft Utility (LCU) and auxiliaries' platform for BN and BCG. KSY also built merchant ships like Oil Tankers, Cargo and Container Vessels, Tugs Inland and Coastal Work Boats, Pilot Boats, Heavy Duty Speed Boat, Search and Rescue Boat, Barges, Ferries, Floating Cranes, Fishery Research vessel, etc. It is the first warship builder in Bangladesh. Since 1957, KSY has built 400 new ships and repaired more than 3000 vessels. This shipyard is earning profit and is the highest tax paid industry in the Khulna region.

After the independence of Bangladesh, the only significant development in public sector was the Chittagong Dry Dock Limited (CDDL). At that time, most of the state owned shipyards like DEW and KSY failed to keep their reputation and subsequently became losing enterprises for many reasons. However, On 23 December 2015, CDDL has been handed over to BN. The dockyard with an area of 48 acres, located within the Chattogram Port area is capable of repairing 175m length, 24m breadth, 8.5 draft and up to 22000 dwt ships in her dry-dock. Since inception, CDDL has repaired more than 1000 merchant and naval ships. Presently CDDL is earning profit and planning to build Frigates and OPV for Bangladesh Navy. CDDL will be capable of building more than 20000 DWT merchant ships in near future after construction of a second dry dock.

There are hundreds of indigenous private shipbuilding and repair yards at various location of Bangladesh that are manufacturing and repairing almost all the inland and coastal water transports. Among these, some have long shipbuilding history and reputation. As an example, High-Speed Shipyard Ltd has 60 years of shipbuilding history. Again, some private shipyard has gained international standard and are manufacturing small and medium new ships for international market. Recently few of these shipyards have attained the capability to manufacture 10000 DWT merchant ships. Few local private shipyards have received orders from the foreign ship owners (such as Germany, Japan, Denmark, Netherlands, EC, Mozambique, India, Nigeria, etc). Those promising local shipyards are Annada Shipyard and Slipway Ltd (ASSL), Western Marine Shipyard Ltd (WMSL) and Karnophuli Shipyards and Slipway Ltd (KSSL). Those local shipyards have constructed and handed over dozens of ships to foreign owners. Few more local shipyards are improving their capability. New hope has been developed to receiving FDI in local shipbuilding from foreign countries.

Bangladesh has long and glorious shipbuilding and maritime history. It will encourage local entrepreneurs and foreign investors to come forward in this field and definitely we will be successful in this sector. Around 40,000 thousands inland and coastal ships and around 100,000 of mechanized country boats are plying all over the country, which carry more than 85% of oil product, 65% of

cargo and 25% of passengers in total. All of those ships and boats are manufactured and maintained by local shipyards. There are around 100 indigenous shipyards in Bangladesh, and 4 local shipyards are capable of making class and export standard ships around 10000 DWT. Another few shipyards are developing facilities and capacity aiming to enter into export market. Around 200,000 skilled and semi-skilled/casual workers are employed in these shipbuilding industries. Two million people are also related with the local shipbuilding industry either directly or indirectly.

Productivity of Bangladesh shipbuilding labor is 11.43, and average hourly labor wage is only USD 1.00 (in 2009) which has been shown in table 2 and figure 4 respectively below. Again relative labor wage of local shipyard is only 0.45 and that is the lowest in the world (in 2009) which has been shown in table 3 below. On the other hand, the comparison of relative labor wage in different nations around the globe has also been shown in figure 5 when Bangladesh he lowest in the world. However, average hourly labor wage in Bangladesh in 2021 has increased but again remained comparatively lowest in the world. Ultimately Bangladesh shipbuilding remains at advantageous position in the world in term of cheap labor wages.

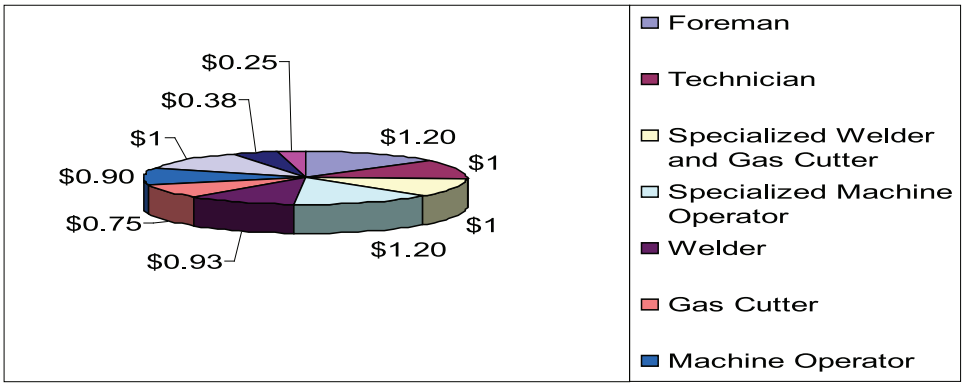

Fig 4: Average labor wage for class ship build in local shipyards in 2009 (Source: MSC Thesis 2010, Hossain et al 2017)

Country	Formula for Labor Productivity = Man-Years/Unit Output (in CGT)	Productivity
Japan	Using basic formula	1
European countries	Same	2
United States	Same	4
China	Same	6
India	Same	10
Bangladesh	Same	11.43

Table 2: Shipbuilding labor productivity of different nations in 2009 (Source: MSC Thesis 2010, Hossain et al 2010)

Country	Relative Labor Wage	Country	Relative Labor Wage
Bangladesh	0.45	Canada	11
India	1	Japan	12
China	1 to 2	Italy	13
Singapore	3	France	13
Hong Kong	3	Denmark	13
Taiwan	3	Norway	14
South Korea	6	Sweden	14
U.K.	10	Finland	15
USA	10	Germany	15

Table 3: Relative labor wage for different nations around the globe in 2009

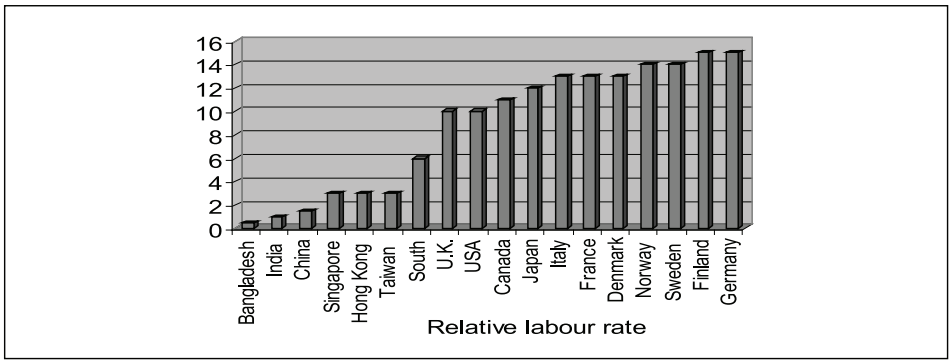

Fig 5: Relative labor rate or wage for different nations around the world (Source: MSC Thesis 2010, Hossain et al 2010)

Type of Ships Built in Bangladesh Shipyards

A number of various types of ships and vessels are built in local shipyards. There are around 40,000 inland vessels which are playing in rivers and sea coast, and half are registered in Department of Shipping (DOS). Beside those, around 100,000 mechanized country boats and trawlers are also operating in various

rivers of Bangladesh. More than 500 coastal ships have been registered with Mercantile Marine Department (MMD). The real number of vessel actually built in local shipyards is quiet more than the registered vessels in DOS and MMD. Principal data (L, B, d, dwt, etc) of most common types and sizes of ships which are built locally and ply in inland and coastal water has been shown in table 4 below.

Three types of designs/drawings are use being in shipyards for building a new ship. For them, basic and technical designs come from internationally recognized design house. Local shipyards and design houses are capable to supply working drawing for the class vessels. However, local ship designers are providing all drawing for inland ships. ASSL, WMSL and KSSL bought basic and technical design from international market to build their export quality ships. However, most of the primitive types of local shipyards has no basic and academic knowledge about ship design. That's why faulty ships are constructed and accidents occur in Bangladesh in every year. DOS of Bangladesh has shown keen interest to develop the inland shipbuilding sectors. But they have shortage of qualified technical personnel to implement the existing rules and regulations. There are dozens of shipyards and firms/houses enlisted in DOS to design inland and coastal ships. There are billion dollars ship design business floating in the world market. Bangladesh has golden opportunity in this profitable business. Naval architects are the nucleus of a ship design firm or house. Unfortunately at present Bangladesh neither has qualified naval architect nor has such business motive.

Dredger	30-100	10-30	4-8	2.0-3.0	Inland
Dredger	30-100	10-30	4-8	2.0-3.0	Inland
Types of Vessels	DWT or no of passenger	Length in Meter	Breadth in Meter	Draught in Meter	Usually Ply
Multipurpose ship or Coaster	1500- 4000	60- 120	10- 16	3.5- 6.0	Coastal
Cargo	1000- 3500	50- 100	10- 15	3.0- 5.0	Inland and Coastal
Passenger ship or Ferry	300- 1500 Passenger	60- 110	10- 20	3.0- 4.0	Inland
Tanker	1000- 4000	50- 120	10- 16	3.0- 6.0	Inland and Coastal
Sand Carrier	200- 500	20- 40	5- 10	2.0- 3.0	Inland
Barge	200- 1000	20- 60	6- 14	2.5- 3.5	Inland

Table 4: Principal data (L, B, d, DWT, etc) of most common types and sizes of ships which built locally and ply in inland and coastal water

Suitable Market for Bangladesh Shipbuilding Industry

Mordor Intelligence has calculated and announced that, 'the global shipbuilding market value in 2021 was USD 132.52 billion. They have evaluated and anticipated that, 'future global shipbuilding market will reach USD 175.98 billion by 2027, at a Compound Annual Growth Rate (CAGR) of 4.84%'. We know that, the COVID-19 outbreak has impacted the global shipbuilding industry. The pandemic's negative effects were evident in worldwide on ship supply chains. Shipbuilders need extended duration to construct ships. So shipbuilders are expected to incur more costs for these delays. That's why pandemic-induced interruptions are likely to hinder the shipbuilding market growth during the first few years of the forecast period. They also predict that 'the shipbuilding market is expected to grow over the forecast period due to few reasons. Such as: increasing seaborne trade, economic growth, rising energy consumption, the demand for eco-friendly ships and shipping services, and, automation in shipbuilding' (Mordor Intelligence 2022a). Prediction of shipbuilding growth by Region from 2022 to 2027 has been shown in figure 6.

The shipbuilding market is expected to reach USD 186.6 billion in 2025 at a CAGR of 4.2%. However, tentative size of global shipbuilding market is expected to be USD 200 billion, where small ship building market is around USD 20 billion. There is a serious demand of container ships in all size (Business Research Company 2021). UNCTAD, WB, WTO, and OECD have detected the high demand of container ships in coming days ahead. Small niche shipbuilding market is suitable for local shipbuilders. In coming future, the world will need few thousand of vessels, mostly small to medium sized. Old single hull tanker fleet will be replaced totally and immediately as per IMO requirement. In future we need to develop our own merchant fleet to maintain our export and import business of cargo, energy and other goods. There will be another local niche market for us.

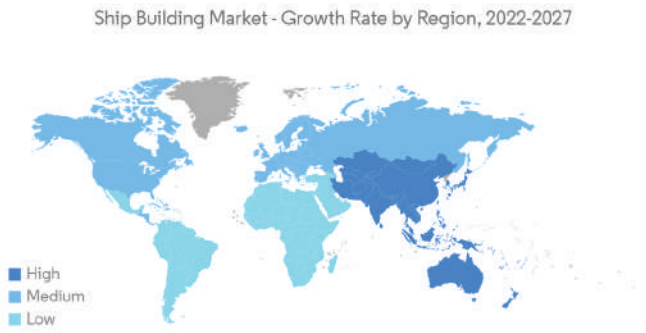

Fig 6: Prediction of global shipbuilding growth by region from 2022 to 2027

(Source: Mordor Intelligence 2022)

The sea area of Bangladesh is of enormous importance, because it is the only way of direct connectivity to the rest of the world during crisis with any of our neighbors. Constant presence of BN and BCG are imperative for keeping the sea lanes of communication secured, establishing and maintaining the sovereign rights over our 118813 sq. km sea areas and economic benefit of the country. In order to avert any threat to national security by 'traditional' and 'non-traditional' means, both the organizations remain vigilant by deploying ships at sea. The military troop transportation in the bays also necessitates some landing crafts for the navy and army. In these ways a good number of military ships are required for operational tasks both in peace and wartime. And that is also a local niche market for BN operated private shipyards along with huge local inland and coastal fleet. Bangladesh is capable to capture 2% of global shipbuilding market (mainly small and medium) and that value is around USD 3.5 billion. But, it needs special care, appropriate policy and sustainable strategy.

Present Challenges of Bangladesh Shipbuilding Industry

Only few local shipyards have found to be careful and have attitude to improve quality, health, safety, and environmental (QHSE) aspects, which are again at average level. Pressure from the government and the foreign buyers together with the awareness program and training on QHSE aspects will lead the local shipyards to international ones. Most of the local shipyards are very

reluctant to follow corporate management culture. Family members occupy the important managerial appointment. Such family management culture is one of the hindrances for development of the shipbuilding. For example ASSL has failed to continue their success in ship export business due to family management culture. We need to change our attitude like “get rich quickest way possible”. We need to improve our mentality to a more sustainable way. For example WMSL has failed to continue their success in ship export business due to their attitude to get rich in the quickest way. Unfortunately they invested to other business in the ambition to become rich easily and quickly. Business consistency and sustainable way of doing business is the main tools of success in shipbuilding business.

There is no corporate management culture practiced in local shipyards. Poor job satisfaction observed among the middle level management and skilled workforce. Workforce merely enjoys industrial benefit, like production bonus, and fringe benefit; does not enjoy labor welfare activities like medical, pension, travel or daily allowance, accident and other compensation. Main workforce is employed in casual basis. Local shipyard owners do not bother about working environment and welfare of the employees due to abundance of cheap labor in local job market. As a result, substantial number of graduates and other skilled manpower trained in maritime industry leave frequently from the local private shipyards for overseas employment.

Additional financial cost of local shipbuilding is about 10 to 20% higher than the other competing nations like China, Korea, Japan, India, Vietnam, etc. High price and shortage of electricity and gas supply as well as other poor infrastructure are major obstruction, which hinders the setting up shipbuilding industries in Bangladesh. Relatively poor state diplomacy, country image and lack of activities to promote local shipbuilding are creating obstacle to growth of this promising industry. The government allocation of Annual Development Program (ADP) for waterways and water transport is below 4%, whereas for road is above 70%. Local shipbuilding industry is still at a vulnerable stage; need so many things to do, to develop into international and competitive standard. If this sector get same facilities as given to the RMG sector, the net benefit will be better in comparison to that of RMG.

Future Challenges of Bangladesh Shipbuilding in Contest of 4IR

In the recent time, the impact of 4IR or Industry 4.0 has been discussed everywhere. The first industrial revolution introduced water and steam-powered mechanical manufacturing. "The second industrial revolution brought electrically powered mass production system and the third industrial revolution introduced electronic and Information Technology (IT) for achieving automation in manufacturing process" (Wikipedia 2022). On the other hand, "the incoming 4IR leads to the complex use of digitization, combining the cyber world with the physical world by including AI, IoT, big data analytics, cloud computing, virtual and augmented reality, simulation, human-machine interaction, 3D printing, advanced materials technology, etc" (Kobylinski 2018). The main goal of 4IR is intelligent shipyard which is characterized not only by adaptability, resource efficiency and ergonomics but also close integration among all stakeholders (Andi Reni et al 2020).

Actually 4th IR is balanced to connect, integrate and automate everything on a grand scale: man, machine, materials, manufacturing process, products, logistics, customers and that across the whole spectrum. This new industrial revolution wave in the shipbuilding sector is called shipbuilding 4.0 and it is basically the follow up of the industry 4.0 concept applicable in shipbuilding industry. Industry 4.0 will definitely influence in the whole maritime sector and the transformation that will come in the shipbuilding industry is also believed to be very crucial (Noordstrand 2018). The main goal of shipbuilding 4.0 is intelligent shipyard which is characterized not only by adaptability, resource efficiency and ergonomics but also close integration among ship owner, shipbuilder, suppliers, the partners in the business and value processes.

The shipyards that will fail to follow the changes will not survive and make profit. The shipbuilding 4.0 promotes not only the digitization of the design and ship construction, but also requires further development of process optimization, standardization, digital inter-connectivity, optimization of information, interfacing the material management and information management within the entire supply chain. Full implementation of 4IR or Industry 4.0 and shipbuilding

4.0 is still a long way; but definitely more automation will come in future to cut production time, manual labor, etc. The new machine-based advanced technology will evolve and shipyard needs a good infrastructure to work with man and machine. There may be change of supervision and inspection techniques. Application of drones and automatic welding will reduce risky job during the construction of ships (Bearingpoint 2022). In shipbuilding 4.0, the shipyards need to have skilled engineers, naval architect, specialists not only in technical science, but also in IT science.

Future engineers must have enough qualification to do all work done in a multidisciplinary environment using advance technology with interaction with machine while the ship is at her production stage. Also, in the design phase, it is very important to design innovative solutions together and in the closer cooperation with the selected suppliers. In near future shippers will be benefited from better forecasts with the increased availability of shipping data and advances in big data analytics, providing shippers with greater visibility into market and pricing trends. Automated Identification System (AIS) is a constellation of satellites that keep track of ship movements, will integrate data with information such as bills of lading to give shipping strategists a clearer understanding of how trade routes evolve over time (Andi Reni et al 2020).

Ship designer needs to be minimized the design period as well as the engineering costs for future classes of ships. We need to acknowledge the facts and take necessary steps to embrace IR 4.0 especially for our promising export-oriented shipbuilding in Bangladesh. We must understand that only cheap labor cost may not be the major competitive factors in future for shipbuilding. We need to identify possible areas of improvement based on the scientific studies considering present industrial structure and future needs and requirements of shipbuilding (Bearingpoint 2022). Government and stakeholder should come forward to support this industry. The 4IR is anticipated to reach at the peak around the middle of the 21st century and bring disruptive changes by exploring and implementing new technology in all spheres of trade and shipping to create safer, efficient, greener, and viable solution.

The technologies like Robotics, AI, Machine Learning, IoT, Blockchain, Drones, and Augmented Reality (AR) are going to change the equation of the job sectors and give a new dimension of maritime industry (Wikipedia 2022). To overcome the present situation and future complexity few measures need may be adopted by government, maritime administration, shipyards, ship-owners, MET and technical institutes. The policy, strategy, context and learning process in the mass and technical/MET education need to be formulated accordingly to develop the skills and knowledge for new generation. There may be skill development program for seafarers and shipbuilding workforce to meet the future challenges. Such program are: communication and coordination, QHSE, adaptability and cognitive flexibility, automation and AI, digital proficiency, innovation and creativity, critical thinking, emotional intelligence, technical skills, self learning (on-line), data-based decision, people management and negotiation, complex problem solving skill, service orientation, etc.

Future Hope of Local Shipbuilding

Present government has taken some step and drafted a shipbuilding policy to improve the shipping and shipbuilding sector as a whole. Before implementing the policy, it needs to consider proper evaluation and uniform priority, so that both public and private shipyards get benefit equally from the policy. Recently the opportunity of FDI has created in shipbuilding sector. Country like China, Turkey, Netherlands are showing their keen interest in this sector. So creation of an export shipyard zone or air-marking a special zone for export oriented shipbuilding can positively help to develop healthy growth of shipbuilding industry in Bangladesh. Small and medium size container, tanker, cargo, multipurpose and special types of ships with around 3000-10000 DWT is suitable for Bangladesh. Bangladesh has all potential and capacity to capture this niche market with competitive price.

Conclusion

Actually, Bangladesh can make a considerable economic progress by properly nourishing and utilizing this export oriented shipbuilding industry. Entrepreneurs have also confident on good prospect of local shipbuilding industry. Bangladesh is taking the advantages of its long history of maritime activity, favorable geographical location and availability of cheap work forces. Export oriented shipbuilding is truly a global industry. It is a technological, labor and capital intensive industry. Bangladeshi-made ships of international standard are roughly 10%-20% less costly than ships made in Japan, Korea, China even Vietnam or India. However our cheap labor alone cannot be the only factor for the sustainability of this industry in Bangladesh. Nowadays advance technology could bring cost savings and, in that case, we have a chance to lose our competitiveness, if we only rely on labor cost. Therefore, for the development, expansion and long-term sustainability of this industry, numerous issues need to be addressed because the ultimate goal is to become competitive relative to other shipbuilding countries in the long run.

Bangladesh can make a huge economic progress by properly nourishing and utilizing our export oriented shipbuilding industry. Entrepreneurs have also confidence on good prospect of local shipbuilding industry. Bangladesh is taking the advantages of its long history of maritime activity, favorable geographical location and availability of cheap workforces. Export oriented shipbuilding is truly a global industry. Bangladeshi-made ships of international standard are roughly 10%-30% less costly than ships made in Japan, Korea, China even Vietnam or India. Bangladesh has all capability and possibility to grip 2% of global shipbuilding market share within 2030; but which need appropriate policy, sustainable strategy and government support.

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Biography of the Writer

Commodore Khandakar Akhter Hossain, (E), NUP, psc, PhD, BN has join in Navy as cadet and got commission in engineering branch in 1990. He is a renowned naval architect and marine engineer and working last 32 years with excellent reputation in home and abroad. He has immense experience in shipbuilding, ship-repair, ship recycling, port management and construction, marine pollution control, waste management, clean environment, energy solution, blue economy and other maritime field. He did his B Sc and M Sc Engineering in naval architecture and marine engineering with distinct result (first class first) from Bangladesh University of Engineering and Technology (BUET). He did his Ph D both from California, USA and from BUET. He did ISMC from USA. He did MDS and MBA from reputed public University. He served as engineer officer onboard different ships including five modern frigates/corvettes (BNS Bangobandhu, BNS Omar Farooq, BNS Shadhinota, etc) and as instructor/professor in Naval Academy, Marine Academy, NIT and MIST. He also served as GM (Shipbuilding), GM (Production) and GM (planning and marketing) in Khulna Shipyard, Narayangonj Dockyard and Chittagong Dry-dock Ltd respectively; and as Staff Officer in UN Mission in Sudan. He also works in Naval Headquarters as Deputy Director. He has serve as member engineering in Chittagong Port Authority. He successfully works as Managing Director of DEW Ltd and make it a profitable shipbuilding industry. He has served as Head and Dean of NAME Dept and Mechanical faculty of MIST. He also successfully works as Managing Director in Khulna Shipyard Ltd. He has more than fifty international publications/articles on shipbuilding, ship re-cycling, energy solution, human management diversification, port operation and engineering technology in different international technical journals. Presently he is working as CSD in BN Dockyard. He is happily married with Dr Sharmin and blessed with twin daughters and two sons.

TSUNAMI HAZARDS AND STUDY OF PREPAREDNESS IN SOUTH COAST OF BANGLADESH

Commodore A K M M Sherafullah, (H), NGP, BCGMS, psc, BN

Abstract

Ocean is a source of several natural phenomena including disastrous events such as tsunami, cyclones and associated storm surges. Out of different causes, normally tsunami generates due massive earthquake in the ocean. Tsunami consists of a series of water waves. It may occur at any time, day or night. World did not forget the devastating tsunami of Indian Ocean that occurred on 26 Dec 2004. Killer tsunami touched many countries around the Indian Ocean keeping the trace of unbearable destruction. Although not very frequent, tsunamis are among the most terrifying and complex physical phenomena.

Tsunami wave moves with very high speed of 500-1,000 km/hour and a very long 100-500 km wavelength. Tsunami Warning Centre (TWC) provides an early warning based on some information from different sources. With the help of modeling, characteristics of tsunami can be estimated for dissemination warning messages. Subduction zone in between Indian and Burma plate near Andaman-Nicobar-Sumatra arc may trigger massive earthquake and subsequently abled to generate tsunami which can travel up to southern coast of Bangladesh. As per historical record, a major earthquake of ~8.8 magnitude took place in Arakan in 1762. It created tsunami causing huge damages in the coastal belt including Chattogram of Bangladesh and travelled up to Dhaka. Devastating tsunami may cause catastrophic situation in the Bangladesh Coastal area, as the land configuration of the country is mostly flat. Thus, a viable tsunami awareness system with root level effective preparation may help to mitigate risk of tsunami ruin in the coastal area. Geologists think earthquake of 1762 density may be repeated in 500-700 years. The Andaman-Nikobar-Sumatra fault has the potential to host earthquake 8.5+ magnitude that may cause tsunami generation in the Bay of Bengal.

For Bangladesh, presently Bangladesh Meteorological Department (BMD) is disseminating Tsunami early warning messages after receiving

inmation from Indian Tsunami Early Warning System (ITEWC). It is to be noted that ITEWC disseminate Tsunami Advisories based on the earthquake data as received from seismographic stations available in the region and tidal data. In the sea beaches of Bangladesh daily almost 50,000 tourists visit. Besides, 255 registered trawlers, ~68,000 fishing boats are engaged in fishing daily. So it will be a challenging task for passing warning messages to large group of fishermen those will be out off harbour.

Bangladesh is considered as a model for disaster management. Ministry of Disaster Management and Relief (MoDMR) coordinates under the guideline of National Disaster Management Council (NDMC) led by Honorable Prime Minister. The National Plan for Disaster Management and Standing Orders of Disaster are two important documents that addressed 9 major possible natural calamities for guiding and monitoring Disaster Management activities in Bangladesh. These documents defined clear responsibilities by all concerned agencies and organisation in order to strengthen interoperability, coordination and collaboration within themselves for effective implementation of action plan outlined by the Government.

Introduction

Blue water is getting more priority as source of natural phenomena that are beneficial to humankind. However, oceans are also associated with disastrous events such as tsunami, cyclones and associated storm surges. Danger from a tsunami can last for several hours after the arrival of its first wave and have ability to move faster than a person can run. World did not forget devastating tsunami of Indian Ocean that occurred on 26 Dec 2004 off the coast of Sumatra. Killer tsunami wave touched many countries around the Indian Ocean.

Tsunami and earthquake appears as a surprise without adequate notice unlike other natural calamities. Though not very frequent, tsunamis are among the most terrifying and complex physical phenomena and have been responsible for great loss of life and extensive destruction to property. Because of their destructiveness, tsunamis have important impacts on the human, social, and

economic sectors of societies. While travelling, it paints unexpected destructions enroute of its journey showing every scope of devastating touch.

As tsunami normally generates in a convergent area of subduction zone of tectonic plates, mostly it is found in the submerged subduction zones of Pacific. The subduction zone of ocean, where plate movements are very prominent, most volcanic eruption and tsunami found. There are some active movements of tectonic plate near Andaman-Nicobar-Sumatra arc. Tsunami generating from this area has can travel up to southern coast of Bangladesh. Bangladesh coast is very flat and most of its land is within 10m of sea level. Thus a viable tsunami awareness system with effective preparedness may help to mitigate risk of tsunami devastation in the coastal area of Bangladesh.

AIM

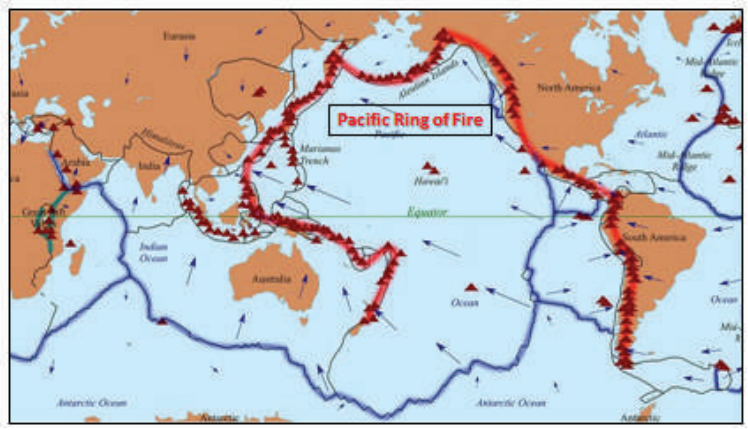
Aim of this paper is to provide basic understanding on tsunami giving emphasis to its cause, impact and orthodox alerting mechanism with a study of preparedness in south coast of Bangladesh.

Tsunami and its Behavioral Impact

The word tsunami is composed of two Japanese words "tsu" (which means harbour) and "nami" (which means "wave"). A tsunami can be generated by any massive disturbance that rapidly displaces a large mass of water. Tsunami waves are completely unrelated to the tidal wave. Tsunami phenomenon is a series of large waves of extremely long wavelength and period usually generated by a violent, impulsive undersea disturbance or activity near the coast or in the ocean. Tsunami waves behave very differently in deep water than in shallow water. In shallow water, wave height increases and strike shore which may inundate low-lying coastal areas resulting in mass destruction.

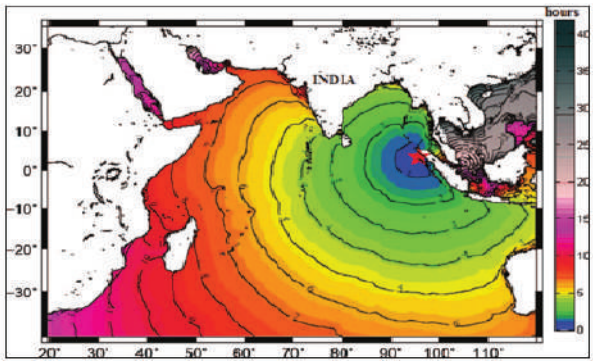
Tsunami can be generated in all of the world's oceans, inland seas and in any large body of water where mainly subduction of tectonic plate found to be more active. Tsunami is being recorded in all the major oceans of the world. Most tsunamis occur in the Pacific Ocean and its marginal seas as it covers more than one-third of the earth's surface and is surrounded by a series of mountain

chains, deep-ocean trenches and island arcscalled the "ring of fire" (pic-1), where most earthquakes occur.



Pic-1: Pacific Ring of Fire

Although not as frequent as of Pacific Ocean, tsunamis are also generated in the Indian Ocean mainly by the subduction zone related earthquakes from two potential source regions, i.e. Andaman- Nicobar-Sumatra island arc and Makran subduction zone in north of Arabian sea. In last 300 years, this region recorded 13 tsunamis and 3 of them occurred in Andaman and Nicobar region. On 26 Dec 2004 (Boxing Day), an earthquake of 9.3 magnitudes originated off Sumatra coast (pic-2) that created killer tsunami with a surge of approximately 33m (108 ft). Killer tsunami wave touched as many as 14 countries around the Indian Ocean and as per latest updated records, more than 20,00,000 people killed.



Pic-2: Tsunami Limit of 26 Dec 2004

Causes for Tsunami

a. **Earthquake due Tectonic Plate Movement:** Large vertical movements of the earth's crust can occur at plate boundaries. Subduction earthquakes in water bodies are particularly effective in generating tsunamis.

b. **Volcanic Eruption:** Although relatively infrequent, volcanic eruptions can displace a great volume of water and generate tsunami waves.

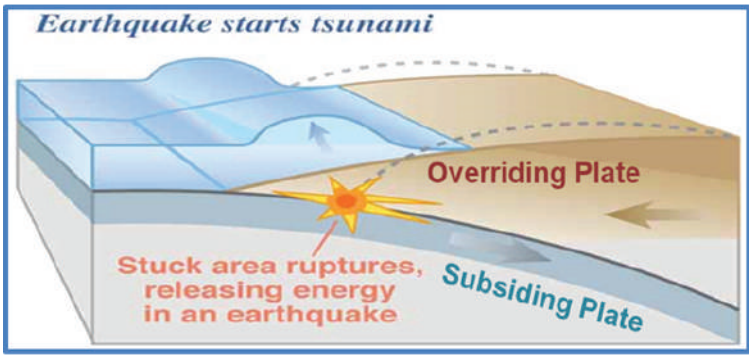
c. **Submarine Landslides:** Submarine landslides are sometimes triggered by large earthquakes as well as collapses of volcanic edifices may also disturb the overlying water column causing tsunami.

d. **Meteorite Impact:** It is possible that an asteroid may have fallen on the earth in prehistoric times and it would have the potential of generating tsunamis of catastrophic proportions.

e. **Ice fall from Glacier.** Millions of tons ice falling from the glacier can cause earth quake and tsunami.

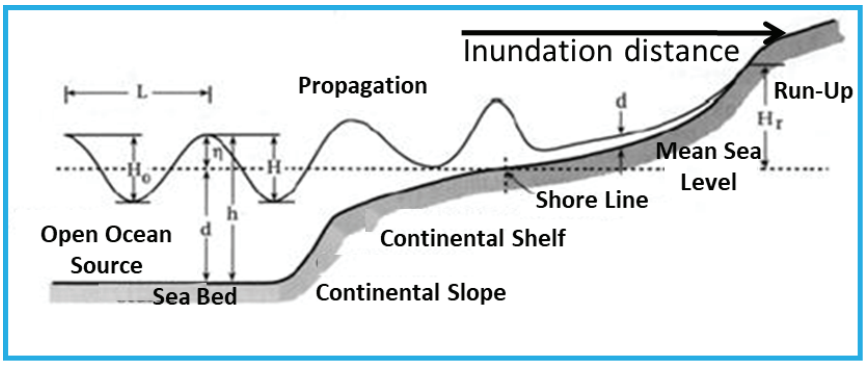
Characteristics of Tsunami

Generation. To generate a tsunami, the fault where earthquake occurs must be underneath or near the ocean and cause huge vertical movement over a large area (up to a hundred thousand square kilometers). Shallow focus earthquakes (depth around 70 km) along subduction zones are responsible for most destructive tsunamis (pic-3). This initial water surface disturbance is transformed into a long gravity wave radiating from the earthquake source.



Pic-3: Graphical View of Tsunami Generation

Propagation. Tsunamis waves travel outward in all directions from the origin. Its speed depends on the depth of water, so the waves undergo acceleration and deceleration in passing over an ocean bottom of varying depth (pic-4). Specifically Tsunami waves undergo a process of wave refraction and reflection throughout their travel. General characteristics are:



Pic-4: Tsunami Propagation

a. Movement of water wave by entire ocean column (often several kilometers depth) with a major influence of its behavior and appearance.

b. Wavelength is very long, sometime crest to crest distance 100 - 500 km.

c. Wave traveling speed 500- 1000 km/h.

d. It contains huge energy and can travel great transoceanic distances with little energy loss.

e. Its energy flux that depends on its wave speed and wave height remains nearly constant.

f. Sometimes it appears as just one wave but often multiple waves found travelling a few minutes apart.

g. As the wave approaches shore, due to the frictional effect tsunami's speed decreases and height goes-up, sometimes 30m+ when it bangs coastline.

h. Tsunamis begin to lose energy as they rush onshore and part of the wave energy is reflected offshore.

Run-up. Height of propagating tsunami wave that appears coast with influence of near-shore bathymetry and coastal morphology.

Inundation. The distance in the shore area that covered by tsunami wave.

Tsunami Warning System

TWC works to detect tsunamis and issue early warnings to prevent loss of life and property. It provides information to emergency officials, and as appropriate, directly to the public. It consists of two equally important components:

a. Seismic Stations. As primary component of risk assessment, global and local seismograms give real-time seismicity in order to locate potentially tsunami-genic earthquakes.

b. Sea Level Measurement. Bottom Pressure Recorder (BPR) gives information by measuring abnormal sea level changes in the earthquake zone that actually triggered a tsunami or not.

Tsunami Modeling for Operational Forecast. One of the most important requirements for tsunami warning system is to generate simulations of expected travel time and run up height of tsunami wave. Pre-run scenarios available in the database help TWC to predict characteristics of tsunami wave. By using different numerical modeling tsunami travel time from the source, potential run-up height and inundation limit in the coastal area can be determined. For running the modeling, quality and fine interval data on land elevation and bathymetry are required. Presently different types of codes like Tunami, MOST/COMMIT, COMCOT, MIRONE, ANUGA etc. are being used for tsunami modeling.

Operating Procedure at Early Warning Centre

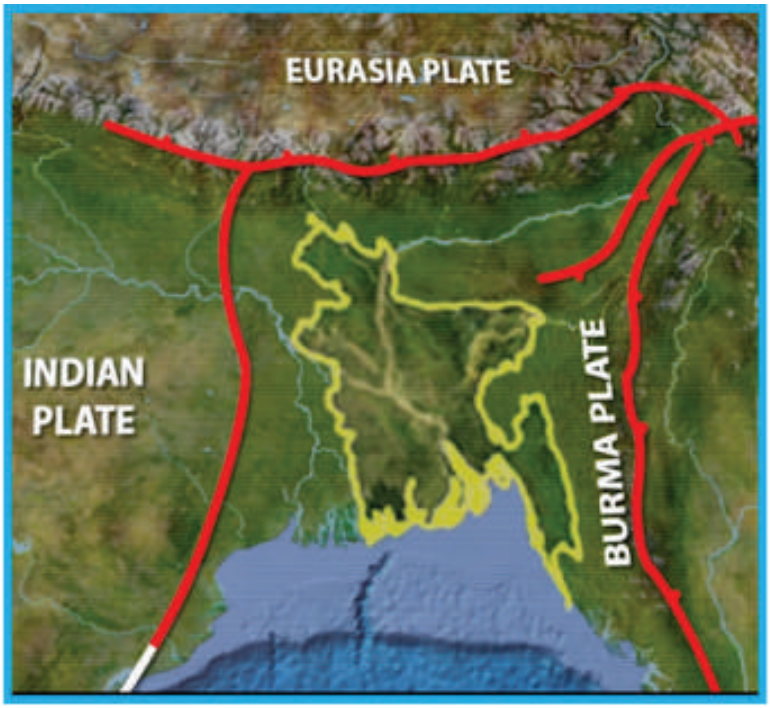
When a large earthquake occurs, TWC determine the earthquake's hypocentre, the initial rupture point and its magnitude. If hypo centre is under or near the ocean and not too deep within the earth, and if magnitude is sufficiently large, then tsunami generation is possible. The first indication of a tsunami usually comes from the BPR, located nearest the earthquake.

After getting an indication of tsunami, TWC disseminate tsunami advisory and warning messages to designated national or local authorities for their subsequent action. For a local tsunami, TWC should respond within 2-5 minutes and for distant tsunami, it responds within 10-20 minutes.

TSUNAMI VULNERABILITY IN BANGLADESH COAST AND STATE OF PREPARATION IN MITIGATION OF DAMAGES

Tsunami Vulnerability of Southern Coast of Bangladesh

Bangladesh is geographically positioned in between Indian, Eurasian and Burmese Plates (pic-5). Chattogram is situated on the presumed fault between Indian and Burmese Plate. Indian plate is advancing at a speed of 7cm/year north-easterly. But, Eurasian plate is moving ~2.4cm/year northerly. Geologists think, it has the ability to host 8.5+ magnitude earthquakes with a possibility of tsunami generation in the Bay of Bengal.



Pic-5: Bangladesh & Tectonic Plates

As per historical record, a major earthquake with a magnitude ~8.8 in Richter scale took place in Indian and Burma tectonic plate subduction zone on 2 April 1762. The epicentre was not well-constrained and likely locations have varied from near Chattogram to along Arakan coast. It was associated with major areas of uplift and subsidence in Chattogram and Arakan Coast. As per study three uplifts were found due this earthquake. In Bangladesh coast the Saint Martin's Island has been uplifted by 2-2.5m and in Myanmar coast, Foul Island to Ramree Island were uplifted. An area of about 60 square miles permanently subsided beneath the sea near Chattogram coast. The land was reported to be sunk at Bar Chara, just north of Cox's Bazar and ~500 people died. For this, course of Brahmaputra River was changed, from east of Dhaka to 150 kilometers west, via Jamuna River. In Chattogram, it was reported that all brick-built buildings was severely damaged/ destroyed and many died. A tsunami was reported along the coast of Bangladesh with a surge 2m. Starting from Chattogram it travelled up to Dhaka and Kolkata keeping touch of different destructions. Geologists think similar phenomenon may be repeated in about 500 years.

Threat Level Study in Bangladesh Coast Comparing Victims of 2004 Tsunami

After study of 2004 tsunami destructions, mostly following three categories of people in different countries of Indian Ocean found to be victimised:

a. Tourists in the sea braches.

b. People engaged in tourist services and tourism business.

c. Fishermen out for fishing.

Considering above three categories of people, while talking about Bangladesh, it is felt that everyday almost 410,000 people found to be at risk of tsunami vulnerability, like:

a. Approx 50,000 tourists visits sea beach (Cox’s Bazar: 30,000, Kuakata: 5,000, Patenga: 5,000, Other: 10,000)

b. Approx 10,000 people engaged in tourism service or business.

c. Approx 350,000 people goes out for sea fishing (255 Registered Trawler, ~68,000 Mechanised & non-mechanised fishing boats)

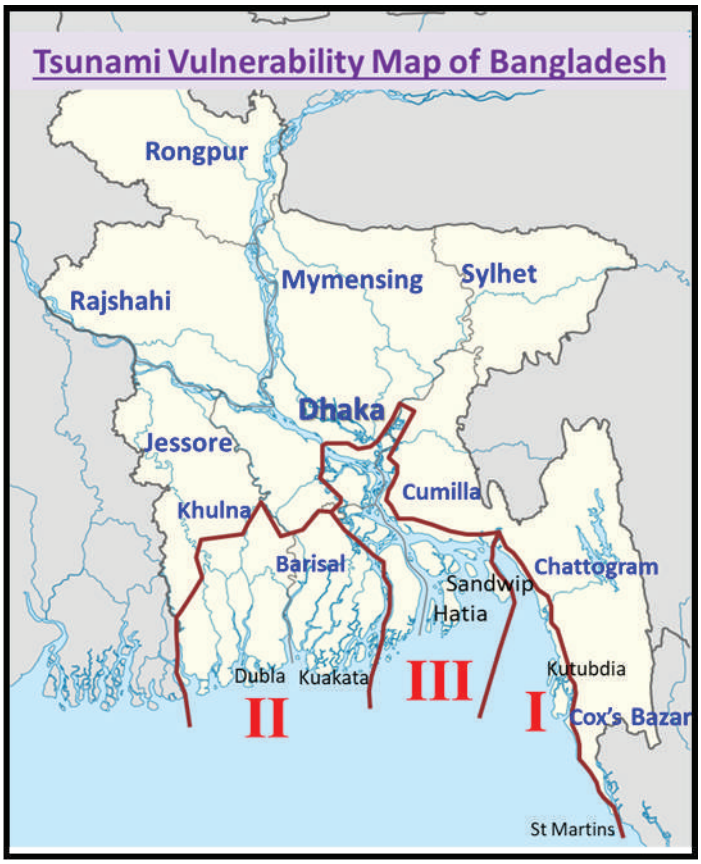
Distance of coastal points from Andaman is less than 1,000 km. If tsunami is triggered due severe earthquake in Andaman zone, it will take 40-50 min to reach Bangladesh coast. Thus overall reaction time is not at all enough for taking adequate preventive measures against tsunami destruction. If at all tsunami wave with water surge of ~3m comes towards Bangladesh coast, it will just arrive as bombshell to the coastal area of Bangladesh that includes St Martins, Teknaf, Coxs Bazar, Moheskhali, Kutubdia, Anowara, Patenga, Sandwip, Hatia, Bhola, Kuakata, Dublar char, Mongla and many more low lands. Though 3m wave height is less than many mega tsunamis, this might be a very influencing factor for creating devastation in the Bangladesh coastal belt. It is to mention that, in 1762, when tsunami triggered near Andaman, that time, there was no tourism cultures in the aforesaid sea beaches. People were not interested for catching fish from sea. So the lateral damages were less. But if that type of tsunami takes place in the northern Bay of Bengal, it may cause fatal devastation to at least 400,000 people. So, it will be a very challenging task for passing warning messages and taking fruitful measures in saving lots of lives.

Tsunami Vulnerable Zone of Bangladesh Coast. Considering the state of tsunami vulnerability and potential seismic sources, Geological Survey of Bangladesh has divided Bangladesh coastal belt into three zones (pic-6):

a. Tsunami Vulnerable Zone-I (Chittagong-Teknaf coastline). Most vulnerable, because the intradeltaic coastline is very close to the tectonic interface of active Andaman-Nicobar fault.

b. Tsunami Vulnerable Zone-II (Sundarban-Barisal coastline). Moderately vulnerable, becauseit is very closely located to the‘Swatch of No Ground’.

c. Tsunami Vulnerable Zone-III (Barisal-Sandwip estuarine coastline). Low vulnerable due to presence of numerous islets and shoals in the upper regime of continental shelf.



Pic-6: Tsunami Vulnerability Zone

Preparation in Mitigation Tsunami Destruction

National Plan for Disaster Management: MoDMR of Bangladesh has the responsibility for coordinating all kind of national disaster management. NDMC, headed by honourable Prime Minister, is the supreme body for taking any kind of decisions on Disaster Risk Management (DRM). Considering tsunami as one of the 9 main hazards, MoDMR is producing 'National Plan for Disaster Management (NPDM)' periodically since 2010.

Standing Orders for DRM of Tsunami: A Standing Order for Disaster (SOD) is prepared and promulgated by MoDMR with an objective to inform all concerned about their roles and responsibilities at every stage of DRM.

Appendix-15 of SOD-2019 engraved total 33 lines detailed responsibilities for relevant organisations for tsunami DRM. Besides, it also mentioned that, emergency management procedures for other hazards also applicable to tsunami hazard. The document is very healthy and well-articulated in tsunami disaster handling. Important points which are considered as critical elements while preparing this SOD are:

a. Comprehensive Risk Assessment (Hazard Assessment and Vulnerability Assessment), including tsunami inundation modeling and evacuation mapping.

b. Warning Guidance, including seismic and sea level monitoring, data evaluation, processing and interpretation, forecasting methods and warning dissemination.

c. Mitigation and Preparedness, including education and awareness programs structural and non-structural mitigation, and government policy and emergency management procedures. Existing Cyclone Preparedness Program (CPP) should be strengthened in a way that it can prepare community for tsunamis as well as cyclones.

d. Development of Rescue, Relief and Rehabilitation Plan of Action based on the Comprehensive Risk Assessment.

Tsunami Early Warning System in Bangladesh. BMD monitors tsunami risk and early warning. A tsunami inundation risk assessment was undertaken with support from Comprehensive Disaster Management Program (CDMP) for the coastal areas of Bangladesh. The assessment identified fault zones in the Bay of Bengal which could possibly cause tsunami inundation in many coastal areas. Out of 3 regional tsunami service providers (RTSP) in Australia, Indonesia and India, presently BMD is disseminating Tsunami early warning messages after receiving information from ITEWC.

Preparation in Mitigation Tsunami Destruction

Two published documents by MoDMR 'The National Plan for Disaster Management' & SOD are well articulated for guiding, monitoring & managing

tsunami disaster in Bangladesh. However, in mitigation tsunami disaster, following points may be considered to add or edit existing SOD:

- Conservation of Coral Reefs (Can act as submersed natural breakwater)
- Development of Sand Dunes, Revetments, Dikes (Sand Dunes can be used effectively to protect land, life, ecosystems and infrastructure from excessive overtopping and damage)
- Planned use of coastal vegetation partial barrier
- Monitoring abnormal changes in animal/ fish/ bird sense behavior
- Hybrid solutions (Combinaison ofnatural /artificialmethod)
- Developing general awareness by tsunami education program
- Establish better ‘Evacuation Routes’ and ‘Safe Areas’
- Sea beaches can be brought with effective broadcast system

Conclusion

Tsunami is considered as one of the most terrifying natural calamities. Large tsunamis are significant threats to human health, property, infrastructure, resources, and economies. Post tsunami effects can be long-lasting, and can be felt far beyond the coastline. Tsunamis typically cause the most severe damage and casualties near the source, where there is little time to warn people. But large tsunamis can also reach distant shorelines, causing widespread damages. World still remember Indian Ocean tsunami that took place on 26 December 2004. It had characteristics of creating trans-oceanic wave and travelled many countries of Indian Ocean keeping a horrified touch of huge damages.

In the coast of Bangladesh, normally tsunami is infrequent. The tsunami of 12 April 1762 is still in the record of history. It was created due ~8.8 magnitude earthquake near Arakan in the convergence area of subduction zone of Indian and Burma Plate. That earthquake triggered tsunami affecting whole coast of Bangladesh, even the inundation reached up to Dhaka on the north and Kolkata on the west. If any earthquake is created in the line of andaman-Nicobar-Sumatra

subduction zone of northern Bay of Bengal, that may lead to trigger tsunami in the coast of Bangladesh. Geologists think that the earthquake of similar intensity of 1762 may be repeated every about 500 years. Those kinds of earthquake have all kind of potentialities to generate tsunami.

Unlike formation of cyclone, scientists cannot predict when and where the next tsunami will strike. But TWC can predict which earthquakes are likely to generate tsunamis and can issue necessary bulletins/messages. TWC monitor networks of deep-ocean and coastal sea-level observation systems designed to detect tsunamis and use information from these networks to forecast coastal impacts and guide local decisions about evacuation. It is true that tsunami warning mechanism have dramatically improved after devastating touch of Indian Ocean Tsunami-2004. BMD is responsible for dissemination of tsunami early warning in Bangladesh coast. In this aspect, BMD works with joint collaboration of Indian Ocean Tsunami Warning System.

Bangladesh is disaster prone country facing every year different type of natural calamities. For DRM of any kind of disaster definitely Bangladesh is a model and well organised by disseminating responsibilities to concern organisations/ units/ agencies. Bangladesh Government made an inter-accountability process for disaster risk management. As focal point, MoDMR has the responsibility for coordinating national disaster management efforts under the guideline of NDMC. Tsunami is very sudden and its appearance is very surprising. Everywhere, it is found to be very difficult as well as challenging to inform all kind of people with an early warning message and their timely evacuation. For Bangladesh coast, many will be out off home with boat for fishing, ferrying, cargo transportation etc. At a single day, approximately 410,000 people found to be at direct risk of tsunami wave, when it is triggered.

The possibilities of dissemination of tsunami warning messages for people working in the field like fishing boats, boats engaged in ferrying, cargo carrying boats etc and their evacuation to shelter station within shortage possible of time (~40 min) is of real challenge. However, carefully written two national documents namely ‘The National Plan for Disaster Management’ and SOD by

MoMR are important milestone for guiding and monitoring Disaster Management activities in Bangladesh to save invaluable life and property from the likely affected area. These two national documents have touched upon all possible means to reduce damages that may occur from at least 9 major possible natural calamities. Further, SOD defines clear responsibilities by all concerned agencies and organisation in order to strengthen interoperability, coordination and collaboration within themselves for effective implementation of action plan outlined by the Government." There is no control on the natural act of calamities. However, steps may be taken to reduce collateral damages that may cause due natural calamities by improving preparedness with the help of technologies, experiences and resources.

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Commodore A K M M Sherafullah, (H), NGP, BCGMS, psc, BN was born on 10 July 1970. He joined Bangladesh Naval Academy as Officer Cadet on 01 January 1989. On completion of his successful basic training, he was commissioned in the Executive Branch of Bangladesh Navy on 01 July 1991 and has got 32 years of outstanding blend of professional and academic career profile. Cdre A K M M Sherafullah completed his Basic Hydrography course in 1997 from BN Hydrography School, BNS ISSA KHAN, Chittagong. He then completed Category-B Hydrography Course from Ecole de Hydrograph, EPSHOM, Brest, France in 1999. He has completed Long Hydrography course from Hydrography School, BNS ISSA KHAN in 2009 and Category-A Hydrography Course from Fost-HM, HMS Drake, Plymouth, UK in 2014. He has also completed MBA in Executive Management from Royal Roads University, Victoria DC, Canada in 2009. He is a distinguished graduate of Defence Services Command & Staff College, Mirpur, Dhaka. He has completed 71th Senior Staff Course from BPATC, Savar, Dhaka in 2015. Cdre A K M M Sherafullah has excellent mix of command, staff and instructional appointments throughout his career. Prior taking over the duties of BN Chief Hydrographer on 30 December 2020, he successfully completed the duties of Commanding Officer of BNS SHEIKH MUJIB. He also served as Staff Officer (Hydrography) in NHQ, Officer in Charge, BN Hydrography School, Chief Hydrographer of Chattogram Port Authority, Deputy Director Hydrography in Naval Headquater, CSO to COMCHIT, Deputy Commandant of Coast Guard Training Base Agrajatra, Director, Personnel in BCGHQ and Director Hydrography in NHQ. He also commanded various warships and hyrographic servey ships of Bangladesh Navy namely BNS TAWFIQ, BNS ANUSHANDHAN, BNS SHAIBAL, BNS DARSHAK and BNS TALLASHI. He served in UN peace keeping mission in Congo as Contingent member and in South Sudan as Contingent Cdr of BANFMU-4. Cdre A K M M Sherafullah is happily married and blessed with one son and one daughter.

THE SCOPE OF MARITIME COOPERATION BETWEEN BANGLADESH AND INDIA THROUGH ESTABLISHING TRANSBOUNDARY MARINE PROTECTED AREA IN THE BAY OF BENGAL

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

Abstract

The present bilateral diplomatic relations between Bangladesh and India are unprecedented. Marine conservation reduces anthropogenic damage to marine ecosystems, and restores damaged ecosystems, including endangered species. Bangladesh declared its first Marine Protected Area (MPA) in 2014 at the Swatch of No Ground (SoNG) area of the Bay of Bengal (BoB) for the protection of endangered cetaceans. Transboundary MPA facilitates marine conservation through maritime cooperation among neighboring states. Expanding SoNG into transboundary MPA jointly with India facilitates the preservation of endangered species of BoB at large. It helps prevent IUU fishers' poaching since it will turn into a 'no-go' buffer zone along the International Maritime Boundary Line (IMBL). Bangladesh must pursue Track II diplomacy amidst SDG 14 and formal diplomatic channels with India to protect globally endangered marine species in the SoNG area. As such, the study was undertaken to examine the scope of jointly establishing transboundary MPA in the Swatch of No Ground area by both Bangladesh and India to foster maritime cooperation in the Bay of Bengal. The study, firstly, examines the potential of SoNG MPA for expanding into transboundary MPA jointly by the neighboring littorals. Secondly, it evaluates the scope of maritime cooperation by both neighbors to benefit each other by expanding SoNG into a transboundary MPA. Finally, the study attempts to propose agendas for Bangladesh toward expanding SoNG into a transboundary MPA.

Keywords: *Bangladesh-India Relations, Transboundary Marine Protected Area Marine Conservation, Track II Diplomacy, Bay of Bengal, SDG 14, Maritime Cooperation.*

Introduction

Bangladesh joined Indian Ocean Rim Association (IORA), which was established to focus on maritime, economic, and conservation cooperation in the Indian Ocean region (Islam, 2020). The bilateral relations between Bangladesh and India are imperative, having a solid historical basis. Both countries try to move forward based on mutual benefit and respect. Besides, having a close and friendly formal relationship between India and Bangladesh, both neighbors are also blessed with the informal nature of diplomacy, known as Track II diplomacy (Islam and Faisal, 2020a). At present, the state of diplomatic affinity with India is at an all-time high. Greater understanding, regional cooperation, diplomacy, and dialogue between the neighbors are crucial in further strengthening the existing strong and friendly relation (Rahman, 2021). Fostering multilateral connectivity through maritime cooperation among the Bay of Bengal (BoB) littorals is the cornerstone for achieving blue economic growth of the IOR region. The neighboring states can resolve their environmental disputes through transboundary Marine Spatial Planning (MSP) and effective Transboundary Marine Protected Areas (TBMPA) governance. Marine conservation reduces anthropogenic damage to marine ecosystems, and restores damaged ecosystems, including habitats, biodiversity, and endangered species. Overexploitation of marine living resources significantly contributes to the degradation of marine ecology (Hassan, 2021).

Marine Protected Area (MPA) is an area designated to protect marine ecosystems, processes, habitats, and species, including the essentials of marine biodiversity, which can contribute to restoring and replenishing resources for social, economic, and cultural enrichment. MPAs are globally elected as essential area-based tools for tackling declining marine biodiversity (Agardy, 1997; Belfiore et al., 2004) and ensuring viable fisheries, including producing ecological, economic, and social benefits under appropriate design and management conditions (Boersma and Parrish, 1999; Kelleher, 1999; Ban et al., 2012; PISCO UNS, 2016 and FAO, 2007). Accordingly, MPAs have been designated worldwide, particularly since the last decade of the past century, as portions of the marine environment primarily delimited for marine biodiversity

conservation but also as tools for fisheries enhancement (Boersma and Parrish, 1999). MPAs can be transboundary in nature, covering large or small areas, and can be established anywhere in marine waters, including high seas having conservation potential. Typically, it restricts activities like navigation, fishing, and harvesting living and non-living resources within a defined marine area. Besides, a transboundary MPA offers additional advantages in facilitating marine conservation through maritime cooperation among neighboring states (Hassan, 2019).

Following the historic verdict of the Permanent Court of Arbitration (PCA) with India in 2014, the total marine water of Bangladesh stood at approximately 1,18,813 sq km. It facilitated Bangladesh declaring its first MPA at Swatch of No Ground (SoNG) in 2014 to tap the potential for sustainable blue growth amidst marine conservation (Hassan, 2019). Besides, target 5 of Sustainable Development Goal (SDG) 2030 requires Bangladesh and India to conserve at least 10 percent of their coastal and marine areas, based on the best available scientific information by 2020. So, expanding SoNG into transboundary MPA mutually with India not only facilitates preserving endangered species of BoB at large but also helps prevent poaching by Indian fishers since it will turn into a 'no-go' buffer zone along the International Maritime Boundary Line (IMBL). Thus, if implemented, the proposed SoNG transboundary MPA will foster further maritime cooperation between the neighboring littorals of BoB.

Objectives

The broad objective of the study is to examine the scope of transboundary MPA in Bangladesh in fostering maritime cooperation with India. Therefore, the study's specific objectives are to examine the potential of SoNG MPA for expanding into transboundary MPA jointly by Bangladesh and India and to evaluate the scope of maritime cooperation by both neighbors to benefit each other by expanding SoNG into a transboundary MPA. Finally, the study proposes options for Bangladesh to expand SoNG into a transboundary MPA.

Methodology

The study is explorative research based on secondary literature, documents, and official records. Various data used in the study were collected between September 2022 and December 2022 from secondary literatures, official documents, desk reviews and the researcher's personal observations. The collected data were then analyzed thematically, and critical findings were proposed as potential agendas for Bangladesh toward expanding SoNG into a transboundary MPA in the BoB.

Literature Review

The very geographic location of Bangladesh and India demands security cooperation from each other (Ali, 2022). Track-II diplomacy is a vital apparatus to encourage the formation of mutual understanding of differing perceptions and needs based on strong problem-solving relationships (Islam and Faisal, 2020b). Research-based overarching MSP across maritime borders and sectors will facilitate blue growth efficiently, safely, and sustainably. Monitoring of the maritime area for border control, safety and security, fisheries control, customs and environment will ensure sustainable blue growth (Alam, 2019). A prudent foreign policy securing maritime connectivity based on reciprocity and mutual respect in the BoB is a dire need for Bangladesh. (Hossain and Islam 2019). Limited scientific study and appropriate data on marine ecology, habitats, species, stocks, etc., are major setbacks for the marine spatial planning of the BoB (Hassan, 2019). According to the last survey report of M V Meen Sandhani, the vessel identified 457 ocean creatures in the Bay of Bengal. (The Business Standard, 2021). On the other hand, the United Nations flag carrier and specially equipped Norwegian marine research vessel Dr Fridtjof Nansen conducted a marine survey on the fisheries stock. The survey report is expected to unveil new possibilities in establishing MPAs based on scientific data, thus contributing to the emerging blue economy of Bangladesh (Hassan, 2019).

Marine mammal species worldwide are known to be impacted by several anthropogenic activities, most of them being addressed as direct threats caused by human activities (Avila et al., 2018). In most cases, the development and

implementation of management approaches must be very dynamic due to the long list of threats marine mammals are exposed to, often requiring international collaborations and agreements (Toma s and Sanabria, 2022). SDG 14 is one of the most challenging global goals due to its critical role, limited research, and required funding (Salvia et al., 2019; Johansen and Vestvik, 2020). As research has shown, the achievement of SDG 14 is a prerequisite to the achievement of other SDGs (Singh et al., 2018). Ensuring the sustainable use of our oceans is now a global and national priority, especially under various national blue economy strategies, which often refer to SDG 14 and associated targets (Voyer et al., 2021). Marine conservation has gained much traction in the country, with consistently increasing MPA establishments and plans to improve marine and fisheries legislation to account for environmental protection (Islam, 2021).

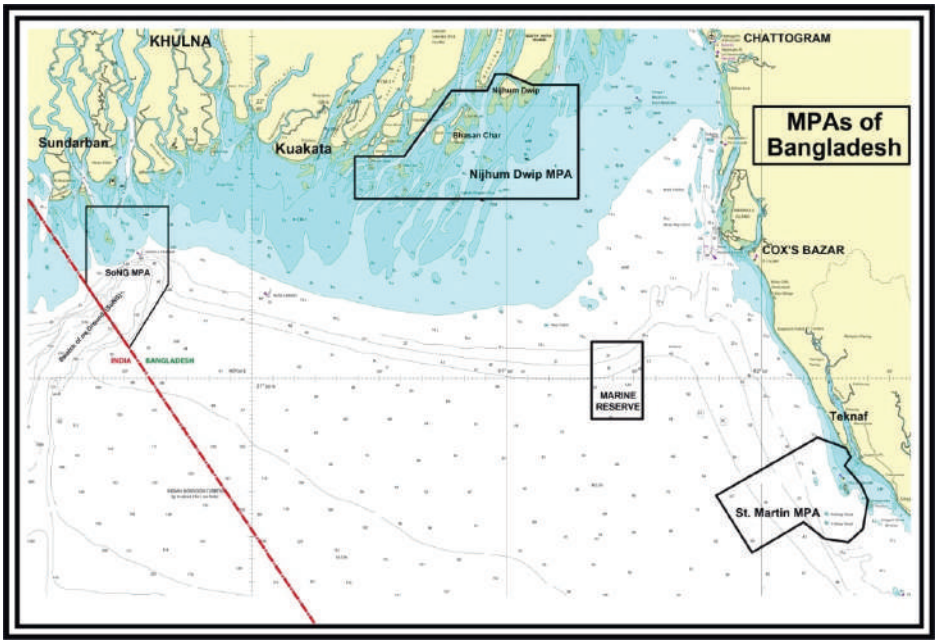
With an EEZ of more than 2.3 million sq. km., India has vast interests in the maritime domain (Narula, 2017). Based on current progress, India ranks 70th out of 165 countries in the world for life below water and is moderately improving in terms of conservation efforts (IDR, 2022). Bangladesh, by far, declared 6.28% of its sea area as MPA against target 5 of SDG 14. So, Bangladesh still needs to declare another 4,416 sq. km, i.e., 3.72% of its EEZ, as MPA so as to fulfill the marine conservation pledge of SDG 14.5 (Hassan, 2022). The objectives of formal transboundary governance arrangements are exchanging ideas and identifying shared interests. However, they often move toward increasing formalization through sharing resources, working on common problems, and delivering specific types of services (Matthew McKinney, 2015). Marine transboundary conservation between India and Bangladesh would go a long way to replenish fish stocks through biomass spillover and further assist in holistic biodiversity conservation (Tiwaryand Bajaj, 2021). SoNG MPA will also encourage dialogue with India about a potential transboundary protected area, including cetacean habitat on the other side of the border (WCS, 2015).

Marine Protected Areas in Bangladesh

The Ministry of Fisheries and Livestock (MoFL) of Bangladesh declared a Marine Reserve (may also be considered as MPA) of 698 sq. km. near the South patch and middle ground area of BoB in 2000 under section 28 of the Marine

Fisheries Ordinance, 1983 (MoFL, 2000). Later, the Department of Forest of the Ministry of Environment and Forest (MoEF) also declared part of SoNG, a submarine canyon south of Dublar Char, as its first MPA (Figure 1) on October 27, 2014, under the Wildlife Conservation and Security Act, 2012 (MoEF, 2014). The MoFL declared Nijhum Dwip and its adjacent area covering 3,188 sq. km. as Marine Reserve/ MPA on June 23, 2019, under the provision of clause 28 of the Marine Fisheries Ordinance, 1983 (MoFL,2019). Of late, the Ministry of Environment, Forest and Climate Change (MoEFCC) declared St Martin's Island, including its adjacent 1,743 sq. km. of sea area, as MPA under sections 13(1) and 13(2) of the Wildlife Act 2012 on 12 January 2022 in order to protect its rich biodiversity and ecosystem (MoEFCC,2022). However, the declared 04 MPAs of Bangladesh are depicted in the map below:

Figure 1: Marine Protected Areas in Bangladesh

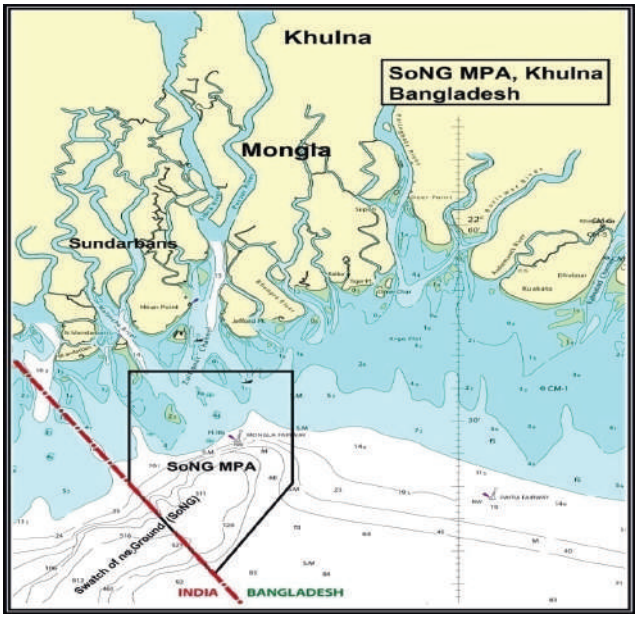


Source: Reconstructed by author

Swatch of No Ground (SoNG) Marine Protected Area: An Overview

The Swatch of No Ground (SoNG) Marine Protected Area was established in 2014 to protect cetaceans that inhabit the offshore waters of Dublar Char, Bangladesh. The MPA, with an average depth of 900 meters covering approximately 1,836 sq km of the marine area, has been a critical habitat and an essential breeding and spawning ground of whales, dolphins, sea turtles, sharks, and other globally endangered oceanic species. The MPA aimed to ensure the long-term protection of marine life in the SoNG area in the BoB. The announcement officially restricts fishing and other offshore commercial or unauthorized activities in the area (Hassan, 2022). Part of the habitat of globally endangered cetaceans lies in the Indian part of the SoNG area, which too has huge potential to be declared as MPA by the Indian government for the protection of the marine environment, including depleting organic species therein. The declared SoNG MPA is depicted in the map below:

Figure 2: Swatch of No Ground (SoNG) Marine Protected Area



Source: Reconstructed by author

Potentials of SoNG as Transboundary MPA: Bangladesh Perspective

MPA can also be transboundary in nature, covering large or small areas, and may be established anywhere in marine areas, including high seas, having conservation potential. A transboundary MPA offers additional advantages in facilitating marine conservation through maritime cooperation among neighboring states. As such, the declared SoNG MPA that borders the territorial waters of India will also facilitate maritime cooperation by establishing a potential transboundary MPA by both Bangladesh and its neighboring India amidst common global challenges like the over-exploitation of fish and climate change (Hassan, 2019). Maritime tourism has become a strong driver for the economic growth and job creation of many coastal countries from the Caribbean and South Asian regions. Maritime and coastal tourism has a substantial potentiality in the economy of Bangladesh due to the existence of BoB in the southern part of the country (Rifat and Alam, 2023).

Illegal, Unreported, and Unregulated (IUU) fishing is highly detrimental to the livelihood of the coastal fishers and the overall marine ecosystem (Rikita, 2022). Among all maritime security crises, IUU fishing is the most common and immediate factor affecting a country's economy and nutrition. Bangladesh is the most victimized country as most of the fishermen of India, Myanmar, or even Thailand often poach to the EEZ of Bangladesh (Firoz, 2021). However, MoU between Indian Coast Guard and Bangladesh Coast Guard was signed in 2015 to establish a collaborative relationship to combat transnational illegal activities at sea, including IUU fishing, thus stepping forward to develop regional maritime cooperation (Islam, 2020).

As mentioned, Bangladesh has declared three MPAs and a Marine Reserve since 2000. However, out of the above declared MPAs in Bangladesh, only the SoNG MPA borders India's territorial waters, bearing colossal potential to facilitate maritime cooperation by expanding it into a potential transboundary MPA by both Bangladesh and India amidst common global challenges like over-exploitation of fish and climate change. Ideally, treaties provide the legal framework for establishing transboundary MPA between states, and political

will is the prime driver in making treaties. So, it is presumed that the biodiversity conservation potentials of SoNG in its EEZ may provoke India to a dialogue of expanding SoNG into a transboundary MPA, mutually benefitting both the neighbors.

Marine Protected Areas in India: An Overview

India has an extensive coastline of 7,517 km, including 5,423 km in peninsular India and 20,942 km in the Andaman & Nicobar and Lakshadweep islands. India has an enormous EEZ of 2.02 million sq. km. It is estimated that nearly 250 million people live within a 50 km wide swath along the coastline of India (UNISDR/UNDP, 2012). There are 24 MPAs in peninsular India, covering a total area of about 8214 sq. km. and there are more than 100 MPAs in the country's islands. India has also identified 12 protected areas as transboundary under the framework of the IUCN transboundary protected area program. Sundarbans National Park and the Gulf of Mannar Biosphere are the two MPAs in India having transboundary potential (Kuppusamy, Mathur, and Pande, 2014). The declared MPAs of India are depicted in the map below:

Figure 3: Marine Protected Areas in India

Source: https://www.drishtiias.com/daily-updates/daily-news-analysis/international-marine protected-areas-congress

Potential of SoNG as Transboundary MPA: Indian Perspective

Adequate protection of marine, coastal and inland environments against human activities and climate-induced anthropogenic threats increasingly requires cooperation and decision-making by various actors, including neighboring states, global and regional organizations, government and private sector entities, and local communities within and across state boundaries. The migratory patterns of numerous marine species due to climate change impacts constitute other imperatives for solid and effective collaboration through MSP and the establishment of MPAs across international boundaries to conserve and manage living resources (Warner and Marsden, 2016). Despite the tremendous ecological and economic importance and the existence of a policy and regulatory framework, India's coastal and marine ecosystems are under threat (Kuppusamy, Mathur and Pande, 2014).

India is the 16th largest maritime country in the world, with 7,517 km of coastline and 2.02 million sq. km of EEZ. India is pledged to declare .20 million sq. km of its EEZ as MPA by 2020, according to target number 5 of SDG 14. India has taken several steps towards achieving the Aichi Biodiversity Targets, mainly targets 11 and 14. Towards achieving these targets, 106 coastal and marine sites have been identified and prioritized as Important Coastal and Marine Areas (ICMBAs) by the Wildlife Institute of India (Kuppusamy, Mathur and Pande, 2014). However, by far, it declared 25 MPAs in the peninsular region and 106 in islands covering only 10,000 sq. km of its EEZ, which put India far behind in meeting the requirement of the target of SDG 2014. As such, marine conservation has gained much momentum in India in fulfillment of SDG target 5 of Goal 14. Besides, international legislations like the RAMSAR Convention (1971), World Heritage Convention (1972), UN Convention on the Law of the Sea 1982 (UNCLOS III), and Convention on Biological Diversity 1992 (CBD), etc. facilitate India to prioritize marine conservation in the BoB.

Scope of Maritime Cooperation Expanding SoNG MPA

Monitoring the EEZ is essential to ensure the security of the Bay from international piracy and IUU fishing. Bringing the whole EEZ under proper

surveillance is quite challenging and hugely expensive. (Sharwar, Alamgir and Mahmud, 2023). Bangladesh aspired for sustainable blue growth amidst marine conservation soon after the peaceful maritime boundaries delimitation with India. SoNG MPA was declared for biodiversity conservation of globally endangered species like dolphins, whales, sharks, and turtles. The SoNG area has got huge potential for marine tourism that has long been unrealized. The SoNG will be an exciting place for visitors to observe marine wildlife. Whales and dolphins that often appear could be an attractive touristic amenity (Rifat and Alam, 2023). Besides, the SoNG area is also known to be the hot spot of biodiversity and fisheries for the IUU fishers. It is learnt that Indian fishers often cross over the IMBL in search of the catch in the SoNG area despite having regular patrol by Bangladesh Navy (BN) and Bangladesh Coastguard (BCG) ships. Approximately 720 Indian boats, on average, are reportedly encountered and driven away yearly by maritime law enforcement agencies of Bangladesh since 2018. Besides, destructive fishing by the native IUU fishers is also rising in the SoNG area. As such, expanding SoNG into a transboundary MPA will not only prevent illegal trespassing and poaching by the IUU fishers but also would facilitate maritime cooperation of both neighbors. Notably, the IUCN also urges neighbors to cooperate in conducting detailed assessments on resident and migratory species for establishing transboundary MPA (IUCN, 2015).

Cost-Benefit Analysis on SoNG Transboundary MPA

Key threats to the marine environment and its resources include unsustainable fishing practices, marine pollution, and unplanned marine development activities. It is proven that ‘no-go’ and ‘no-take’ MPAs successfully conserve habitats and populations and may sustain the increase of the overall yield of nearby fisheries by exporting spillover. The commissioned report studied by the World Wildlife Fund in 2015 concluded that MPA expansion is an economically advisable option, and the economic rate of return ranges between 9 to 24 percent. Establishing SoNG MPA in the Indian marine water and its effective governance would ensure the conservation of the marine environment in the BoB from offshore challenges like overfishing, poaching, usage of illegal fishing gears, and destructive fishing by the illegal, unreported,

and unregulated fishers. In the most optimistic scenarios, the benefit-to-cost ratio of expanding MPAs is as high as twenty times. Besides, the economic rate of return in expanding MPA networks is approximately 24 percent which is more significant than the usual discount rate. Under all scenarios, benefits are more than triple the costs of establishing an MPA that may provide a helpful pathway toward a sustainable blue economy (Reuchlin-Hugenholtz and McKenzie, 2015).

If India agreed to expand SoNG MPA further in its EEZ and both the neighbors declare SoNG as a 'no-go' and 'no-take' transboundary MPA, then the critical habitats for globally threatened marine wildlife, including dolphins whales, porpoises, sharks, and marine turtles, not only be protected but also the transboundary SoNG MPA will facilitate marine biodiversity conservation in the BoB. The IUU fishing by the fishers of both neighbors will be prevented, and thus high-risk of bycatch that threatens marine wildlife, including habitat, will be mitigated. So, under all scenarios, it can be deduced that the benefits are more than the costs contributing to establishing SoNG transboundary MPA in the BoB by both the neighboring littorals. However, both states' political will is the cornerstone for establishing a SoNG transboundary MPA in the BoB.

Towards SoNG Transboundary MPA: Options for Bangladesh

Establishing SoNG transboundary MPA in the BoB is easier said than done, and it needs enormous efforts by both India and Bangladesh's state and non-state actors. However, the options for Bangladesh regarding the expansion of SoNG into transboundary MPA are as under:

a. Bangladesh needs to demonstrate strong political will and pursue Track II diplomacy through formal diplomatic channels amidst SDG 14 with India focusing sense of urgency concerning marine environmental protection for globally endangered marine species.

b. Bangladesh needs to build institutional capacity regarding technical knowledge, research, monitoring, and marine scientific data for handling transboundary issues with India. Besides, joint monitoring of both the neighboring nations may establish a center to monitor, surveillance, and control the marine environmental pollution, IUU fishing activities, and

preservation of globally endangered marine cetaceans in and around the proposed SoNG transboundary MPA.

c. Conducting regular seminars, dialogue, and publications on the benefits of transboundary MPA may raise public awareness and provoke academia, marine environmental think tanks, marine conservation professionals, civil societies, and the policymakers of both Bangladesh and India in realizing individual win-win situations amidst SDG 14.

d. Building a joint institutional governance framework for Bangladesh-India maritime cooperation through expanding SoNG MPA into a transboundary MPA. The management plan, including funding issues of the proposed SoNG transboundary MPA, must also be considered while making the joint Institutional framework for Bangladesh-India maritime cooperation.

Conclusion

Bangladesh-India acquaintances are both social and financial. The two nations are bonded by linguistic, communal ties and shared characteristics that are already reflected in multi-dimensional engagements at different levels of association (Rahman, 2021). Present ties between Bangladesh and India are good. However, interactions need to be institutionalized based on the spirit of Track-II diplomacy to deepen the relationship in the coming days (Islam and Faisal, 2020b). Marine conservation is challenging and often unwanted by the fishers and other ocean users due to their livelihoods. By contrast, the prospects for nature conservation will improve if biodiversity is being considered as a measure of the ecological integrity of an area and of its ability to guarantee the continued delivery of ecosystem-derived goods and services (Vasilijević et al., 2015). SoNG area is considered a safe breeding and spawning ground for endangered species like dolphins, whales, sharks, turtles, and other marine wildlife. The SoNG MPA of Bangladesh shares a border with the territorial waters of India. The biodiversity potentials of SoNG MPA merits marine transboundary conservation between India and Bangladesh by protecting fisheries and globally endangered species. It also has enormous potential in

facilitating maritime cooperation by jointly establishing a transboundary MPA by both nations amidst common global challenges like over-exploitation of fish, preservation of globally endangered marine cetaceans, and climate change issues. As such, non-traditional security threats like loss of biodiversity conservation in the maritime domain warrant increased marine environmental awareness at all levels. Urgent initiatives for ensuring proper management of the SoNG MPA are required. Bangladesh should do whatever it practically can to conserve the protected species in the SoNG MPA and attempt to establish a transboundary MPA in the surrounding areas with the neighboring country India (Karim and Uddin, 2019). However, the political will and a shared vision amidst SDG 14 for sustainable marine conservation between India and Bangladesh are furthermore necessary for establishing transboundary SoNG MPA in the BoB.

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FORMULATION OF A COMMON MULTILATERAL MARITIME STRATEGY FOR IOR LITTORALS TOWARDS COLLECTIVE MITIGATION OF MARITIME THREATS AND CHALLENGES

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Abstract

Transnational maritime threats and challenges are becoming indispensable for security of the IOR littorals. There is a need for new thinking and fresh multilayered approaches to deal with the threats and challenges in a comprehensive manner. Given the growing strategic and economic importance of IOR vis-à-vis the quantum of challenges therein, there is no alternative to inclusiveness. There is a need of meaningful partnership among the littorals and significant cooperation and interaction among their maritime forces. The key to have cooperation lies in identifying convergence of interests achieving a resonance. There are scopes of regional and sub-regional approaches to combat the threats having trans-border consequences. However, IOR littorals have disparity in geo-strategic and geo-economic dimension and disparity in maritime forces' capabilities. Littorals need to explore opportunities to bridge gaps between their navies transcending all the barriers. Scopes for a common multilateral maritime strategy may be explored for a collective mitigation of maritime threats and challenges. A maritime oceanic cord will bind the IOR littorals together through cooperation and engagement.

INTRODUCTION

Maritime nations are in the quest for maritime security. With time, new types of threats, mostly non-traditional in nature, have emerged in the maritime domain. In the present days, the security of a nation has gone beyond its traditional definition encompassing political, economic, environmental and social dimensions intertwined with the military dimension. The meaning and the nature of security differs from nation to nation as each one of them is exposed to different kinds and levels of threats. A host of maritime challenges, many of them being transnational in nature, are becoming indispensable for security of the nations. These threats impinge upon the maritime security environment of a

nation, a region or the globe. Thus, there is a need for new thinking and fresh approaches to deal with the newer challenges in a more comprehensive manner.

The Indian Ocean is a critical maritime space owing to its transformed strategic, security and economic importance. The maritime-littoral space accommodates huge population, resources, developing economies, congested sea lanes and contested territorial spaces. It has thus gained tremendous geo-political, geo-economic and geo-strategic value. Indian Ocean may be characterized at one end by volatility, instability and complexity and at the other end opportunity and interdependence. However, some disparity lies among the IOR littorals in terms of their varying economic conditions and the capability to address maritime threats. More so, the threat perception and the hotspots vary at large in different parts of the IOR. Given the growing strategic and economic importance of IOR vis-à-vis the quantum of challenges therein, there is no alternative to inclusiveness. There is a need of meaningful partnership among the littorals and significant cooperation and interaction among their maritime forces. As such, scopes for a common multilateral maritime strategy and operating protocols may be explored for a collective mitigation of maritime threats and challenges.

AIM

The aim of this paper is to coin a charted course for collective engagement mitigating the existing maritime threats and challenges in the IOR having conceived a common multilateral maritime strategy and operating protocols.

THREATS TO MARITIME SECURITY ENVIRONMENT OF IOR

Apart from conventional threats from state actors, today's maritime security challenges refer to a wide spectrum of low intensity maritime crimes or conflicts. It includes illegal exploitation of marine resources, attempt to intentionally pollute the sea, threat to life and property equated with 'piracy', threat to peace and security by the acts of gunrunning, narco-terrorism, maritime terrorism, illegal immigration, threat to the Sea Lines of Communications (SLOC), etc. These threats are mostly emanated from the non-state actors. Added to these are different forms of Humanitarian Assistance and Disaster Relief (HADR) operations. The threats listed here are not exhaustive. However, these are common in maritime domain in the present days.

Poaching for Fishing. 'Illegal Unreported and Unregulated (IUU)' fishing incidents are common in the IOR especially in all disputed and unregulated waters. The exhaustion of traditional fishing grounds and the competition for newer stock prompt the fishermen to encroach into the others' waters. Overfishing in Somalia waters by IUU fishing vessels from both within the region (Kenya, Pakistan, Saudi Arabia, Sri Lanka and Yemen) and outside it (Belize, France, Honduras, Japan, South Korea, Spain and Taiwan) is common in Western IO.[1] Illegal fishing accounting around $ 10 billion a year affects the food security of the world. Poaching issues also have the potential to generate tension between nations. Over fishing may cause the ecological imbalance too.

Marine Pollution. Marine pollution is caused by the discharge of oil used in the propulsion machinery of all vessels where the ballast discharge and washing out of bilges at sea are the principal contributors. Pollution causes ecological and environmental disasters. The violators find safe heaven for dumping their waste in waters of the IOR littorals having poor surveillance and lack of capabilities for implementing laws. Maritime pollutions due to dumping at sea, for example, in waters of Somalia by Swiss and Italian farms,[2] are also amongst reported incidents. IOR littorals are deeply concerned with major oil spills or wrecks of oil tankers at narrow approaches to choke points, since such spills can seriously affect the flow of merchant shipping traffic.

Piracy. There have been growing concerns in the recent years over the significant number of piracy attacks in South East Asian waters of IOR. In 2021, this sub-region accounted for 56 piracy incidents (including 9 in Indonesian waters, 9 in Philippine's waters and 35 in Singapore Strait)[3]. It is encouraging to note that, no such incidents took place during the period in question in the Red Sea and off Somalia (only one in the Gulf of Aden) because of the efforts of the regional and extra regional navies (CTF 151, EUNAVFOR Atlanta, NATO are patrolling and Indian, Chinese, Russian, South Korean, Iranian, Thailand and Japanese warships are escorting their own merchantmen). However, it is believed that still the Somalian Pirates have the capacity to carry out attack and a single successful hijacking of a merchant ship will rekindle their passion to resume piracy efforts.

Narco-terrorism and Gunrunning. The proximity of drug-infested areas like 'Golden Triangle' and 'Golden Crescent' are the major security concern for the IOR on narco-terrorism. The cementing of a diabolic relationship between insurgent groups, arms dealers and narco-terrorists is a great concern. The extent of illegal weapon trade is unknown and probably would remain unknowable.

Maritime Terrorism. The Mumbai attack on November 2008 has given a new dimension to maritime terrorism in the IOR. The menace of the maritime terrorism can be perceived through the terrorist attacks on USS Cole on October 12, 2000 in Aden Harbour, Yemen and on French tanker MV Limburg in 2002 in the Gulf of Aden. The hijacking of Italian cruise liner Achille Lauro in 1985 off the coast of Egypt and attempting to seize Pakistani Navy Ship by Al Qaida in September 2014 are some of the examples of maritime terrorism in the Indian Ocean. With a dramatic increase in smaller transport under 'flag of convenience', the problem has grown significantly. Transportation of mercenaries to a country to destabilize a regime[4] also took place. One more security concern is mining in a constricted area like Malacca or any other choke points by miscreants that has the potential to create havoc on international merchant shipping. Seaborne terrorism could potentially cripple global trade and have adverse effects on global economies. More so, a prospective nexus between pirates and maritime terrorists would add further complexity in addressing the issue. Use of small vessels by this nexus for smuggling weapons of mass destruction (WMD) cannot be ruled out.

Illegal Immigration. Political instability, economic disparity, lack of employment opportunity, etc cause people to cross the nation's boundary in whatsoever means including through the seas illegally. Thousands of illegal migrants are drowned every year when their boats sink, or die enroute to their destination[5]. Often the illegal migrants are vulnerable to ruthless economy and social exploitation[6]. Illegal immigrations of fortune seekers through sea route towards European and Arabian waters have been the security concerns for the IOR.

Threat to the SLOC. The IOR is home to many choke points. Any disruption in traffic flow through any of these points can have disastrous consequences. For instance, closure of the Strait of Hormuz would practically cut off Gulf supplies to the East altogether and affect the West considerably. Similarly, closure of Strait of Malacca, can seriously threaten the economies of South East Asian countries, China and Japan due to the increase in trade cost for using longer alternative routes through Sunda or Lombok. In any of the events, economy of the IOR littorals will be adversely affected.

Threats Emanating from Natural and Man-made Disasters. An important category of challenges in maritime environment of IOR is presented by nature itself. The IOR is the locus of almost 70% of world's natural disasters demonstrated in cyclones that regularly hit the Bay of Bengal littorals.[7] IOR is also a Tsunami prone region. More so, there are significant numbers of marine accidents taking place in the IOR. Added to these challenges is the effect of global warming that has the potential to trigger a demographic upset and a resource crunch in the neighbouring region.[8]

LEGAL FRAMEWORK AND COLLECTIVE APPROACHES IN ADDRESSING THREATS TO MARITIME SECURITY ENVIRONMENT OF THE IOR

Legal Framework

International law dealing with maritime security has been almost static since 1958[9]. Even UNCLOS III, being the constitution of the world's oceans, has failed to provide an appropriate legal framework in this regard and has created several grey areas that adds to the confusion.

UNCLOS III gives the coastal states the sovereign rights of exploring, exploiting, conserving and managing the natural resources and the authority to enforce laws to prevent poaching for fishing in their EEZ. It imposes the obligation upon the state parties to adopt local laws and regulation for the prevention, reduction and control of marine environment pollution. Within the legal framework, piracy involves the pursuit of strictly private objectives in the high seas. Thus, politically or ideologically motivated acts of violence at sea

cannot be considered as piracy. The greater weakness in the fight against piracy lies in a vague jurisprudence[10]. The definition of piracy by International Maritime Bureau (IMB)[11] is broad but lacks in legal status by international laws as it goes contrary to several provisions of UNCLOS III. Coastal states have the right to enforce laws of customs and immigration in their Contiguous Zone. Beyond this area, coastal states have no jurisdiction in these regards. Again, if the illegal immigrants are not declared or traced as slave, coastal states have little to do. UNCLOS III is silent on maritime terrorism and narco-terrorism. The international conventions for the prevention of marine pollution, acts of violence, drug trafficking, etcetera are mutually supportive and complementary and promote bilateral or international arrangements.

International laws are unclear on many points on the question of enforcement. Thereby, combating such issues is mostly subject to the domestic laws of the states. Again, the coastal states have little scope to take actions under their domestic laws against the violators outside their internal waters. The hot pursuit of such violators is again subject to take place before the offender's entrance to the territorial sea of any other state. Thereby, the regional and sub-regional efforts have the potential to support in maintaining healthy security environment in the maritime domain.

Organizational Approaches

Although a maritime oceanic cord should have bound the littorals of the IOR together, maritime cooperation have not attained the importance they deserve in this region. Hence, convergence of interests on security issues has not been readily forthcoming. The Indian Ocean Rim Association for Regional Cooperation (IOR-ARC) was formed on 05 March 1997 with an aim to boost economic cooperation amongst its member states leaving much room for considerable development till date. The Gulf Cooperation Council (GCC) is barely effective without the inclusion of relevant regional powers like Iran and Israel. Meanwhile, because of ignoring issues of maritime cooperation, Australia's efforts to introduce a security agenda have not been much successful. Consequently, maritime issues are ignored in the Indian Ocean Rim Business

Forum (IORBF) and the Indian Ocean Rim Academic Group (IORAG). An economic community comprising Bangladesh, India, Myanmar, Sri Lanka, and Thailand (BIMST-EC) was launched in June 1997. It has been overshadowed by an effort to enliven the South Asian Association for Regional Cooperation (SAARC), and both are not much equipped to handle maritime challenges.

The geo-politics has driven the IOR nations towards extra regional powers instead of having cooperation amongst them. Thereby, surprisingly, so far, there is no collective maritime security regime created in the IOR. However, joint patrols of India and Indonesia in Andaman since 2002, anti-piracy drive of Indonesia, Malaysia and Singapore, launched in 2004[12], etc have been little effective and have shown light of maritime cooperation. More so, the Regional Cooperation Agreement on Combating Piracy and Armed Robbery against Ships in Asia (ReCAAP) signed in November 2004 by 16 countries is a positive step towards combating piracy[13]. There are larger scopes of having regional or sub-regional cooperation in IOR considering the maritime interests and requirements of respective sub-region to deal with transnational threats. Indian Ocean Naval Symposium (IONS) has been effective since 2008. However, enormous prospects of IONS in playing an effective role in the overall governance mechanism of the IOR are yet to be revitalized.

CHALLENGES IN CONCEIVING COMMON MULTILATERAL COLLECTIVE APPROACH

Disparity in Geo-strategic and Geo-economic Dimension

The IOR is a profile with disparity in dissimilarities and diversities. It is the cradle of world's oldest civilizations but is persistently dogged by religious conflicts and militant fundamentalism. The IOR is a region of huge natural resources that serve as sources of conflict both globally and locally. The IOR consists of many sub-regions with their own particular interests and requirements: South Asia (Bangladesh, Pakistan, India and Sri Lanka), South-East Asia (Myanmar, Thailand, Malaysia, Singapore and Indonesia), Arabian/Persian Gulf Region (Saudi Arabia, North and South Yemen, Oman, United Arab Emirates, Qatar, Bahrain, Kuwait, Iraq and Iran), Red Sea Region

(Sudan, Egypt, Israel and Jordan), Horn of Africa (Somalia, Ethiopia and Djibouti), East Africa (Mozambique, Madagascar, Tanzania and Kenya), South Africa, Western Australia and Island Countries (Reunion, Comoros, Seychelles, Mauritius and Maldives). Disparity lies in littoral's national interests and so in sub-regional approaches. Disparity lies in the economic conditions of the IOR littorals. On the economic front, the region is the poorest in the world. Only one-twelfth of their populations live in states with a per capita annual income of over $1,000. The growth rate of the littorals of the IOR is uneven causing the prevalent disparity. Disparity issues are further intensified by the gaps in understanding amongst the IOR littorals on inter-regional and intra-regional political and security grounds.

Disparity in Maritime Forces' Capabilities

The disparity in nations' capabilities to deal with the maritime security challenges, disparity in conceiving Maritime Domain Awareness by the littorals, difference in being exposed to dissimilar types of threats etc are some of the reasons for IOR to have disparity in maritime forces. Australia, India and South Africa have blue water naval capability[14], while the smaller island nations can hardly be compared.

Disparity lies in the size and shape of zones of responsibility of the IOR littorals. The disparity exists in the capability of their maritime forces in terms of the number, size, sophistication and type of platforms to ensure good orders at sea. Disparity lies in having purpose oriented platforms and resources. More so, the capabilities of maritime agencies like the navy, the coast guard and the marine police vary to a great extent. The capability to conduct surveillance in the respective zones of responsibility varies at large. The capabilities of law enforcement are different because of varied legal framework among the littorals. Again, it is a difficult proposition to have correct mix of platforms to deal with the perceived threats. The extremely sophisticated ships may not be suitable in terms of cost-benefit analysis to undertake the policing duties at sea. On the contrary, there are vessels of various displacements dedicated for policing, but many do not possess adequate reach and sustainability.

From a study on the maritime forces of the IOR littorals[15] it may be stated that, eleven states (Australia, Egypt, South Africa, India, Indonesia, Iran, Israel, Malaysia, Pakistan, Singapore and Thailand) may be viewed as large standing naval powers in the IOR for having good number of surface combatants to deal with the perceived threats. These countries have various strategic interests in the IOR. Some of these interests are common in nature and others are more specific to their geographical location. Besides these large naval powers, some have reasonable sized forces to protect their respective national interests at sea. Some have the potential to deploy their forces beyond their territories, while some countries have very small maritime forces (Comoros, Madagascar, Maldives, Mauritius, Mozambique and Seychelles).

Because of varying capability, disparity in threat perception and different dynamic political environment, there has not been any meaningful holistic approach by the maritime forces of the IOR in addressing transnational maritime threats comprehensively. Rather, different navies are aspiring to secure their maritime security environment with the assistance of extra regional powers. Besides, some naval cooperative engagements are prevalent in the form of different naval exercises with regional and extra regional navies. Time has come to explore opportunities to bridge gaps between navies of the IOR littorals transcending all the barriers.

IMPERATIVES FOR IOR LITTORALS IN CHARTING COURSE FOR COLLECTIVE MITIGATION OF MARITIME THREATS AND CHALLENGES

The competition is bound to exist among the IOR littorals in the face of individual pursuance of national interests. However, the key to have cooperation lies in identifying convergence of interests thereby achieving a resonance. It also lies in realizing the exigency of having concerted efforts against the transnational issues. There is a scope of regional or sub-regional approach to combat the threats having trans-border consequences. Littorals can share intelligence amongst them and undertake joint effort to curb the sub-region specific threats. Such joint efforts are prevalent in distant waters. Italy and France are launching frequent joint patrols against illegal immigration from North Africa[16]. Turkey

and Greece despite having different security concerns for long have been cooperating in the fight against maritime crimes in Aegean Sea[17]. The regional marine fishing programmes in European waters of the world are isolating marine fisheries violations. Similarly, the IOR littorals can come forward to have cooperation in securing the maritime environment.

Because of the growing geo-strategic and geo-economic importance of the IOR, power play of extra regional powers will continue in the foreseeable future. As such, harmonizing with the Strategic Calculus of the extra regional or global powers need to be handled delicately. At the same time, the IOR maritime forces need to act with consorted efforts leaving tangible gains for the IOR littorals. Now, the IOR littorals and their maritime forces need to come forward and devise some meaningful cooperative mechanism. The littorals need to sit together and identify the hotspots including the nexus of different types of threats within their respective sub-regions and devise correct mechanism to address those.

In view of the maritime matrix of the IOR, and the various threats being posed to its maritime domain, it requires making a fresh appraisal of the various threats likely to jeopardize the maritime security environment. Thus, there is a need to study the imperatives to deal with the threats in maritime domain that could be described as follows:

a. **Conceptualizing and Implementing Regional Blue Economy.** The prosperity of the IOR littorals lies with the prospects of exploration and exploitation of marine living and non-living resources of the IO. As such, a 'Regional Blue Economy' may be conceived taking all the littorals in the board for a prosperous IOR.

b. **Considering Regional and Sub-regional Maritime Policy.** In order to ensure a holistic approach to the solutions of the problems of maritime domain with a legal and institutional framework, a regional maritime policy is needed. Such policy could interface the sub-regional maritime policies, Maritime Domain Awareness and the various issues of maritime governance to ensure good order at sea. Maritime policy specific to the

sub-regions of the IOR needs to be conceived by the littorals of the concerned sub-region within the overall insight of regional maritime policy. Again, the means and approaches for addressing the security issues demand appropriate maritime security strategy to be conceptualized for which maritime domain awareness among the maritime nations, theirs governments and subjects is necessary.

c. **Reforming / Restructuring Laws.** The IOR nations are yet to formulate and execute maritime specific laws in line with the relevant international laws. These prompt the violators to take advantages of the weak laws or the absence of laws. To deal with the threats, the national legal frameworks need to be reformed accordingly. Moreover, regional legal framework towards maritime security may also be considered.

d. **Ensuring Extended Maritime Cooperation.** To deal with the complex maritime matrix and coordinate maritime resources and the agencies, maritime cooperation in national, sub-regional and regional level is necessary. The maritime agencies need to cooperate with each other, share intelligence and respond accordingly to deal with transnational issues. Regional and Sub-Regional Maritime Cooperation Centre, in any given name, may be established where all the violations could be reported and be dealt with by concerned agency of the coastal nation. The Maritime Cooperation Centre may have the representatives of the concerned littorals.

e. **Ensuring Multi-Layered Security Measures.** A multi-layered threat response is needed to deal with the transnational issues. Challenges predominantly located around the coast of a nation require a unilateral approach by its own maritime forces. Challenges concerning adjacent coastal nations (like poaching for illegal fishing) may require bilateral approach, while challenges concerning the region (like piracy or HADR) may require multilateral / regional approach.

f. **Ensuring Coordinated Patrol and Surveillance.** Regular patrols may be conducted by individual IOR littoral's maritime forces. In need of addressing the sub-regional challenges, the patrol efforts of concerned

maritime forces may be well coordinated. IOR maritime forces need to ensure gapless surveillance in the sub-regional hots pots. Collaborative surveillance with adjacent maritime forces, if required, setting up a 'neighbourhood watch' system, may also be considered into this effect. For sharing information with each other, Sub-regional Information Centre (SRIC) may be established in co-existence with Sub-regional Maritime Cooperation Centre (SRMCC).

g. **Arranging Regular Interactions among Maritime Forces.** Regular interactions between the maritime forces in the forms of dialogue, seminars or symposiums will help them understand each other and develop mechanism to address the challenges. Different Subject Matter Experts Exchange (SMEE) programmes may be conducted in order to share experiences and gain necessary expertise on specialized issues. More so, sub-regional maritime forces may conduct regular exercises and devise necessary Standard Operating Procedures (SOP) in addressing maritime challenges. Regional maritime exercises may be planned periodically (for instance biennially). Such exercises will grow confidence among the IOR littorals.

There is a need to transcend all the barriers towards maritime cooperative engagements. Identification of convergences with complimentary interests is of great importance into this effect. Large maritime powers of the IOR and their maritime forces need to carry their neighbourhood along having gained their confidence. There may be a 'building the blocks' strategy in conceiving the 'multi-layered' approach in order to secure the maritime security environment of the IOR. The sub-regional navies may form a 'block' and be made capable and responsible for ensuring the desired maritime security environment of their respective sub-region. Sum of all blocks (sub-regionally secured environment) may contribute in making an overall secured IOR. As part of multi-layered approach, individual littorals need to strengthen all their maritime forces (Navy, Coast Guard, Marine Police and all other maritime law enforcing agencies) to guard their respective territories at least. Bilateral arrangements may be there with other adjacent navies in order to remove existing pours. Littorals may have

sub-regional arrangements on converging and common issues. Sub-regional entities may have further overlapping between them in order to ensure gapless coverage in ensuring overall secured maritime environment of the IOR.

CONCLUSION

Maritime security deals with the security concerns emanating from the maritime domain. Transnational threats are the maritime security concerns which encompass the issues of poaching for illegal fishing, pollution of the marine environment, piracy, illegal immigration, drug trafficking, gunrunning, maritime terrorism, threat to the SLOC etc. These transnational threats affect the political, socio-economic and military security interests of a nation or a region or the globe.

The competition for newer stocks of fish vis-à-vis the overlapping claims of maritime boundaries are the primary reasons for transnational poaching for fishing to occur. Marine pollution is caused due to marine accidents and dumping of toxic and harmful substances at sea. Piracy is a global crime posing constant threat to the maritime security environment. Illegal immigration has become a growing concern. Smuggling of narcotics and gunrunning are taking place through the sea because of its vastness and the limitations of the nations to guard it. Threats to SLOC have the potential to challenge the global economy. After the 9/11 era, followed by Mumbai attack, the maritime terrorism has added a new dimension to the definition of maritime security. All these transnational issues prevalent in the IOR are affecting its overall maritime security environment.

International legal framework on the issues related to the transnational threats lacks in clarity and execution. UNCLOS III, that is the sole basis of all maritime policies, lacks in clarity on many of the maritime security issues. However, IMO effort in combating maritime security issues including port security and illegal immigration are some to note. The international conventions and protocols with their provisions provide guidelines to the state parties in combating transnational threats in maritime domain. However, the varying capability of the coastal states and the lack of perception to work together are the grey areas in the maritime domain.

Due to the growing concern of transnational threats in the maritime security environment of the IOR, it is imperative for all coastal nations to curb these issues. While many of the nations have the limitations in doing so, regional efforts/initiatives are gaining the considerations of the coastal nations in terms of sharing intelligence and taking joint initiative for curbing the same. More so, abiding by international laws and regulations in maritime sector would make the issues easier to be dealt with.

The IOR littorals need to have a fresh appraisal of various transnational threats likely to affect the maritime security environment. Conceiving 'Regional Blue Economy', formulating appropriate regional and sub-regional maritime policies having grown the maritime domain awareness, structuring the laws and regulations in line with international standards and strengthening the maritime agencies are the requirements into this effect. To deal with the trans-border issues, maritime cooperation with multi-layered security measures is a better option. The IOR sub-systems may be considered effective in addressing the maritime challenges of the entire IOR.

IOR littorals need to conceive the feasible mechanism for cooperative engagement in order to ensure a secured maritime security environment of the entire IOR. The littoral maritime forces need to be strengthened in order to make them capable partner of such cooperative engagement. A holistic approach needs to be undertaken by the maritime forces of the IOR. The IOR navies need to identify the hotspots of the threats within their respective sub-regions and devise correct mechanism to address the challenges. Ensuring gapless surveillance and information sharing are the keys to address all the maritime security challenges. Regular patrol efforts on converging interests may be well coordinated with other maritime forces. Regular interactions between the maritime forces may be considered in order to share experiences and develop standard procedures. Conduct of regular regional and sub-regional maritime exercises will increase interoperability between maritime forces and grow confidence among the IOR littorals towards having a secured maritime environment of the entire IOR.

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Biography of the Writer

Captain Mohammed Faizul Hoque, (C), psc, BN was commissioned on 01 July 1995. He is a graduate from the DSCSC Mirpur, Bangladesh and DSSC Wellington, India. He is a Communication Specialist and did his Long Communication Course in India. He also attended International Maritime Officers Course in the USA, Overseas Directing Staff course in the UK and Defence Planning Course in Turkey. The officer commanded different types of warships: CGS PABNA (Coastal Patrol Craft of Coast Guard), BNS DURVEDYA (Fast Attack Craft Missile), BNS SURMA (Patrol Craft), BNS MADHUMATI (Large Patrol Craft) and BNS OSMAN (Guided Missile Frigate). He served as Staff Officer (Operations and Plans) and later as Director Welfare in Naval Headquarters. He also served as Directing Staff and later as Senior Instructor Navy in the DSCSC Mirpur. He was employed in UN Mission in Liberia as Military Observer. Before joining the present billet as Chief Staff Officer to COMCHIT, he was in Command of School of Maritime Warfare and Tactics (SMWT). The officer has the experience of planning large scale Naval Exercises and Maritime Seminars. He has also participated as one of the Lead Planners in SEACAT 2017 in Singapore. Last November, he presented a paper on "Collective Maritime Strategy and Operating Protocols for Goa Maritime Conclave Nations for Addressing Maritime Challenges" in Goa Maritime Symposium 2022. Captain Faiz is married and blessed with a son and a daughter. He enjoys reading books and journals.

HAZARDS OF SHIPBOARD HELICOPTER OPERATION AND ITS PREVENTION

Captain Ashraf Mahmud Riadh, (TAS) , NGP, psc, BN

Abstract

The invention of flying machines excelled the revolution in air transportation vis a vis military use of the same. The unprecedented success on aerial battle during the second world war permeated the navies to develop air superiority through integrating onboard operations. Shipborne helicopter operations is an important and integral part of modern navies that pledges noteworthy footfall in ruling the maritime domain. Such operations are different than that of shore based and therefore demands matured supervision. The associated risks in this connection looms a plenty and therefore must be mitigated through comprehensive safety measures. The optimal enforcement of safety management system would yield highest Flight and Ground safety onboard ships that coincides with the operational objectives of such missions as well. The essence of safety systems needs to be carefully examined and adopted irrespective of size and shapes of the surface platforms that would guarantee safe flight operations onboard at all times.

Introduction

The invention of flying machine by Wright brothers in 1903 is probably the most phenomenal innovation that sparked the evolution of aviation marvels across the globe. The most significant impact of such discovery was soon perceptive in both civil and military air transportation pattern. The successful employment of aircraft during the Second World War loomed the revolution in the paradigm of military aviation for days to come. As a sequel to that, the navies focused on adopting their aviation competency comprising both fixed and rotary wing aircraft. Soon, the result was yielded with unprecedented success of these flying machines both in peace and war time engagement. Aside, the commercial use of aircraft particularly helicopters picked the pace to be an integral part of offshore operations. The versatility of helicopters both in combat and benign

missions has made it a vital part of naval operations at sea. As anticipated, most of the navies in present days' time have focused to develop integrated ship helicopter operations capability.

The antiquity of Shipboard Helicopter operations dates back to the era prior World War II. Right from the integration, the helicopter has imprinted a forte predominantly because of her competency of flight in regions that is impossible for any other air vehicle to perform. Helicopter operation from ship's deck is a very challenging task and varied widely from shore operations. The success of the operation widely depends upon establishing a safe envelop of features like human factor, environment and platform. A study on the cases of helicopter accidents at sea revealed the fact that the cause of those accidents were centered on the lapses of one or more of these factors. Mentionably, the features are interlinked and therefore cannot be viewed separately. The preventive measures in order to eliminate the hazards in connection with helicopter operations from ships need a methodical approach. The approach should be channelized through an appropriate system keeping safety issues at the root. Different SOPs, equipment and systems have been introduced in this aspect to augment the strategies to prevent hazards/risks of flight operations on board. The overall scenario necessitates a clear understanding on criticality involved in shipboard helicopter operations in order to tailor appropriate preventive measures.

Aim

The aim of this writing is to discuss the hazards associated with shipboard helicopter operations and its prevention.

Definition

For a better understanding, it is imperative to know the definition of terms involved in the discussion. A few of those are depicted below:

a. **Shipboard Helicopter Operation.** In military, the shipboard helicopter operations signify the system that allow operations of rotary wing aircraft from naval vessels. It includes preparing the aircraft and crew for the mission, cargo and ordnance handling (for armed helicopters), passenger supervision, aircraft departure, communications with the ship during the mission and recovery.

b. **Hazard.** A hazard is any object, situation, or behavior that has the potential to cause injury, contribute to an accident or damage to property. Hazards can be multifaceted particularly in aviation business as a hazard free environment is impossible to establish. Most occupational hazards are inactive or have a low potential of actually occurring. However, operators must be prepared to deal with them since a hazard becoming active, can lead to an emergency situation.

Use of Helicopters Onboard

The utilization of helicopters onboard has been diversified with the rapid and dramatic flourishing of helicopter production. In present world scenario, the use of helicopter is considered equally essential for both commercial and military operators. The most commonly use of helicopters for shipboard operations includes but not limited to the following:

a. **Commercial Use:**

(1) Transfer of passengers and stores onboard merchant ships/passenger liner

(2) Entertainment onboard yacht/cruise ships

(3) Ferry service to oil/gas rig and other offshore installations

(4) Ambulance service

b. **Military Use:**

(1) Combat tactical missions and exercises

(2) Search and rescue operations

(3) Special forces operations

(4) CASEVAC/MEDEVAC

(5) Sea surveillance

(6) Crew training

(7)Replenishment and crew transfer

Hazard Matrix of Onboard Helicopter Operations

Onboard flight operation is a critical task that requires a matured skill to perform. The associated hazard elements of such operation generally centered on the features like:

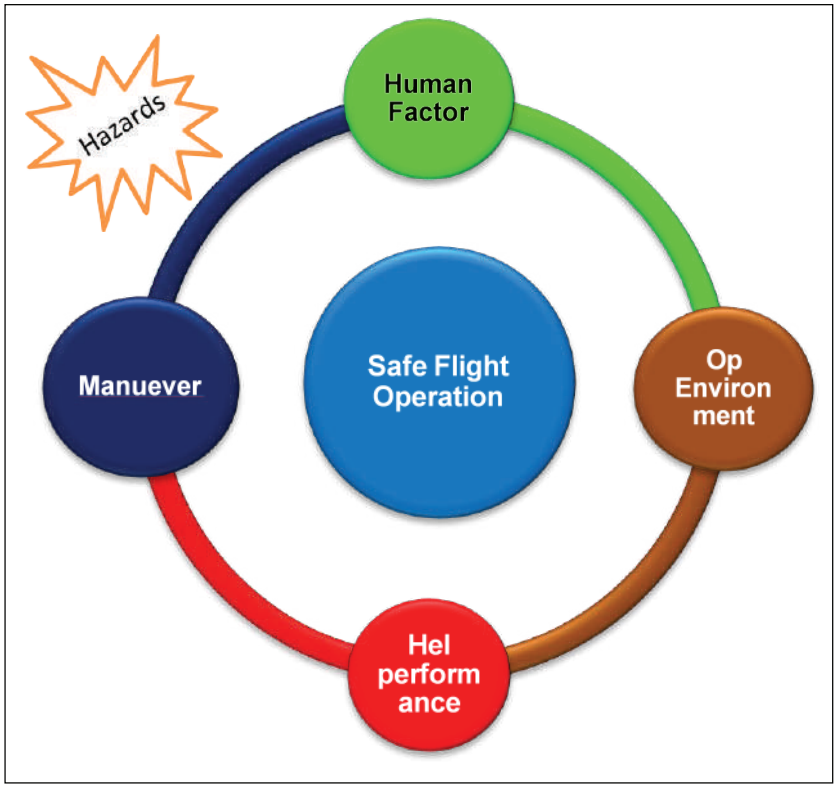
a. Human factors (Air crew and ship's crew)

b. Operating Environment (weather, sea condition, day/night time etc)

c. Helicopter performance

d. Maneuver

Fig 1: Elements of hazard affecting helicopter flight onboard

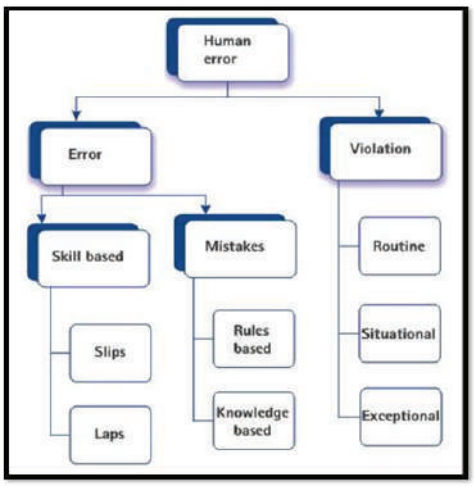


The understanding of relationship amongst the factors is the key in assessing safety hazards. An evaluation of each of these risk elements directly influence the Decision Making Process (DMP) of the Pilot-in- Command in particular. It also assists the operator to achieve an accurate perception of the helicopter flight scenario. The factors are discussed in brief in the subsequent paragraphs:

Hazard Elements

Human Factor. It is always man behind the machine that plays the key role in executing flying missions and hence most helicopter accidents are attributed to human factors. Likewise, a skillful set of crew is essential for helicopter operation from ship decks. For a pilot, this kind of operation is very demanding that yields a considerable increase of pilot workload. Therefore, detailing of pilots for such missions should be done carefully. According to aviation physiology, the principal human factors that govern a pilot's capability in executing flying missions include his condition of health, emotional state, fatigue, stress, flight experience, environment etc. Any lapses in these factors shall induce an elementary hazard towards the safety of operations. Typically, the lacking in these factors contributes to a state popularly known as 'Human Error' that can be expressed as follows:[6]

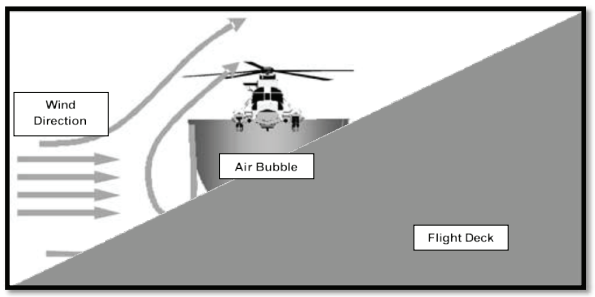
Figure 2: Classification of Human Error



Operating Environment. The 'Environmental Effects' represent the properties of the vessel and/or its systems and surrounding environment, which result in a degraded local atmosphere in which the helicopter is expected to operate. These environmental effects are characterized by structure-induced turbulence, thermal emission of the ship's funnel, sea state, time of the day, obstacles, Nav Aids, Air Traffic Control etc. An incorrect assessment of the conditions could be proved very costly and certainly would increase the pilot's workload in the cockpit. The most significant effects of those conditions are highlighted below:

a. **Wind on Deck.** The effects of airflow and turbulence around the ships flight deck are influenced by the dimensions of the ship, the relative speed and wind direction. The relative wind condition measured by the anemometers on the ship is influenced by the disturbances in the airflow around the superstructure. Therefore, actual measurment of wind on flight deck is always difficult to obtain. When the air flow passes off the hangar roof with a bow wind, it descends to the deck to reattach approximately half the length of the deck behind the hangar door. Consequently, a recirculating region is developed behind the hangar face. When the helicopter's rotor disc moves into this region, the effects become very problematic due to rotor's variable aerodynamic behavior, resulting the measurment of a precision control of the pilot to complete the maneuver. The wind pattern on the deck greatly influences the helicopter's approach and departure. A popular phenomenon of such influence is known as "Pressure Wall" that repels the approaching helicopter on deck while making a side approach.

Figure 3: 'Pressure Wall' condition on an approaching helicopter



The downwash from the rotor forms a bubble underneath the rotor disc and the flow approaching the windward side of the deck is accelerated through the decreasing gap between the bubble and the deck edge. The resultant "pressure wall" tends to repel the advancing helicopter. Pilot requires an extra amount of control on helicopter with a risk of punching through the pressure wall too hard and transiting across the deck too far.

b. **Sea Condition.** The environment where the shipboard helicopter operations take place may become distinctly hostile at times. The Take Off and Landings are largely affected by the sea condition namely Roll and Pitch. The induced hazard linked with the high sea state would cause the pilot to lose his visual cues that is the most essential safety tools for any maneuver. Any rolling motion of the ship will cause considerable sideways velocity of the deck under the landing helicopter. On the contrary, a pitching motion will cause vertical translation of the flight deck. In such circumstances, if the pilot is focused on the hangar whilst preparing to land and the ship pitches bow up, the deck will move downwards relative to the helicopter. The pilot can interpret this as the helicopter moving upwards, and correct with a reduction in collective pitch. As the helicopter moves downward, relative to earth, the ship will pitch bow down as the cycle continues resulting in a large vertical impact of the helicopter and the deck.

Fig 4: Landing onboard in a high Sea State Condition

c. **Day/Night Condition.** The flying techniques at day and night times are completely different and therefore have to be guarded to prevent potential hazards to occur. Flying over water compels the pilot to rely heavily on aircraft instruments. Yet it is important for a pilot to maintain visual cues in order to perform maneuvers specially during. Take Offs and Landings. During day time, the absence of horizon may become a potential source of illusion making the approach difficult or impossible. During night time, the situation gets even dangerous. This time, a pilot's stress in the cockpit multiplies significantly as he needs to distinguish between ship's reference lights and heavenly bodies or shore scattering lights. The conditions may lead to Auto Kinetic illusion causing an accident.[8]

Fig 5: A cockpit view at night showing inadvertent flying due illusion

Helicopter's Response. The nature of flight over water demands the helicopter to be flown with adequate engine power and better flight control response. The pilot while operating from ship must take into account about the loading of the helicopter, fuel state, engine performance, floatation kit, lifesaving gears, airworthiness, wind envelop etc in order to safe accomplishment of the mission. Particularly, the mass of the helicopter and the engine power margins are strongly related to each other and significant during low speed maneuver. Besides, the power margin is also important to execute 'Flyaway' technique close to the water surface due missed approach or single engine failure condition.

Maneuver. The inter relation amongst the factors as discussed above has an implication on the maneuver or nature of flight. The pilot must understand the critical maneuvers and limitation of himself as well as the aircraft to enforce a safety barrier of accident prevention. Flight operations during the normal conditions, emergency by day or by night, landing and take off significantly affects the decision-making process. Mission planning is therefore, key to assess the hazards involved in the operation after considering the weather condition, crew health, ATC procedure, flight deck preparation and organization, FOD checks, Status of Nav Aids etc.

Other Factors. Apart from the previously discussed conditions, the hazards in shipboard helicopter operations may induce from several other factors. Such situations may include rotor downwash, incorrect approach procedure towards the helicopter, traversing of helicopter to and from the hangar, handling of ordnance onboard, refueling, excessive noise, aerials/obstructions onboard etc.

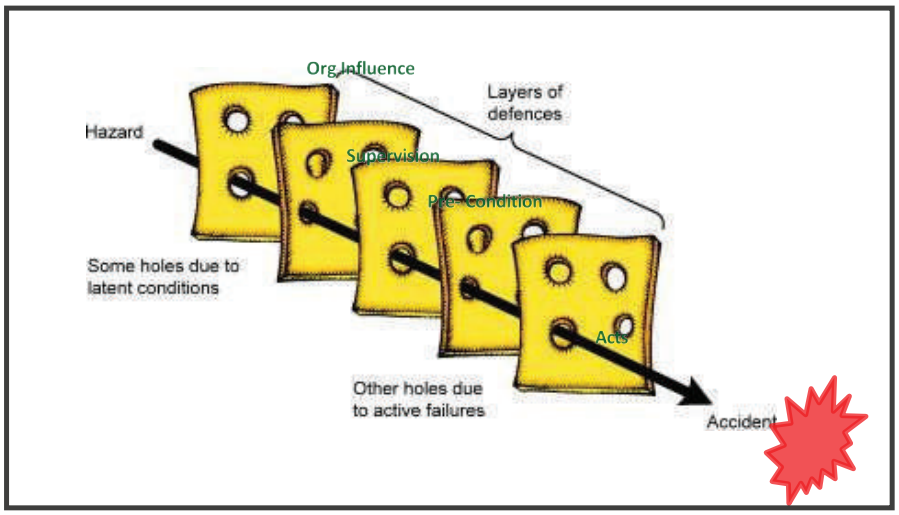
Fig 6: A Safety Awareness Slogan to Eliminate Hazards of Flight Operation

Hazard Prevention Considerations

Hazard prevention is an extreme challenging task and therefore complete elimination of hazards associated with the onboard helicopter operation is nearly impossible to achieve. Theoretically, it may be achieved by stopping flight

operations and maintain other routines that is impractical. The core consideration in preventing such hazards is centered on functioning of a **'Safety Management System' (SMS).** The system must be effective and efficient in assessing the potential risks involved and suggest desired action plans to mitigate them. The significance of SMS can be best narrated through a 'Swiss-Cheese' Model below that shows the interface between latent conditions and failures from a hazard and leading to accidents:

Fig 7: James Reason's Swiss-Cheese model of Accident Causation



The model illustrates that multiple defense mechanism is placed as safety devices between hazard and accident. However, each mechanism is induced with lapses due latent conditions and failures and if those are aligned together, an accident shall occur. Therefore, in aviation, the success of hazard prevention depends on correct functioning of Safety Management System.

Hazard Mitigation Principles

Shipboard helicopter operation involves a great deal of risks that must be looked through appropriate tools as part of SMS. The idea is to keep the risk or hazard level as low as possible and produce an optimum safe working environment to complete the task. The key philosophy to adopt such method in this regard would be to:

a. Avoid taking unnecessary risk.

b. Accept risk (if unavoidable) when the potential benefit outweigh the potential cost.

c. Make decision at appropriate management level to address the risk.

It needs to be remembered that the adopted philosophy has to be evaluated constantly to see the effectiveness and adjusted accordingly. The evaluation process would require the expertise in respective field to endorse appropriate preventive actions.

Hazard Prevention Method

The analysis of different accidents of shipboard operations depicts the fact that majority of those mishaps were an outcome of sheer negligence at any certain stage. The nature of such operation is not similar to that of a standalone system and therefore a comprehensive and collective effort is necessary to place the barrier. Again, the involvement of multiple elements/operators in the operation may make the effort a bit critical to implement. The preventive measures in this aspect must be applied with the essence of flight safety that in turn would augment the SMS adaptation process. Few pertinent measures of hazard preventions are discussed below:

a. **Maintain a Safety Culture.** Safety culture refers to the ways that safety issues are addressed in a workplace. The fundamentals of hazard identification and prevention techniques must be centered on the concept of creating and maintaining a safety culture. It needs to be remembered that safety is everybody's business and is the outcome of a collective effort. Every individual must understand the benefits of observing safety in the workplace to mitigate the latent hazards and thereby contribute to promoting safety. The portrait of a strong safety culture would encompass the components like hazard identification and reporting, safety awareness programme (video show, case study etc) safety communication, willingness to promote safety etc.

Fig 8: Elements of Safety Culture of an Organization

b. **Supervision.** The supervisors play the key role in eliminating the risk or hazards. The supervisors must ensure that the assigned tasks are being performed with a appropriate tools, manpower and in accordance with correct procedure. They also need to act as a bridge of safety between management and ground crew through reporting any unsafe acts/conditions. To prepare flight operations onboard, a supervisor's checklist would cover the following:

(1) A FOD drill is carried out.

(2) Helicopter securing and marshaling arrangement is tested.

(3) Manning of station/quarters is completed.

(4) Emergency/life saving arrangement is in place.

(5) Appropriate state of readiness is maintained.

(6) Crew Briefing is performed along with the detailing.

(7) Helicopter's Airworthiness is checked and released for the flight.

(8) Safe fueling/refueling and power supply arrangements are ensured.

(9) Stress and fatigue condition of both air and ground crew is assessed and accounted for.

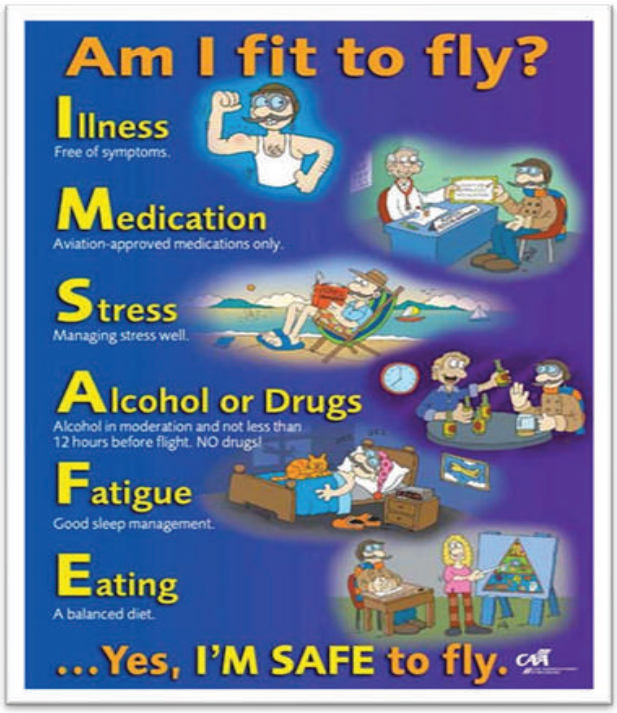
(10) Prevailing environmental conditions for the operation criteria of the mission/task.

c. **Training.** Training is the best safety device to prevent risk or hazard. A pilot needs to be correctly trained and categorized to handle the workload in the cockpit. In case of flying over sea, Crew Resource Management (CRM) is an identical safety tool to reduce pilots workload and enhance flight safety. The air crews also need to master on handling the aircraft during the maneuvers following the checklist and keeping all the limitations in mind. They also need the reflex to handle the emergencies of the aircraft if encountered in the air or on ground. The skill can be developed through a systematic and continued training programme by the flying squadrons. Similarly, the ground crews (ac maintainer, flt deck crew etc) also need appropriate knowledge to maintain and handle the aircraft. In real practice, it is often observed that inexperienced crews are detailed to handle/perform a critical task that infuses the risk significantly.

Fig 9: Flight Check List

d. **Avoiding Unsafe Act/Practices.** The operators at every stage should bear in mind about the catastrophe of safety breach in workplace. A pilot must declare himself fit both physically and psychologically to undertake the flight operations. A good safety check card in this aspect is 'I M SAFE' idiom which is illustrated in following picture:

Fig 10: A Pilot's Aide-mémoire for Safe Flight



Apart from the pilot, the ship undertaking flight operations needs to ensure the correct maintenance of flight deck and other equipment associated with flight safety to avoid unsafe conditions or accident. In many navies, a separate inspection organization is established to certify the appropriate flight safety standards and readiness of the ship to carry out flying operations. Determination of appropriate Ship Helicopter Operation Limit (SHOL) for shipboard helicopter operations is another safety check to eliminate hazard. It is imperative for the aircrew to operate the helicopter within the SHOL to avoid critical situation. Likewise, the air craft maintainer needs to carry out the maintenance,

airworthiness checks and daily inspections in accordance with the SOP/bulletin/manuals to endorse correct safety practice. Flight Deck Crews should be aware of the functioning of the equipment and compliance of the checks to eliminate possible safety risks on the deck.

Relevance to Bangladesh Navy (BN)

BN commenced the shipboard helicopter operations training in 2015. The frequency and magnitude of such operations have been gradually increasing since then and is likely to intensify further. However, it is felt that the attaining of required standard to undertake a full scale shipboard helicopter operation demands a strong approach. The criticalities that need to be taken into cognizance include but not limited to the following:

a. The variety in class, size and types of helicopters carrying platform necessitating the need to acquire different training and maintenance capability.

b. Absence of independent standardization/inspecting organization to check the operational state of the ship's flight deck and other associated equipment.

c. Long and complex training cycle of the air, ground and maintenance crew.

d. Insufficient flight safety awareness campaign onboard ship.

e. Lack of flight expertise onboard.

f. Insufficient number of helicopters and less flying sorties planning from onboard ship.

g. Less exposure of ship's personnel to flight operation environment onboard.

Conclusion

Military use of aircraft marked a prodigious impact in delivering the assigned tasks. The success had inspired the navies to develop their arsenal with aircraft particularly helicopter. In today's time, organic helicopter has become

an integral part of naval missions at sea. Beside the versatility of shipboard helicopter operations the degree of hazards involved in it cannot be overlooked. It needs to be remembered that hazards are always lurking and may become a great deal of danger if not striped off timely. Every individual involved in flight operations should be equipped to manage safety in order to strengthen and circulate the SMS within the organization. Otherwise, the threat to flight safety shall be overshadowing the success no matter how sound the pilot, aircraft, training or organization is.

Although helicopters have been utilized onboard for decades, the launching and recovery of helicopter is still a difficult task even for the most experienced pilots. Contrasting to land-based operations, the confined landing areas behind the ship's superstructure leaves the crews with little margins for error. The operation is often being influenced by some vital safety rudiments like human factors, environmental conditions, aircraft and maneuver. The factors are interconnected and therefore cannot be weighed separately to ascertain the primitive work plan. The complexity of such operations should be assessed correctly and carefully to minimize the possible accidents.

Helicopter safety has improved significantly over the years with the advent of technologies. Yet, the accidents are still occurring. The potential in reducing helicopter accident rate lies down in implementing an effective SMS. The system should be appropriately adopted blending with technology, regulation and training so as to act like a barrier to prevent damages. Each component of the protective system must be worthwhile to measure and assess potential hazards and risks. The intricacy of shipboard helicopter operations are comprehended in specific conditions and thus it is important to develop strategies and measures against all the sources of accident causation.

BN has stepped into the episode of shipboard helicopter operation in the recent past. The present scale of such operations is limited to landing onboard only. This low intensity operations has yielded a comparatively lesser risk situation to handle with. It is anticipated that the capacity building of shipboard helicopter operation is time consuming and lengthy process. The graph in this aspect has to be uniform i:e indicates identical progress of all the components.

Any asymmetry in the process would not only defy the progress but also become a breeding ground of hazards. It needs to be remembered that the success of ship-helicopter integration shall act as a launching stage for much wider scale of helicopter deployment in a more complex environment. This shall in turn, give exposure to greater risks to prevent. Therefore, a well articulated plan should be adopted in order to support the future shipboard operations eliminating the hazards.

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Biography of the Writer

Captain Ashraf Mahmud Riadh, (TAS), NGP, psc, BN was commissioned on 01 July 1997 in Executive Branch of Bangladesh Navy. He has attended various professional course both at home and abroad. He served as Executive Officer and Commanding Officer of Frigate, Patrol Craft, Specialized Officer on board Frigate and Staff Officer (Operations) to COMBAN. Captain Riadh is the pioneer aviator as well as helicopter instructor pilot of Bangladesh Navy. He is also the first BN Pilot to land with helicopter on ships deck. He was graduated as a Qualified Helicopter Instructor from FL, USA and has flown nearly 2000 hours on six different Aircrafts. He commanded the Hel Sqn of Naval Aviation for 04 years and paved the way for capacity bulking of the org. He has been qualified to conduct Rescue missions both on shore and at sea. He has visited number of Countries like India, Srilanka, Maldives, Oman, Yemen, UAE, South Sudan, Kenya, Thailand, Malaysia, USA, Canada etc. Captain Riadh is happily married to Mrs Taslima Mahmud and blessed with a son and a daughter. He loves to play Tennis, Golf and Basketball. Presently, he is serving as the commanding Officer Flying Wing of Naval Aviation.

EVOLVING MARITIME SECURITY: CHALLENGES, INTERNATIONAL EFFORT AND OPTIONS FOR BANGLADESH

Captain Tanzim Faruq, (ND), NGP, psc, BN

Abstract

Maritime Security involves a wide range of issues that are growing as well. States play vital role in ensuring maritime security; however, it is not possible by states to ensure it alone. An enhanced cooperation at regional and international level is an answer to prevent threats and risks imposed by the new challenging forces. Maritime security rules were applied for a long time without much change. But, contemporary problems and facilities like technological development, legal issues are challenging the age-old practices to adopt new instruments. It is necessary to identify maritime interests, threats and risks of Bangladesh. Bangladesh Navy is trying to add value to regional and global peace by focusing on prevention of piracy, smuggling, illegal migration, terrorism at sea, gunrunning, drug trafficking, etc. However, the existing national practices may be modified to address the evolving maritime security threats. The paper may be useful for the policymakers and professionals for awareness building and policy formulation on Maritime Security of Bangladesh.

Introduction

Maritime Security deals with a wide range of concerns. This concept is getting enlarged to address the old and newly emerging challenges. Particularly the new challenges demand enhanced cooperation at international level to prevent and address threats. Ports and shipping promote economic developments worldwide but provides opportunities to terrorism and crimes as well. A fundamental distinction exists between terrorism, which infects its constituents for political or ideological purposes whereas piracy is caused by an unhealthy environment which supports poor standards of living. In the era of globalisation, maritime security rules were applied for many decades without a major change. But contemporary problems demand new concepts, efforts and initiatives. Despite all the efforts at developing and implementing policies and organisations

to deal with such issues and to safeguard ports and ships, problems still remain due to different agenda and mindset of different authorities and their often-diverse security organisations, the wide range of private sector interests ranging from shippers to private security firms to port operators to ship owners.

Now there is compelling need to identify maritime interests of Bangladesh, threats and risks in order to seek and promote innovative solutions using new methodologies and technologies. Bangladesh's foreign policy, geostrategic, economic and cultural realities encourage us to address maritime security challenges peacefully in coordination with other regional and international organisations/ actors. Bangladesh Navy is trying to add value to regional and global peace by focusing on prevention of piracy, smuggling, illegal migration, terrorism at sea, gunrunning, drug trafficking, etc. However, the existing national practices may be modified to address the evolving maritime security threats.

Aim

The paper aims to discuss the basics of maritime security, its evolving nature, challenges experienced by Bangladesh and ongoing efforts.

Security and its Changing Perception

Security had always been an import issue for us like all other living beings. The concept of security is too large and complex as security perception depends on many components. Its degree defers from person to person and the number of elements that are needed to be secured in our lives and environment. In general, security is the 'state of being secure' or 'the state of being free from danger or threat'[1]. Although security is one of the constant figures of human life, its perception changes with time. With changing security perceptions, the tools and devices to provide security changes as well.

Since beginning of this century, besides national security, security studies started getting focus on societal, individual and environmental security. Floods, epidemics, poverty, human trafficking, arm and drug trafficking, pollution, information, media sources are also considered as challenges to security. In present world, States, international governmental, non-governmental institutions

and individuals are playing greater roles in providing security on earth. In one side, the growing world community with a greater respect to peace, showing hopes of a more peaceful international order. On the dark side, there are other factors that contribute to the deepening of insecurity perceptions of world public opinion. Regional military campaigns, food insecurity, energy crisis, terrorist activities, environmental degradation, civil wars, growing poverty and less efficient administrations are potential causes for unsecured condition.

State, Regional and International Organisations as Security Providers

Security and state are deeply related which are expected to support each other[2]. Out of all the institutions, State is the most dominant actor to provide security. State is the strongest and primary actor in both domestic and international arena. The international organisations involved with maritime security functions at global or regional levels; they can be intergovernmental or non-governmental organisations as well. It is the state that provide, protect or break security environment. States protect national security in their territories; composed of land, water and air spaces of a country. Previously it was assumed that protecting national borders, waterways and airspace ensured national security. Nevertheless, newly emerged sources of threat, made it impossible to ensure national security by traditional means. Neither land nor water or air borders could be protected efficiently without required economic means, without a well-functional and a stable domestic order, without a non-hostile international environment, and without an international cooperation.

Defining Maritime Security

Maritime security may be defined as all the activities that governments, commercial and private organisations will carry out in order to prevent and respond to and recover from any kind of attack that may take place in maritime domain[3]. It appears to be a large and sometimes nebulous concept. Many entities from international, public and private sectors who all are involved at preserving the freedom of the sea, facilitating and defending commerce, and maintaining good governance are related with maritime security.

Role of Navies in Maritime Security

Since ancient time, rivers, coastlines, lakes, and seas are used for the movement of goods and people. From that time on,Naval forces are primarily developed by countries to provided maritime security– the defence of a country's maritime interests[4]. Thus, naval power has been contributing in maritime security since time memoir[5]. The contemporary maritime challenges are piracy, armed robbery, maritime terrorism, illicit trafficking by sea i.e. narcotics trafficking, small arms trafficking, smuggling, human trafficking, cargo theft, global climate change, etc. They keep evolving. Furthermore, these challenges are usually interconnected and unpredictable mix of traditional and irregular warfare, terrorism or organised crime. Now states confronted numerous and unprecedented challenges that had to be confronted with a variety of new institutions and organisations. Navies continue to play vital role in national security efforts, but they also had to adopt to be able to counter new maritime security challenges.

Emerging Challenges to Maritime Security

In recent decades the security concerns have expanded greatly because of a new threat – terrorism and modern piracy along with traditional wide variety of criminal activities such as trafficking in weapons, people and drugs as well as environmental issues such as IUU (Illegal, unreported and unregulated) fishing and the dumping of illegal waste. Therefore, maritime security now has to address not only traditional war fighting, but also prevention of pirate attacks, smuggling, etc. These have serious human, social and economic implications.

Two decades have witnessed a major increase in the volume and the numbers of illegal migration of people through sea. Illegal migrates are viewed as security threat by destination countries. Therefore, they increase their efforts of preventing these migrates by policing their coastlines. Perceiving irregular migration as a security issue causes inhuman way of dealing with migrants. These migrants are very vulnerable and need protection against life threatening dangers at sea.

The concern with terrorism requires attention to a wide range of facilities ranging from ports to containers to ships of all kinds including cruise ships, bulk cargo ships, container ships, tankers and small vessels. In addition, a good number of private and public stakeholders are involved along with ship owners, importers, flag states, port operators, shippers, etc. It is not easy to keep the national and global supply chains safe under these conditions; the challenge is not for the national authority alone; international and regional organisations and private stakeholders have to face it as well.

Changing Maritime Security Situation

Communications and transportation are the key factors that have fuelled the phenomenon commonly referred to as Globalisation. Globalisation has accelerated greatly in recent years and has led to the creation of global supply chains that continually grow in size and importance depending on economic conditions. This globalisation has profound impact on changing maritime security situation[6].

The development of the container in the 1950's can be considered as the key technological innovation that has greatly reduced costs and time needed for both loading and unloading of cargo. Since then, it has become the most common means of goods movement because of its numerous advantages case of handling, reduced costs, and potentially enhanced security of the goods being transported. Presently, more than 90 percent of global trade moves on the oceans, transported in millions of containers on 50,000 merchant ships flagged by approximately 150 nations where cargoes are picked up and delivered at over 4000 ports. Altogether over 400 million containers carry 90% of all cargo.

Containerisation has affected all aspects of the supply chain. Specialised ships have been built that carry ever larger numbers of containers, the latest over 16,000 twenty foot containers. Ports too have undergone change as old ones have expanded and new ones have emerged since manufacturing no longer has to take place close to the decks; Some have been created explicitly to handle containers. Production and manufacturing have been increasingly outsourced as reduced transportation costs have given countries with inexpensive labour a big

advantage over manufacturing in the more advanced countries. Therefore, goods are transferred from developing to advanced countries in huge quantity. Containers now moves in ships, tracks and railways to move goods to and from the ports. This integrated system has not only expanded the security frontiers significantly but has also added numerous difficulties since additional organisations and staffs are involved[7].

The main ports in the world act as main hubs of the global supply chains. However, it is difficult to achieve a high level of security in these ports. They are accessible by both land and water thus an attack could be mounted from either side and, even, perhaps, from the air. Moreover, passenger ships, cargo and container vessels, trains, cars, trucks, workers and visitors visit ports frequently at a huge number. Ports also cover very large areas in the vicinity of crowded metropolitan centres and also host storage and processing facilities for a variety of hazardous materials. Ports, where liquid natural gas are handled may become targets of terrorists. Moreover, a large number of containers are stored temporarily in majority of the ports; these are also lucrative targets and may bring disaster to the adjoining cities. Other critical infrastructures of port, such as information technology and energy are also susceptible to cyber-attacks.

Many agencies and actors remain involved in security of a port. Its security, like that of any major port requires effective interaction between ship owners, insurance agents, port and facility operators, naval forces, non-governmental, local, national and international organisations, police, fire and harbour commissioners, and intelligence. Such interaction is complicated by the different structures, cultures, and interests, reflected in their security postures, of each organisation. Moreover, security initiatives need to be financed as well.

This intermodal global supply chain has also created new destructive threats and destroyed the gap between social and physical distance. As a result, old threats like piracy and new threats like terrorism have become real concerns. A successful terrorist attack on port, for example, would devastate global trade. Terrorists can use lack of sufficient security mechanism of the maritime domain, such as the lack of sufficient controls for cargo in order to attack the state.

Terrorist can also paralyse trade along with serious environmental degradation by the same way. In fact, a nuclear attack will generate many additional problematic situations that may be difficult to anticipate.

Technology as a Double-edged Sword

Terrorists now have a variety of targets that are vulnerable, ranging from hijacking or attacking ships at sea to attack on ports with or without support of pirate organisation[8]. They have demonstrated their traditional way of using explosives by ramming a boat loaded with them against a ship - as occurred in the attack against the USS Cole in October 2000, while it was harboured and being refuelled in a Yemeni port[9].

The ability to use high tech equipment raises the possibility that terrorists can utilize a new and powerful weapon - the keyboard. Cyber-attacks are difficult to defend as offensive malware, viruses and similar attack programs develop much faster than their defensive ones. For example, in 2010 the cyber-attack caused by Stuxnex virus remained undetected many months[10]. RANSOMWARE attacks from 2016 till today have forced most of the target organisations to paid the ransom sums[11]. Global supply chains are highly dependent on the transmission of information related to shipping. Global trade will come to a halt by a successful cyber-attack that cripple communication systems or transmit false data.

Other deadly possibilities are now available to terrorists; out of which an attack with a nuclear device is at number one. Building a nuclear bomb is no easy but a radiation dispersal device is simpler to manufacture. Possibilities of an attack using bio-chemicals such as plague, botulism, sarin, and anthrax, all of which are relatively easy to produce, disseminate and stockpiled cannot be overruled.

For a long time, terrorism has not been a major concern in maritime security. A number of incidents such as hijacking of an Italian cruise ship Achille Lauro in 1985, during which an American tourist was murdered, the attack on the USS Cole in 2000 and French tanker in the Gulf of Aden in 2002 became global news. Still, only ten terrorist attacks between 1977 and 2022 have involved

maritime facilities or ships. Terrorists now have ability to adopt new and more sophisticated tactics. The 2009 Mumbai attacks, involved capturing a trawler, landing commando style, mounting deadly attacks on multiple locations and aided by Global Positioning Satellites.

A secured maritime domain, secure chain, will prevent transportation of weapon (nuclear/ biological/ chemical) through sea that can be used by terrorists. It will also prevent an attack that aims to disrupt the chain itself, perhaps by exploding a dirty bomb in a container at a major port. Such an event will have calamitous consequences for international trade and economic development in many countries. All trade would come to a sudden halt and create havoc that will lead to a sudden increase in energy prices, shortages of foodstuffs and medicines resulting immense suffering to people. Another innovative terrorist initiative can be a mine laying operation or even the development of an underwater attack, like the submarines with low profiles and low radar reflectivity used by for drug smuggling.

Criminal organisations are no longer local or national but have evolved into the equivalent of multinational corporations. They exploit every opportunity wherever it may exist to enhance their profits by transferring human beings, drugs, weapons, stolen goods globally. Thus, they sell weapons to different groups, smuggle drugs and transport illegal migrates around the world. These criminal activities are as old as mankind. It is the technology that has transformed these localised problems into global issues whose impact cannot be compared to the situation that prevailed in earlier eras.

Criminal and terrorist groups used to be separate as crime bosses were concerned primarily with profits but terrorist groups were concerned with ideology. As terrorist groups are engaging in criminal activities to raise funds for their operations or to smuggle their personnel and weapons; it is becoming difficult to separation them from each other. Terrorists, supported by a pirate group can hijack an oil tanker not to steal the oil or collect the ransom but to blow it up in a major port. Such situation for a liquefied natural gas carrier getting detonated at a major port or near a group of ships in the open seas will have a devastating impact.

In maritime domain, technology has provided powerful new tools to enhance security. For example, harbour surveillance systems know as Vessel Traffic Monitoring System (VTMS) and the Coastal Surveillance System (CSS) have been developed that provides real time information about the kinds of vessels that are operating in ports, off the coasts and waterways. By using Automatic Information System (AIS) and radar sources, they share information to stakeholders at all levels. Such systems act against not only criminal actors but also terrorists.

Challenges in Interagency/ Inter-Govt Coordination in addressing Maritime Security Issues

Criminal and terrorist exploitation of the maritime domain has been addressed by the United Nations and the International Maritime Organization, but strategic diplomacy does not address which agencies within a government may be involved and their integration mechanism. Those decisions occur at the national level.

Now to counter drug smuggling, migrant trafficking, maritime oil smuggling, poaching, piracy, terrorism, etc. civil and military departments are working together. In the absence of a process that mandates coordination, the response can become stovepipes of information, miscommunication and redundancy. Hence, situation may arise where a decision affecting a nation may be made without a complete situational picture of maritime domain.

Coordination is not an issue where the head of state gives direct specific courses of action to achieve the desired national goal. But due to excessive volume of issues, one person cannot address all matters that unfolds in the maritime domain. When there is time for a coordinated response, someone needs to decide which agencies are to be involved and when more senior-level review is appropriate.

Maritime Security Challenges of Bangladesh and Ongoing Efforts

Like all other maritime nations, Bangladesh is facing new security problems that have emerged besides conventional ones due to globalisation and technological advancement. At sea, waterways and coastal areas of Bangladesh,

Bangladesh Navy and Bangladesh Coast Guard assets are accounted for ensuring maritime security. An integrated approach will require action to be taken at both national and international level. In Bangladesh, primary stakeholders of maritime security issue are Bangladesh Navy (BN) and Bangladesh Coast Guard (BCG). BN is trying to add value to regional and global peace by concentrating on prevention of piracy, smuggling, illegal migration, terrorism at sea, gunrunning, drug trafficking, etc. which are maritime security problems of 21st century.

Intra-State Cooperation between Organisations/Agencies

Authorities responsible for defence, law enforcement, border control, customs, marine pollution, fisheries control, maritime safety and security, vessel traffic management, accident and disaster response, search and rescue, etc. are collecting information for their own purposes. Though data sharing across government and non-governmental organisations and the general goodwill for building maritime partnerships are encouraged, the development of information sharing environment confronts difficulties.

The situation will be volatile in time-sensitive environments if threat signals are ambiguous or uncertain. The aim of 'Whole of Government Approaches' (WGA) is to improve coordination within a given government. In addition, as a coherent overall strategy at the governmental level some non-state actors of the state are also included in such strategy which acts as a 'whole of system' approach. Since 2006 several countries have implemented similar frameworks to ensure that their governments respond effectively to maritime security threats. The United States effort is known as 'Maritime Operational Threat Response' (MOTR) Plan which was implemented in 2006. To counter piracy and other maritime crisis, an Inter-Ministerial Group (IMG) was established in India. Mechanisms in Canada, Australia, Philippines, the United Kingdom, and Singapore also seek to ensure coordinated interagency or inter-ministerial responses to maritime threats. Similarly, an effort may be taken to establish a 'National Maritime Division' (NMD) in Bangladesh to integrate multiple departments for discussions, assessments and decisions through a network of national-level command and operations centres. It shall provide a degree of consistency, compel information sharing and connect agencies on a regular basis.

Maritime Situational Awareness

Maritime security can be enhanced through continuous and real-time information sharing about maritime activities between governments and their institutions, in other words through maritime situational awareness. The sensors of Coastal Surveillance System, Satellite based Monitoring/ Surveillance System, AIS, VTMS, etc. generate real time data about ships movements and behaviours. Maritime Situation Awareness relies on the quality and quantity of the data and collaborative networks to share data between countries. Such data need to be correlated with other sensors that can confirm the suspected vessel. Sometimes, the amount of traffic data is too big to be analysed by human operator. To generate a real time Maritime Situation Picture all data need to have same characteristics as well. Data mining tools can be combined with expert knowledge to detect and highlight a subset of potential threats for further investigation by traffic monitoring operators. The Information Fusion Centre (IFC) is a regional Maritime Security (MARSEC) established on April 2009 at Singapore and hosted by the Republic of Singapore Navy. It aimed to contribute enhancing regional Maritime Situation Awareness. The Information Fusion Centre – Indian Ocean Region (IFC-IOR) is a regional maritime security centre hosted by the Indian Navy. Since December 2018, the centre is strengthening maritime security and safety in the Indian Ocean. Bangladesh has opportunity of contributing and obtaining required information from these information fusion centres by providing country representatives like other regional countries.

Inter-State Cooperation

Bangladesh Navy and Bangladesh Coast Guard are actively contributing in enhancing cooperation between maritime states to create a secure maritime space in the overlapping national authorities, avoid gaps in jurisdiction, and the potential involvement of multiple government agencies. BN regularly organise/ participate in Navy-to-Navy Staff Talk (NNST) with neighbouring countries and extra-regional maritime nations where maritime security is a common topic. As an output of such discussion, BN and BCG representatives are maintaining communication with counterparts of similar services of neighbouring countries at different levels to address maritime security issues. Coordinated patrol

(CORPAT) with her neighbouring country has been introduced to give a strong signal to the non-state actors. At regional level BN is organising/ participating in Indian Ocean Naval Symposium (IONS) and its various events like workshop, exercise where maritime security and sharing of information amount member states always get priority. Western Pacific Naval Symposium (WPNS) is another regional construct where BN is representing Bangladesh as observer state. BN organised first-ever International Fleet Review 2022 (IFR 2022) with the theme 'Friendship Beyond the Horizon' in December 2022 where 28 countries participated. The fleet review and 'Maritime Discourse' of the event emphasised on cooperation among state actors against non-state actors to safeguard maritime security. The Heads of Navy - Coastguard and their representatives stressed on their commitment in support of maintaining peace, stability and good order at sea for the well-being of mankind.

Training of Personnel

Training of personnel involved in shipping industry is paramount importance as human resources are the weak point of supply chains. Statistics show that about 80% of cargo crime is perpetrated with the support of insiders. Other security incidents and accidents are mostly products of human errors. These factors need to be duly emphasised by all maritime stakeholders of Bangladesh. Focus on human resource management, training packages, refresher training, security screening, etc. will have profound impact on enhanced maritime security. Besides, Bangladesh maritime security organisations need to focus on the development of skills to operate and maintain appropriate security technologies.

Conclusion

Maritime Security involves many concerns that requires national, regional and international level cooperation. Globalisation has led to transfer of ever-increasing amounts of goods, particularly by the introduction of widespread use of containers. With the help of technology, it has created a complex maritime supply chain. It handles the enormous demands of global trade, but vulnerable to terrorist attack at many points. Similarly, criminals exploit this system for their own purposes. Technology has eliminated both physical distance and social

distance that made it possible for terrorists to attack from any part of the world. To deal with this challenge, the international community has enacted new rules and regulations to safeguard ports which have many vulnerabilities for shipping. Despite all these efforts to enhance maritime security, nations continue to confront many problems in its efforts to deal with maritime challenges posed by the global need for maritime security. If such awareness is to be achieved, cooperation among different organisations is clearly essential.

Illicit activities regularly unfold on the oceans, particularly in places with overlapping national authorities, gaps in jurisdiction, and the potential involvement of multiple government agencies. Coordinate responses recognise that few issues and even fewer solutions fall under the ambit of a single agency or nation. Many nations have created a process for information sharing and interagency coordination in the response to maritime threats through a whole of government response to security threats .

Collaboration is particularly essential because illicit activity occurs in a vast operating space with overlapping national authorities, gaps in jurisdiction, and the involvement of multiple organisations within a government. Though the onus of resolving maritime threats traditionally rests with naval or coast guard assets, but now it extends into diplomatic, investigative and judicial venues as well. Multiple agencies related with maritime domain possesses a separate chain of command. They have different operating procedures and authorities. These cause considerable coordination and governance challenges. As maritime industry is globally integrated, any disruption or chaos in one geographic area generally has regional and global implications. Considering importance and complexities of maritime security many nations around the world are emphasising on maritime situational awareness. It is done through continuous and real-time information sharing about maritime activities between governments and their institutions. Bangladesh has opportunities of enhancing maritime situation awareness from existing Vessel Traffic Monitoring System (VTMS), by introducing Coastal Surveillance System (CSS) and sharing of intelligence information between maritime security organisation and agencies. Besides, having representatives in regional Information Sharing Centres will beef up the regional capability of addressing maritime security challenges.

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Biography of the Writer

Captain Tanzim Faruq, (ND), NGP, psc, BN joined Bangladesh Navy in 01 January 1995. He got commissioned in Executive Branch in 01 July 1997. The officer is an honour graduate of Surface Warfare Course in USA. He is a Navigation specialist who served as Navigating Officer of BNS BANGABANDHU and BNS UMAR FAROOQ. He held number of sea appointments and commanded Missile boat, Petrol Craft and Large Petrol Craft. He also commanded Flag Ship of the fleet BNS BANGABANDHU. Captain Tanzim served in the Naval Headquarters in different staff appointments. Presently he is posted in the Naval Headquarters as Director of Personnel Services. He is a graduate of Defence Services Command and Staff College, Mirpur and US Naval War College. Captain Tanzim is a widely travelled person. The officer is married and blessed with a son and a daughter.

INFORMATION WARFARE: VULNERABILITIES AND OPPORTUNITIES FOR BANGLADESH NAVY

Captain A F M Ahsan Uddin, (C), NPP, BCGMS, psc, BN

Abstract

Since ancient times, information and intelligence played a vital role in any scenario. Today, human beings are immersed in digital devices and internet connectivity for information affairs in such a way that they will be paralyzed without them. Due to the overwhelming dependency, people try to dominate others with information superiority and fight for the collection, denial, disruption, or security of information. This is otherwise known as Information Warfare (IW)'. IW is quite different from other forms of warfare having many distinctive characteristics. Since it is related to information technology (IT), anyone having expertise in IT can be a potential actor of IW. The threats of IW attack in general and cyber-attacks in particular are increasing exponentially and the military isn't out of that. Being a technology-driven service and dependent on digital equipment and connectivity, Bangladesh Navy (BN) has the scope to explore huge opportunities in IW and guard her vulnerabilities. Bangladesh is densely populated and these people can be converted into an effective IW force if this affordable sector is focused adequately. Modern naval operations are reliant on IT and have certain peculiarities. Considering this BN can focus more on IW, generate effective IW force, and collaborate to develop indigenous cyber-resilient systems to achieve better IW readiness.

Introduction

Today, people are inseparably connected with networks, digital media, and algorithms. Starting from waking-up in the morning and checking messages on cell phones- doing office work on a computer in the daytime- till someone goes to bed at night to watch a movie on Netflix- a person's daily activities are associated with systems and networked equipment keeping digital footprint allover unwarily.

Like a civilian's life, life in the Navy is also highly dependent on such digital devices. Apart from peaceful daily activities, warfare or operational activities, navy, nowadays heavily rely on digital connectivity, satellite, and the internet, be it positioning and navigating a ship, communicating with others, receiving surveillance data, acquiring and passing information, or even launching a weapon.

Imagine a situation, when computers and digital systems are hacked, satellites are disabled and phone networks are faulty, or even down! The whole channel of information flow and related services will be disrupted and networked connectivity will collapse. Both the non-violent civil and operational military lives will be jeopardized and digital data with information might fall in the criminal's/enemy's hands. Hence, personal safety and information protection in particular and national security, in general, will be endangered.

Information and data are playing a vital role in all aspects of present-day life and warfare. In this globalised and modern world, acquiring, processing, and protecting both information and data is crucial for any state. This is because both the state and non-state actors are fighting today for information supremacy. Hence, the term "Information Warfare" came into being in the recent past and a new dimension of warfare emerged.

This Information Warfare (IW) is the corollary of the new era- 'the information age' where information technology (IT) and the Internet of Things (IoT), as a means of communication, opened up a revolutionary new world to mankind. Thus, a revolution in information affairs is currently taking place . It is such a revolution that nations and organisations are utilizing it as an essential tool and a weapon to attack adversaries in any crisis. For example, from 15 Jun 2020, due to the Ladakh skirmish, China tried to carry out cyber-attack on India 40,300 times in just 4-5 days. Thus the, information age and IT create dependencies, capabilities, and vulnerabilities that have to be understood and managed . Being a technology-oriented force, it stands true for Bangladesh Navy (BN).

Therefore, the protection of information and data, ensuring unhindered services and functioning of all digital devices and networks are of paramount importance in today's connected world. In this context, this paper is written to describe IW, its types, elements, weapons, characteristics, vulnerabilities and opportunities for BN.

Aim

This paper aims to discuss IW, its vulnerabilities and opportunities for BN.

Historical Perspective

Since ancient times, people used to acquire, protect, deceive, and trade information for achieving objectives. Deceiving enemies or denying vital information was a common form of Information Operation (IO) in those days. In the 12th Century B.C., Greek warriors created a 'Trojan Horse', deceived the enemy with misinformation, and successfully defeated the Trojans. Similarly, there are numerous examples from history like the battle of FISHGUARD (1797), the Siege of Detroit (1812), the American Civil War, and both the World Wars, where deception through faulty/misinformation played a vital role in the outcome of the conflict. The present-day conflicts are undergoing a revolution in IW which is ever increasing.

Information dominance over adversaries is as old as war itself. States and non-state actors are now devising new ways and means to have this information dominance over others. It was the 1991 Gulf War that inspired the widespread realization of the immense importance of information dominance and superiority in a modern conflict. Advances in communication through the electro-magnetic (EM) spectrum have further expanded the tools and possibilities in the field.

What is IW

Information is a resource that is created from various observations, data, systems, and so on. In general understanding, IW means fighting to acquire, deny, and defend information and use information as a tool to achieve objectives through IO. In relation to the IW and IO, Dr Daniel Kuehl explains that IW is to be performed primarily by the military while IO involves the military and civilian agencies. However, the basic tools and activities of IW and IO are the same.

IO involves actions taken to affect adversary information and systems while defending one's own. Whereas, IW means IO conducted in times of crisis or conflict to achieve one's objectives over an adversary. Whatever may be the context and forms, IW means achieving information dominance over the adversary by exploiting IoT.

Types and Elements of IW

IW is broadly categorized into two types- Offensive and Defensive IW. Offensive IW means corrupting, degrading, attacking or destroying the adversary's information and related systems to achieve "information superiority" for accomplishing or objective. Whereas Defensive IW means protecting the same for own for ensuring operational security (OPSEC) to deny information.[9]

There are a few elements of IW. Those are[10]:

a. **Command and Control (C2) Warfare.** The aim of this is to sever the enemy's C2 structure from its commanded forces. It can be either attacking commander/leader or the command centre, or it can be against the network.

b. **Intelligence Based Warfare.** It means the exploitation of information advantage by integrating various systems for achieving objectives, evaluating combat actions and so on. It is strengthened by different surveillance techniques like Human Intelligence (HUMINT), Signal Intelligence (SIGINT), etc. for different operational and tactical requirements.

c. **Electronic Warfare.** It is the use of various electronic equipment and means to detect, classify, exploit, attack, reduce or prevent hostile use of the EM spectrum and at the same time, ensuring own effective use. It has three branches-Electronic Attack, Electronic Protection, and Electronic Support.

d. **Psychological Warfare.** This is a kind of planned operation to inject selected information and messages into target audiences for influencing their behaviour by exploiting the human psyche. The main aim of this kind of operation is to create ambiguity, spread propaganda, generate dissatisfaction, draw attention towards desired outcome etc.

e. **Cyber/Hacker Warfare.** It means the use of computers and similar electronic devices to attack an enemy's information system in order to steal data, disrupt communication services, create havoc, and paralyze part/total computer-based information infrastructure. It refers to politically motivated hacking to conduct sabotage and espionage. Thereby, it is sometimes referred to as hacker warfare.

f. **Economic Information Warfare.** It means control of economic activity through control of information. It is conducted at the national level and is not necessarily part of the Armed forces' doctrine. It is conducted in two forms – Information Blockade and Information Imperialism .

g. **Network Centric Warfare (NCW).** This is a concept which enables a force to enhance its capability to attack an adversary through networking sensors, equipment, leaders and troops to increase shared knowledge on battlefield information. NCW translates information superiority into combat power by effectively linking knowledgeable entities in the battlespace .

h. **Space Warfare.** Space has added a new dimension to warfare. There is a deep relationship between space and IW as both deal with information and data. The exploitation of space is increasing for obtaining information about the enemy and denying the same for own. Nowadays, forces are increasingly dependent on space-based sensors to gain information superiority.

Weapons of IW

There are numerous weapons used in IW and it is increasing day by day. IT specialists, hackers, and other experts are inventing newer forms of weapons and tools to use. Most of these soft kill weapons are basically some kinds of malicious programmes that infiltrate a target network/computer system, carry out independent or pre-designed actions, and ultimately disrupt, manipulate, control, steal, paralyse or destroy that network/system to gather intelligence for achieving information superiority. Most of these weapons fall under two categories as mentioned below :

a. **Cyber Attack Weapons.** These can be network and wireless security attacks, malware attacks and social engineering attacks. Example are malware, ransomware, trapdoor operations, logic bombs, spam email, trojanhorse, worms, spoofing, hacking, freaking, phishing, chipping, denial/distributed denial of service, smurf, DNS poisoning, domain kiting, data emanation, jamming, evil twin, wardriving, viruses, keyloggers, vishing, smishing, pretexting, tailgating and many more.

b. **Special Weapons.** These are techniques used to disrupt intended network/systems and collapse public/individual networks, systems, and infrastructures to deny services, acquire intelligence, transmit falsified messages and spread propaganda. Examples are mass dialing system, video morphing (a multimedia and voice synthesis tool where a person can be made to say intended things which he/she has not said), van-eck-radiation (an eavesdropping technique of digital spying), destructive microbes (aimed to eat up/destroy critical components by inserting a device), high energy radio frequency (HERF) Guns (to shoot a high-power radio signal to damage a digital target) and EM pulse bombs (to destroy electrical devices), cryptology (a technique to disrupt, encrypt, and crack any secure communication system) and so on.

Characteristics and Strategies of IW

IW is different in many aspects from classical conventional warfare. It has some inherent qualities which make it unique. The prime characteristic is that there is no need to declare war officially. IW is mostly related to IT on which any individual can achieve mastery and utilize it against any person, organization or even a state. Hence, it is quite difficult to identify the enemy. It can achieve huge detrimental effect with very minimum effort as not much investment, infrastructural development, and heavy weaponry are required in this warfare. Uniformed soldiers are not always engaged here. It has very negligible or no collateral damage. It is a nearly silent and seamless warfare whose tempo can be controlled by overseeing the effect it generated .

IW acts in a domain where people are engulfed with numerous digital devices for their daily requirements. Thus, knowingly or unknowingly, people

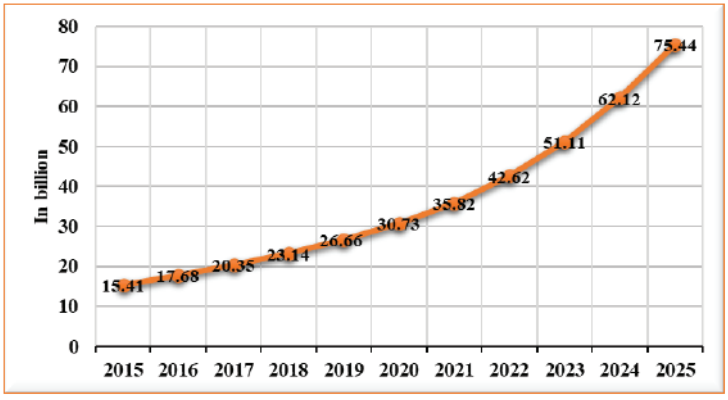
are exposing their signature and digital footprint in this domain which is very prone to IW attack.

Though IW is a quite vast and undefined domain, few strategies can be attributed to it. These are denial of information, deception and mimicry, disruption and destruction, and subversion. All these strategies are applied against an adversary as and when required to achieve the best outcome in IW. Various weapons described above, together with other measures like firewalls, anti-virus, virtual private network, cryptography and so on are the tools for applying these strategies as appropriate.

IW Threats and Attacks

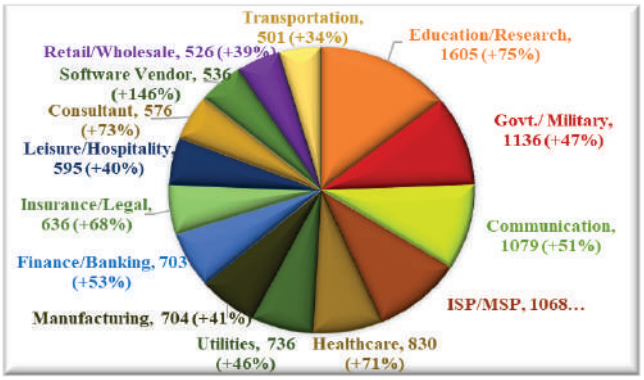
The growth of the IoT (Figure 1) – the network of internet-connected smart devices, embedded with sensors and software, that perform operations in the physical world – has opened a new, yet unfathomed territory with great potential for attack by different actors . The growth of IoT is directly proportional to IW attacks. As such, IW attacks are happening regularly and increasing exponentially. In 2021, an average of 1,136 attacks per week (a 47% increase from 2020) took place in the government/military sector (Figure 2). This indicates how vulnerable are different sectors including the military for cyber-attack.

Figure 1: Global Yearly Growth of IoT



Source: VOX CEPR Policy Portal

Figure2: Average Weekly Cyber Attack-2021 & Increase from 2020



Source: Check Point Research

IW in Navy and Vulnerabilities

Navy is a technology driven service. The technological development and increased digitalization of navies have made them vulnerable to information attack. Navies use many equipment and sensors both in peace and war where computer-based network, satellite, data link, different algorithms, and EM spectrum is utilized extensively. Thereby, like other services, IW is an integral part of navy and naval operations where SIGINT plays a vital role.

SIGINT is defined as a category of intelligence that includes communications Intelligence (COMINT), Electronic Intelligence (ELINT), and Foreign Instrumentation Signals Sntelligence (FISINT) regardless of transmission medium. COMINT is the technical information and intelligence obtained by unintended recipients from different communication sources. ELINT means different technical and geolocation intelligence received from foreign noncommunication EM radiations. It is further categorized as Operational ELINT (OPELINT) and Technical ELINT (TECHELINT). OPELINT consists of intelligence information of the location, movement, and activity of various emitters and associated weapons. Whereas TECHELINT contains different technical parameters of emitters. FISINT is defined as technical and intelligence information received from foreign EM emissions connected with the testing and operation of future systems . In BN, most of the modern communication and IT equipment and devices are of foreign origin. Hence chances of SIGINT collection by any interested group or adversary are self-evident.

Naval activities, operations and actions in all circumstances are dependent on various modern, digital equipment and computer devices. These routine and special naval activities are susceptible to acquiring SIGINT by any adversary. A few of such activities are:

a. Position and movements of ships and location of important installations that are dependent on various digital and networked devices.

b. Routine and secured ship-to-ship and ship-to-shore communications using radio sets and satellite networks.

c. Acquisition of target data, sharing of information using various sensors, radio sets,data links etc.

d. Obtaining fire control solution through radars and sensors using EM spectrum before engaging a target.

e. Testing various equipment and devices, checking their status and condition, thus transmitting SIGINT.

f. Using different software and operating systems for operational (fighting instruments) and administrative (ship's management system) functions.

g. Creating naval, armament and victualling stores and databases and thus storing vital information in computer devices.

h. Other miscellaneous activities like rationing, payroll and different information management issues.

Naval operational activities are primarily based on platforms and equipment. With the advancement of technology, these are getting updated, modernized, and digitalized. Present days warships and equipment are more automated than those of the earlier. Obviously, this automation, based on network, internet, and connectivity, is going to rule naval warfare in future. Hence, the ramification of IW and challenges in OPSEC will be more intensive in future. Furthermore, the digitalization of C2 systems in warships and deployment of naval assets in the same network via radio frequencies, satellite, and data links have made modern ships more vulnerable to such IW attacks.

In future, it may not be surprising to see a belligerent firing the arsenal of her enemy's ship without even the knowledge of the enemy by exploiting IW.

Peculiarities/Challenges of Naval IW

Information plays a vital role in naval warfare. Disruption of any information processing system will certainly degrade the warfare capability and threaten the command's decision-making cycle. It will hamper the navigation system and endanger the safety and security of naval platforms as at sea, there are no landmarks/features like on land. Likewise,in any crisis, if a ship is attacked by an enemy's offensive IW, cannot gather intelligence/information and process required data, she might be blind in the vast sea and unable to carry out desired operation effectively against an adversary. Similarly, if the enemy is having a robust defensive IW capability and collecting information is impossible, a credible platform with modern weapons will probably be of little use.

There are a few other challenges as well. In IW attacks, the enemy is invisible, and the engagement bearing is indefinite. Its weapon is the computer, and its ammunition is data. While it takes years to upgrade a regular weapon system, software to be used in cyber-attacks is perhaps renewed day by day. Therefore, it is more challenging to build countermeasures. Again, it is quite difficult to take any actions against an unidentified adversary from the naval platforms at sea. Moreover, timely identification of IW attacks and damages caused therein is of crucial importance since the timing window at sea during a crisis is short and actions after own data has been lost are of no use. Thereby, improving the ability to identify an incoming attack or providing indications of an attack in a timely fashion is perhaps the most difficult challenge in this regard.

Opportunities for BN

IW is primarily related to IT. IT is a specialist knowledge which any individual can learn. It is less capital intensive and mostly dependent on software and the human brain. Digitalization and dependencies on IT in our daily life are increasing phenomenally which can play havoc in IW. This has offered a huge possibility for a densely populated country like Bangladesh to convert

'population liability' into strength and make IT specialists. Thereby, she can have a quantum leap to a state where it can conduct a successful IW against a superior adversary .

Being a developing nation, it is quite difficult for BN to enhance her capability by inducting more newer platforms and equipment as and when required. BN needs to think, analyse, compare options, carry out a detailed study, constantly keep budgetary constraint in mind, adjust actual requirement, see options for refurbished/used platforms, and then finally select some medium capable platforms/equipment to increase fighting efficiency. However, BN can invest more in comparatively affordable areas of the IW sector that can act as a force multiplier to enhance her overall capability in a much quicker way.

Way Out- Options for BN

In today's modern and overwhelmingly connected world, IW is inescapable. Hence, to be better prepared, BN may explore the following options in order to deal with the threats and grasp the huge opportunities in IW:

a. **Enhance the Focus and Create Awareness.** The inevitability of IW threats demands relatively more emphasis on this. Hence, BN needs to enhance her focus and orientation towards IW. At the same time, thoughtful awareness of IW threats and vulnerabilities needs to be created among the information users so that unintentional digital footprints are not available to the adversary. Regular awareness programmes and related exercises may be conducted in this regard.

b. **Risk Analysis and Vulnerability Check.** The appropriate authority may carry out in-depth risk analysis and identify vulnerable areas. All concerned are to be informed about this and a committee may be formed to propose options to address the issue better. In this regard, communication and information security need to be enhanced with priority.

c. **Identify Key Areas and Develop Expertise.** An appropriate committee may identify required key areas among the elements and weapons of IW on which expertise to be grown. Sectors like cyber, cryptology, cryptanalysis,

information management, IT, SIGINT, ethical hacking etc. are some essential areas where BN may develop expertise through appropriate training.

d. **Recruit Suitable Personnel to Create IW Force.** BN may recruit additional personnel, or train existing manpower, make them specialists, develop their skills, and create a separate IW force. A committee may be formed to look into this issue at length.

e. **Collaboration with Civil Universities/Institutes.** To recruit skilled personnel for the IW force, BN may collaborate with civil universities and institutions where young and intelligent IT specialists are being created. In addition, civilian industries may be explored to produce indigenous cyber-resilient systems, IT and IW equipment for ships to ensure better information security.

f. **Policy Formulation.** Necessary policies may be formulated by an appropriate authority to ensure better information security and information management, creating an IW force, and bringing synergy among IW stakeholders.

Conclusion

The world today is overwhelmed by digital devices that are connected to networks. People are so immersed in such a routine of information exchange and dependency that they tend to forget the consequences of its failure. Information was, is, and will be the key deciding factor in any conflict or war. Generally, different actors get involved in a competition and try to gain information superiority, advantage, and dominance over others through various IO tools. This is broadly known as ‘Information Warfare’.

IW can be both offensive and defensive. There are a few elements of IW like C2 warfare, intelligence-based warfare, EW, psychological warfare, cyber/hacker warfare, economic IW, network centric warfare, and space warfare. Numerous techniques are used in IW as weapons to attack other systems and these are increasing and changing regularly. A few important cyber-attack weapons are malware, ransomware, worms, phishing, hacking, freaking, chipping and many more. The special weapons include video morphing, van-eck radiation, HERF, cryptology and so on.

IW is quite unique to other forms of warfare. Here, the war may not be declared. It is silent and takes minimum effort. The enemy is invisible here. The daily use of digital devices reveals the footprint of the user in the IW domain. Hence, a few strategies like denial of information, deception, destruction and subversion are applied in the IW domain.

IW threats and attacks are occurring regularly and increasing exponentially. The military sector isn't out of this. The navy is a very much technology-driven service. Automation and digitalization are going to rule the future of naval warfare. Hence, naval activities and operations, like positioning a ship, communications, acquiring data, personnel management and even firing a weapon- are quite vulnerable to the enemy's SIGINT collection and IW attack. The peculiarity of naval warfare is that the reaction time against an attack is very short and actions after losing own vital data is of no use. Therefore, it is really challenging for a navy to ensure safety and security in the vast sea. Hence, a potent modern naval platform should be able to gather enemy SIGINT and protect her data in a successful IW.

Since IW is primarily dependent on IT, anyone having an expertise in IT can be a potential actor here. This offers a great opportunity for BN as Bangladesh is having a huge population which can be converted into strength if properly trained in a less capital-intensive IT sector and create an effective IW force. Being a developing nation and keeping the future modern warfare in mind, investing more in affordable IW area than that of purchasing modern platforms might be preferable for BN.

To capitalize on various opportunities, BN may enhance her focus and create awareness about IW, carry out risk analysis, and do vulnerability check in this field. In addition an appropriate authority may identify key areas and develop expertise in sectors like cyber, cryptology, cryptanalysis, information management, IT, SIGINT, ethical hacking and so on. For that, BN may recruit suitable personnel or train existing manpower to create a separate IW force. Simultaneously, BN may have effective collaboration with civil universities/institutes for making indigenous cyber-resilient systems, IT and IW equipment for ships for better information security. With all these, BN might be able to grasp the huge opportunities in IW and be better prepared for the future.

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Biography of the Writer

Captain A F M Ahsan Uddin, (C), NPP, BCGMS, psc, BN was commissioned in Executive branch from Royal Malaysian Naval Academy. He completed his specialization in Communication from India. He served onboard various ships of Bangladesh Navy as Commanding Officer of two fast attack craft and an LPC, Executive Officer of an Offshore Patrol Vessel, other smaller craft and a corvette. He commanded a training frigate of BN. The officer also served in Bangladesh Coast Guard and awarded with Bangladesh Coast Guard Medal for gallantry performance. He took part in the UN mission as a Military Police in D R Congo. The officer also attended Comprehensive Security Responses to Terrorism Course from APCSS, Hawaii. He has done his first Staff Course in DSCSC, Mirpur, Bangladesh and second Staff Course from India. He served as Directing Staff and now he is serving as Senior Instructor (Navy) in DSCSC, Mirpur. He was awarded with Nou Parodorshita Padak (NPP), a peacetime medal for his meritorious service in BN. He is happily married and blessed with two sons.

SUSTAINABLE BLUE ECONOMY VS MARITIME POLLUTION IN BANGLADESH: CHALLENGES AND RECOMMENDED POLICY INITIATIVES

Captain Mohammad Yousuf Alam, (L), psc, BN

Abstract

Blue economy concept promotes optimum use of ocean. It includes fishing, shipping, extracting natural resources etc, in short, exploration and exploitation of sea. For a sustainable development in blue economy, preservation of the sea also carries utmost importance. On the contrary, maritime pollution may hinder extremely the sustainable blue economy. There are considerable opportunities and challenges to overcome on this issue. Necessary discussions circled based on Bangladesh perspectives. Potential cooperation is also felt necessary for sustainable blue economy. From overall discussions, policy initiatives such as good governance, investors initiatives, awareness developments, proactive approach, maintenance of good order at sea, pollution control, coastal surveillance etc are recommended for sustainable blue economy for Bangladesh.

Key Words: *Sustainable, Blue Economy, Cooperation, Pollution, Policy Initiatives, Challenges.*

Introduction

The term 'Blue Economy' is an emerging concept which promotes better stewardship and uses of ocean or 'blue' resources for economic development. Gunter Pauli was the first to propound the idea of a Blue Economy in the year 2010, and published a book (Pauli, 2010). The blue economy goes beyond viewing the ocean economy solely as a mechanism for economic growth. Large-scale industrial nations have seen the development of their ocean economies through the exploration and exploitation of maritime and marine resources. Maritime activities include shipping, fishing, oil, gas, minerals and mining industries etc. By using sea, coastal nations like Bangladesh, despite of her small land and huge population, have the opportunity for boosting their economic growth and to tackle unemployment, food security and poverty. The

worldwide ocean economy is valued at around US$1.5 trillion per year. Eighty per-cent of global trade by volume is carried by sea. 350 million jobs world-wide are linked to fisheries. By 2025 it is estimated that 34% of crude oil production will come from offshore fields. Aquaculture is the fastest growing food sector and provides about 50% of fish for human consumption .

'The Blue Economy' is a social system created gradual step by step process. It is named after this beautiful earth whose sky and ocean are blue, as long as there is no pollution. The waste dumped into the sea include dredge spoils, industrial wastes, sewage sludge, construction and demolition debris, solid wastes, explosives, chemical and radioactive wastes. Pollution at sea affects marine life through toxicity, which kills some plants and animals and reproductive failure in others; it also causes oxygen depletion, ecological disturbance and economic losses in fishing and recreational industries (Mizanur Rahman, 2006, p. 2). Pollution can be controlled by applying zero waste technology, Reduce, Reuse and Recycle (3R) technology, together with wastewater treatment facilities. Every economic sector as well as human activity must produce low or no carbon emissions and waste.

Among the South Asian countries, Bangladesh is, perhaps most vocal about the Blue Economy. In September 2014, Bangladesh hosted a major conference in Dhaka, and proposed the 'Bay of Bengal Partnership for a Blue Economy' for the sustainable development of sea based resources . It is pertinent to mention that nearly 30 million people in Bangladesh are 'dependent on the sea for livelihood, and are engaged in fishing and commercial transportation'. It has instituted several measures, including setting up a 'National Oceanographic Research Institute for the marine scientific community, teaching oceanography at the Universities, and training human resource to develop skills for the sustainable development of resources, and working towards protecting the marine environment and preserving the bio-diversity of the seas'.

Systematic literature review has been carried out and the article is biased by secondary data to a great extent from various print media, Non-Government Organization (NGO) reports, journals, symposium papers and documents of

private and governmental organizations. This article will carefully analyse present state and requirements of a sustainable blue economy for Bangladesh. Considering the facts and figures of sustainable blue economy and maritime pollutions, challenges which may come across in course of time will be discussed. Finally considering and analyzing all the factors, policy initiatives will be recommended in Bangladesh perspective.

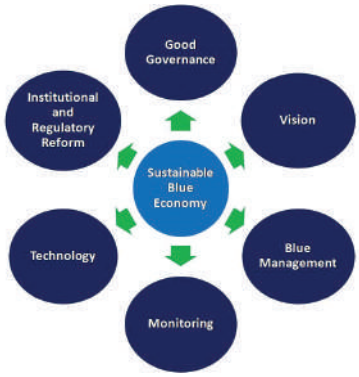
Objective

The objective of this article is to analyse potentials of a sustainable blue economy, sources of maritime pollutions and challenges in Bangladesh to recommend policy initiatives.

Blue Economy

General. The world's oceans, seas and coastal areas are the largest ecosystems on the planet and a precious part of our natural heritage. They are also vital to the livelihoods and food security of billions of people around the globe. Humanity increasingly understands that it is an integral part of the marine ecosystem. It is felt that active leadership is needed, in both the public and private sectors, to steer the blue economy in a sustainable direction. The main pillars of the sustainable blue economy are drawn below:

Figure - 1: Main Pillars of Sustainable Blue Economy

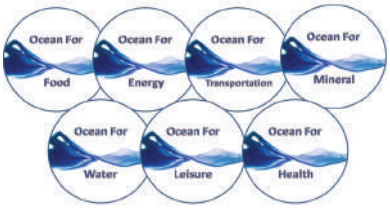


Source: An Emerging New Development Paradigm of the Blue Economy in IORA; A Policy Framework for the Future, p2, Mauritius, 2016

Opportunities. It can be sensed that economic activities in the ocean are expanding rapidly day by day. This is driven primarily by developments in global population, economic growth, trade, rising income levels, technology etc. Looking to 2030, it seems that many ocean based industries have the potential to surpass the growth of the global economy as a whole. The projections suggest that between 2010 and 2030 on a 'business-as-usual' scenario basis, the Blue Economy could more than double its contribution to global value added, reaching over USD 3 trillion. Particularly strong growth is expected in marine aquaculture, exploration and exploitation of offshore resources, offshore renewable energy, shipbuilding and repairs, port activities and seafood processing. The UN Food and Agriculture Organisation estimated that aquaculture provides half of the animal protein and by 2030 it will reach up to 65%. Globally, it has a growth rate of 6.6% per annum, making it the fastest growing animal food producing sector. Growth in the aquaculture sector in Asia accounts for more than 89% of global production.

Coastal and marine areas bear a wide variety of established industries, such as shipping, ship building, ship repair, ship breaking, fisheries, coastal tourism etc. Advancing technology is allowing a coastal nation to access new resources through emerging industries, such as renewable energy, marine aquaculture, offshore wind energy, marine biotechnology and seabed mining. The industries mentioned above contribute roughly USD 1.5 trillion (2.5%) to global gross value added. Calculations on the basis of the Organization for Economic Cooperation and Development (OECD)'s ocean economy database value in 2010 at USD 1.5 trillion. The ocean uses can be summarized as mentioned below:

Figure - 2: Uses of Ocean in the 21st Century



Source:https://bdnews24.com/economy/2014/08/31/bangladesh-eyes-blue-economy-for-sustainable-growth retrieved on 15 July 2020

From the analysis of world blue economic activities, now few of the potential sectors of Bangladesh will be highlighted:

Maritime Transport. Shipping is the safest, secure, efficient and environmentally sound means of bulk transportation. International shipping contributes highly for the sustainable development of any country.

Coastal Tourism. By creating sustainable tourism, Bangladesh can create new jobs and reduce poverty. The private sector must be mobilized to support sustainable tourism and needs access to financing for investing in greening practices. Cross-sectorial consultation and Integrated Coastal Zone Management (ICZM) are required for sustainable tourism, destination planning and development strategies.

Marine-based Blue Energy. It is a priority to reduce the use of fossil fuels and simultaneously use renewable energy including solar energy, wind energy, wave energy, tidal energy, Ocean Thermal Energy Conversion (OTEC) and bio fuel from marine algae and sea grasses. Marine energies have the potential to enhance the efficiency of harvesting the energy resource, minimize land use requirements of the power sector and reduce the greenhouse gas emissions.

Marine Mineral Resources. Between the year 2000 and 2010, there has been an annual increase of about 15% in the price of many non energy raw materials . As per United Nations Environment Programme (UNEP) report, by 2020, 5% of the world's minerals, including cobalt, copper and zinc could come from the ocean floors. This could rise to 10% by 2030.

Blue Biotechnology. The unexplored and understudied nature of much of the underwater world means that the capacity of marine organisms other than fish and shellfish to provide inputs to the blue economy. Some organizations developed first drug of marine origin to fight cancer from small soft-bodied marine animals.

Blue Economy and Potentials for Cooperation in the Bay of Bengal

Regionalism in oceanic affairs can be referred as management of the oceans and their resources at the regional level. Regional cooperation not only

encourages maximum participation by the regional nations, but also favours cost effective and transfer of technology to the developing nations.

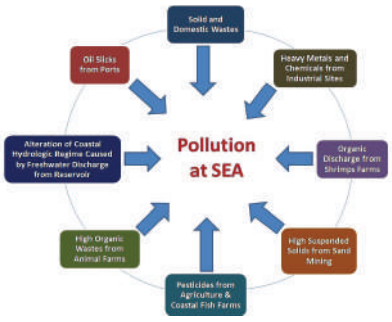
Among the several sub regional groups, the Bay of Bengal Initiative for Multi-Sectorial Technical and Economic Cooperation (BIMSTEC) and Bangladesh, Bhutan, India, Nepal (BBIN) sub regional co-operations are stark examples. Regarding this cooperation, the director of National Maritime Foundation of India opines that Bangladesh and India need to formulate a common coastal development framework. He also expressed the necessity to share and develop scientific knowledge and skilful human resource.

Maritime Pollution – A Threat to Sustainable Development

General. One of the biggest threats to our oceans is man-made pollution. Discarded plastics and other residential wastes discharged from pesticides and industrial chemicals eventually find their way into the sea with upsetting consequences for marine life and the habitats they depend on. Shipping accidents and oil spills add additional toxins to the mix. It is estimated that a staggering 80 per cent of marine pollution originates on land.

Ocean pollution is mainly due to wastewater treatment plants, agricultural runoff, urban runoff, groundwater discharge and atmospheric deposition release from sediments. The sources of pollutions in aquaculture raising environments in general shown below:

Figure - 3: Pollution Sources in the Sea



Source: Kathijotes, Keynote: Blue Economy - Environmental and Behavioural Aspects Towards Sustainable Coastal Development, p9, 2013

Common Ocean Pollutions. People put pressure on ocean environment with urban waste and poor sewage management. In such areas, implementing effective waste reduction initiatives, recycling and effective waste management is the key to improve the healthy oceans. Common ocean pollutions are as follows:

Plastic. Plastic is one of the biggest man made pollutants in the marine environment. It is estimated that each year about eight million tonnes of plastic waste are deposited in ocean. It chokes wildlife above and below the waterline. Fish and other marine life ingest micro plastics which in turn can find their way into the human food chain. 60% - 90% of marine pollution is made up of different types of plastics.

Figure - 4: Plastic Pollutions at Sea

Source: https://thecommonwealth.org/marine-pollution retrieved on 10 August 2020

Pollution from Domestic Sources. In Bangladesh, it is seen that the effluents either directly or indirectly find their way into the water bodies. The unplanned growth and lack of proper waste disposal systems further worsen the problem.

Pollution from Industrial Sources. The industrial sector in Bangladesh is still in its developmental stage. Dumping of untreated toxic or non-toxic waste material into the rivers and other natural water bodies is often practised. It is suggested that no industries, small or big, should be allowed to dump pollutants in the river area without proper treatment .

Pollution from Agrochemicals. The Directorate of Fisheries of Bangladesh reports that increasing application of fertilizers and pesticides is affecting the spawning of freshwater fish in rice fields and those pesticides are killing plankton and affecting their production in the water bodies.

Oil Pollution. The need for a functional oil spill contingency plan was highlighted by the incident took place on 09 December 2014, when an oil tanker with 3,57,664 litres of furnace oil capsized in Shela river (Rahman Sunny, 2017, p. 365). The spill decimated flora and fauna of the surrounding areas of the forest. Acknowledging the damage, the government had taken the issue seriously and therefore launched the formulation of a plan.

Figure - 5: Impact of Oil Spill Incident in Shela River inside the Sundarbans

Source: Siddique, Dhaka Tribune, 'Sundarbans Oil Spill: No Contingency Plan for at Least One Year', Dhaka, 2017

Ship Breaking. Ship breaking is a recycling process through dismantling the old ships. It is being done to recycle the materials used in ship building, specially the metals. In the year 1984, Bangladesh appeared as a major ship

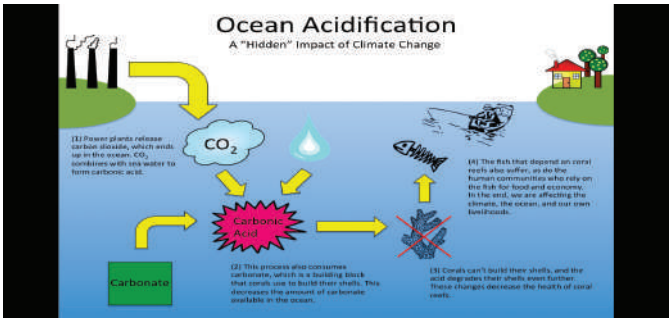
breaking nation in the world (Hossain, Iqbal, & Zakaria, 2010, p. 97). During dismantle process, different types of disposable materials and rubbish are often getting mixed with the beach soil and sea water around. As a result, knowingly or unknowingly, the breaking sites are polluting the marine environment severely.

Figure - 6: Birds Eye View of a Ship Breaking Yard at Chittagong

Source: Author's collection, Chattogram, 2015

Ocean Acidification. The ocean constitutes more than 95% of the Earth's living space, hosting more than 220,000 known species of plants and animals. When Carbon Di Oxide (CO2) is absorbed by the ocean, it changes the chemical makeup of seawater in a process called 'acidification'. Changes in the ocean's chemical environment can also hinder growth and reproduction for other organisms. Ocean acidity will increase by 170% by 2100 compared with preindustrial levels, if present CO2 emissions continue.

Figure - 7: Ocean Acidification



Source:https://in.images.search.yahoo.com/yhs/search;_ylt=AwrxgzNmuFVffBIAnA7nHgx.;_ylu=Y29swMEcG9zAzEEdnRpZAMEc2VjA3BpdnM?p=ocean+acidification&type retrieved on 20 July 2020.

Overfishing and Harmful Fishing Activities. Fishing has been undertaken traditionally by non-mechanised river craft in Bangladesh. Only limited scope has been recognised for the development of mechanised bottom trawling or pelagic fisheries. Over fishing or harmful fishing may hinder the marine environment and break eco system of the Bay of Bengal.

Challenges

General. For a sustainable blue economy, beside the pollutions, maritime security cannot be overlooked. Sea borne terror and piracy are two key challenges to the maritime security. Severe coastal erosion and land degradation are factors affecting blue economy. Challenges like climate change, droughts, flash floods and tropical storms are to be mentioned. Protecting the area from international smugglers, fish pirates, preserving mangrove and sea grass, addressing climate change and managing carbon emission, maintaining sea level rise and change in ecosystem, temperatures from coral bleaching are also major challenges for a sustainable blue economy.

Challenges for Bangladesh to Harvest Benefits from Sustainable Blue Economy. Marine policy refers to a framework of decisions delineating plans to achieve management of vast ocean space. The major challenges for blue growth in Bangladesh tangle over exploration of ocean resources, pollution control, climate change issues and maritime security issues. Bangladesh requires adopting an integrated maritime policy focusing on maritime security, maritime pollution, marine resource protection, maritime research and transfer of technology.

Sustainable blue economy is vulnerable to a changing climate, rising sea levels and changing trans-boundary river flows with water stress for upstream development activities. Challenges for a sustainable blue economy of Bangladesh are mentioned below:

Implementation of Policies on Ground. In the policy level and in implementation level, an orchestrated effort is needed to achieve desired goal. Lack in implementation of policies may hinder the outcome of sustainable economic development.

Coastal Zone Managements. Coastal zone management offers multidimensional challenges like disaster preparedness, environmental protection, maintenance of bio-diversity, and promoting environment friendly economic activities.

Maintaining Good Order at Sea. Bangladesh Navy (BN) and Bangladesh Coast Guard (BCG) have been dedicated responsibilities for crime prevention at sea. It is estimated that constrains of resources and lack in surveillance system sometimes may make BN and BCG ineffective in fulfilling their crime prevention mission at sea.

Lack of Maritime Awareness. The foremost challenge in the maritime sector is the lack of public and political awareness about ocean affairs. Thus the nation severely suffers from the benefit of her maritime zone despite having enormous potentials.

Sea Level Rise and other Environmental Effects. Sea level rise, coastal erosion and land subsidence patterns will causes many types of environmental effect. By the end of the year 2050, the projected 1.44 meter rise of sea level would submerge 16% of the populated land and displace 13% of the population.

Augmentation of Navy. Present force of BN and the organisation are limitedly capable to fulfill both the wartime and peacetime functions at sea. Thus BN needs adequate resources and budgetary allocation to counter any traditional or non-traditional threats and to undertake any mission at sea.

Recommended Policy Initiatives for Sustainable Blue Economy – Bangladesh Perspective

A sustainable blue economy benefits current and future generations, by contributing to food security, poverty eradication, livelihoods, income, employment, health, safety and political stability. Considering all the factors of sustainable blue economy and maritime pollutions, following are the recommended policy initiatives to be taken by Bangladesh:

Governed by Public and Private Processes. A sustainable blue economy may be governed by public and private processes. It is not an easy call to govern sea area without supports from private sectors.

The Blue Economy is a New Concept where Main Barriers will Remain with Access to Finance. The lack of entrepreneurship culture and regulatory uncertainty are to be eliminated by developing a blue economy policy framework at national, regional and international level.

Awareness Building Programs. To build awareness regarding ocean use and ocean pollution, related subjects in school, college and university level may be incorporated. Moreover, conduct of seminar, symposium and campaign on ocean related matters in media may give desired output.

Innovative and Proactive Approach. For sustainable blue economy, all actors are to take innovative and proactive actions constantly to look for the most effective and efficient ways to meet the needs of present and future.

Enhancement of Physical Security and Maintenance of Good Order at Sea. Securities of blue economic activities may be ensured by possessing a formidable Navy. Integration and coordination among various maritime law enforcing agencies, strengthening of forces, integration and coordination among various maritime law enforcing agencies and establishment of centralized monitoring cell may provide desired output.

Integrated Pollution Control. Integrated pollution control initiatives are to be taken by concerned ministries and departments. It is possible by adhering to the government regulations. Baseline study in terms of environmental aspect may be carried out immediately under Ministry of Industry to find the level of environmental pollution occurred and recommend remedial measures.

Establishment of Coastal Surveillance System. Integrated surveillance system is highly required to monitor the presence of any adversary in own water and pollutions. It is obvious that due to lack of surveillance system all efforts may be jeopardized.

Cooperation. The best way to promote and develop the blue economy is to adopt a sub regional or regional cooperation approach. It is possible by initiating development cooperation in the like-minded neighbouring States.

Systematic Regulation of Ocean Economic Activities. It is in need to develop a holistic and integrated approach. The future policy-framework for the success of the blue economy may focus on structural collaboration, translating research in products, motivating and training young generations.

Integration of Various Maritime Agencies. More meeting, seminars & workshops at different levels of the maritime agencies may be arranged to remain in a common understanding. A maritime division may be setup at high level for regulation, communication and monitoring ocean activities.

Conclusion

The oceans cover nearly 70 percent of earth surface and possess enormous potential to support human activity. Nearly 90 percent of trade by volume, and 70 percent by value is transported over the seas. The oceans are rich in living and non-living resources. About 30 percent of the supply of hydrocarbons sourced from the oceans. Seas can generate wind, wave, tidal, thermal and biomass energy. Besides, it is also a major supplier of food and an avenue of livelihoods. A number of industries such as fishery, tourism, ports, shipping, ship building and ship breaking are dependent on it. At another level, nearly 60 percent of the global population lives within 100 kilometres of the coast, and oceans contribute through resources and augment the services sectors. The above indicators are a good example of the economic value of the seas whose potential has, in recent times, come to be labelled as the 'Blue Economy'

The idea of the Blue Economy has gathered momentum at the multilateral level. In October 2014, Indian Ocean Rim Association (IORA) noted about the Indian Ocean countries are strengthening the blue economy through sustainable development of fisheries, judicious exploitation of minerals, harnessing renewable energy, and encouraging coastal tourism and improve food and energy security. The idea is slowly percolating into other groupings, such as the South Asian Association for Regional Cooperation (SAARC), BIMSTEC, and ASEAN. According to UNEP, a switch to a blue economy would unlock the potential of the marine-based economy while reducing ocean degradation and alleviating poverty.

In Bangladesh the most important factor for the pollutants emitted from the vessels is the unconsciousness of the people. By increasing the consciousness of the people and the staffs and by applying strict marine laws, significant reduction of pollutions can be achieved in Bangladesh.

For a sustainable blue economy, opportunities are to be explored. The same scopes are to be unveiled in front of the potential investors. Regulated approach to pursue blue economy will help to gain a sustainable economy. Pollution in the ocean area is a barrier for sustainable blue economy. To upkeep the concept of blue economy, pollution control is also essential. With an orchestrated effort from public and private processes, initiative from investors, awareness building programs, enhancement of physical security and maintenance of good order at sea, sstablishment of coastal surveillance system, cooperation in sub regional or regional level, systematic regulation of ocean economic activities and integration of various maritime agencies may lead to achieve sustainable blue economy for Bangladesh.

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Biography of the Writer

Captain Mohammad Yousuf Alam, (L), psc, BN was born on 03 June 1979. He joined Bangladesh Navy in December 1997 and was commissioned on 01 July 2000 in Electrical Branch. He obtained BSc Engineering Degree in Electrical and Electronic Engineering from Khulna University of Engineering and Technology (KUET). He is an ex cadet of Cumilla Cadet College. The officer has got fine mixture of appointments. In his service career, he served in almost all kinds of ships and establishments in Navy. He has served as instructor at BNA in 2006 and 2008. He was staff officer in Naval Headquarters and Coast Guard Headquarters. He has completed several courses like Long Electrical Course from BNS SHAHEED MOAZZAM, Officer Bomb and Improvised Explosive Device (IED) Disposal Course from Bangladesh Army and Avionics Technology (AVT) Course from Bangladesh Air Force. He performed duties as staff officer in Sector Headquarters at UN mission in Ivory Coast and Contingent Electrical Officer in South Sudan. He is a graduate from Defence Services Command and Staff College (DSCSC), Mirpur. He also earned diploma from Turkish Joint Command and Staff College, Istanbul. Presently, he is appointed at BNS SHER-E-BANGLA as Base Electrical Officer. He is married and blessed with two sons.

PROSPECT OF POWER GENERATION FROM RENEWABLE ENERGY TO MEET ENERGY REQUIREMENT FOR BHASHAN CHAR ISLAND

Commander Mohammad Naushad Bin Abdullah, (L), psc, BN

Abstract

This paper explores the possibilities of power generation with renewable energy sources through microgrid system as an alternate source of energy generation. It looks at the possibility of Bhasan Char island as a case study. Bangladesh is hosting approximately one million displaced Rohingya refugees living in 34 camps in Ukhiya and Teknaf at Cox's Bazar district. Government of Bangladesh (GoB) has converted a low tide elevation, Bhasan Char, into an island in Noakhali district under the supervision of Bangladesh Navy. The GoB has planned to relocate approximately 100,000 displaced Rohingya people from the current camps to Bhasan Char. Therefore, it is important to provide adequate power supply to this place, i.e. electricity. However, Bangladesh is currently struggling to meet the energy demand of the country. Moreover, energy distribution from mainland national grid to Bhasan Char Island is not feasible. Hence, the optimistic and viable solution for the Island is to provide electricity with renewable resources. The concept of independent microgrid for Bhashan Char Island is expected to be a viable option to provide the increasing load demand. Research shows that wind energy is not a viable option to produce electricity due to lack of cut off wind to rotate the turbines. Hence, solar PV and Biomass is the only renewable energy source for power generation.

Introduction

Bangladesh is hosting approximately one million displaced Rohingya people living in 34 camps in Ukhiya and Teknaf at Cox's Bazar district in Bangladesh. Government of Bangladesh (GoB) has converted a low tide elevation, Bhasan Char, into an island at Noakhali district under supervision of Bangladesh Navy[1]. The project was done under the banner of 'Refugee

Management Approaches' to manage the refugees with adequate facilities and security measures. The GoB has planned to relocate approximately 100,000 displaced Rohingya people from the current camps to Bhasan Char. Since December 2021 (The Daily Star 2021), under this project the Island is inhabited by approximately 20,000 displaced Rohingya people. There are some natives who are living there for business purposes and cattle rearing.

Overall responsibility of rehabilitation of refugees is vested upon the Refugee Relief and Repatriation Commissioner (RRRC). Presently, various government agencies, UN officials along with approximately 50 national and foreign NGOs are actively working at the Island. The offices and residence of these agencies has created a great demand for energy supply i.e. electricity. Presently, Bangladesh is struggling to meet up the energy demand of the country. The country has a population of approximately 180 to 200 million who are mostly living in the mainland. The country has power generation capacity of 15,953 MW and the generated unit is 10,958 MW.[2] The yearly demand is roughly 14,014 MW and still unmet demand is 3,056 MW. To meet the unmet demand, renewable energy would be aviable option for Bangladesh.

Load shedding, brownout, blackout, energy distribution and transmission crisis has become a common phenomenon of Bangladesh. Presently, Bangladesh has a generation capacity of 3 MW from solar PV system. To find alternative energy sources to meet energy requirement both at coastal areas along with the islands of Bangladesh various researches were conducted. In most of the researches the HOMER simulation software was used for proposing various grid designs. This software also predicts the cost of electricity with sustainable manners.

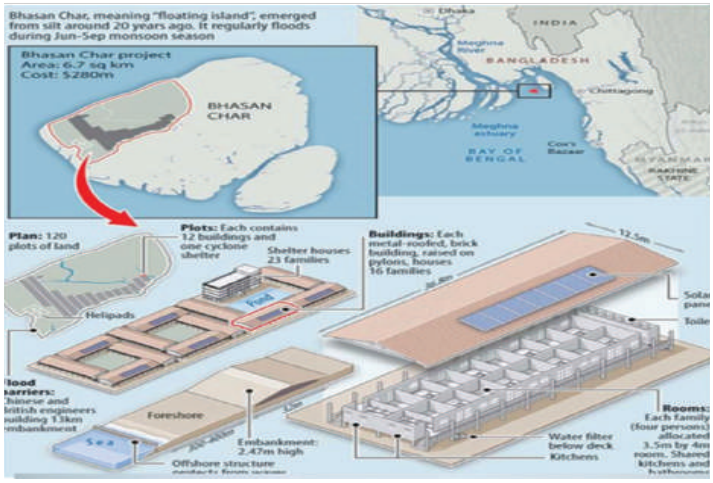
Presently, use of renewable energy as an alternative source of power generation is gradually becoming popular among the population of Bangladesh. Thus, it is expected that in future the renewable energy shall meet the energy crisis as an alternative source of energy for electricity generation. Energy distribution from mainland national grid to Bhasan Char Island is not feasible. Hence, the optimistic and viable solution for the Island is to provide electricity

with renewable resources by means of PV, wind or any other electricity generation systems using microgrid system. The microgrid system with various dispatch strategies from combination of renewable energy resources and generator shall fulfill the present energy requirement of Bhashan Char Island.

Bhashan Char Island

Bhashan Char Island is located in Hatiya upazila of Noakhali District in Bangladesh (Humanitarian Response 2020). The island was formed with Himalayan silt in 2006.[3] The island has a land mass of 13,000 acres including low-lying areas having 6,427 acres usable land. Presently, 432 acres land has been developed for the residential infrastructure, 1,702 acres for embankment construction, and 918 acres for foresting.

Figure 1: Bhasan Char Island



Source: bhasan-char-rohingya-relocation-report4.pdf(skus-bd.org)

'Ashrayan-3 project' consists of 120 housing plots including 120 cyclone centers, hospitals, community clinics, solar systems, water sources, roads for internal communication, mobile phone networks, and a 9-feet high flood protection embankment (Illius 2019). This project also contains adequate health facilities, temporary work, livelihood opportunities and formal and informal education facilities for Rohingya children to make this island liveable (The Daily Star 2020).

Present Trend of Global Renewable Electricity

Globally electricity generation from renewable energy is growing rapidly, both in absolute magnitude and as a fraction of global generation. Total electricity from all sources consumed globally in 2020 was approximately 27000 TWh, representing about 17% of total energy consumption[4]. Nuclear generation was surpassed by the share of total non-hydro renewables power generation which approached 12%[5]. Among the newly installed generating capacity, renewable energy was 83%[6] i.e. solar, wind, and hydroelectric in 2020. These values depict the rapid transition to a clean and sustainable energy system. Presently, Photovoltaics (PV) is playing a significant role in this energy transition along with wind energy. In 1990 the global electricity generated by PV was less than 0.0007%. In 2020, that number was 3.4%, a factor of change of almost 5000[7]. Corresponding growth in total global electricity generation from all fuels in that same time frame went from 11957 to 26823 TWh, a factor of about 2.3[8].

Figure 2 (a) Pie charts showing global share of electricity generation by technology for the indicated years. (b) Pie charts showing global share of electricity-generation capacity by technology for the indicated years. (b) Pie charts showing global share of net expansions of electricity-generation capacity by technology for the indicated years.

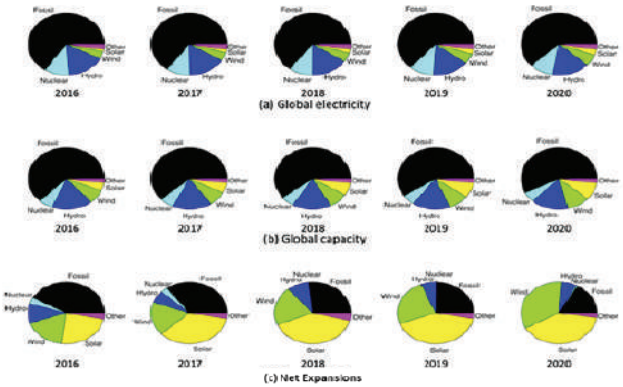


Figure 2a illustrates pie charts of a massive system, dominated by fossil energy. Figure. 2b illustrates pie charts of global share of electricity-generation capacity by technology. Figure 2c illustrates pie charts of undergoing rapid rate of change. In past 05 years combined renewables (solar, wind, hydro, geothermal, and biomass) constitute more than 50% of capacity expansions.

Further, in past 04 years PV and wind combined alone are more than 50% of capacity expansion. However, the fractional global contribution of PV to electricity generation has grown from 1.1% in 2015 to 3.4% in 2020 which is still insignificant. These trends have continued despite the impact of the global pandemic, and policy and emerging technology issues including tariffs, local price structuring, and the growing role of storage and sector coupling.

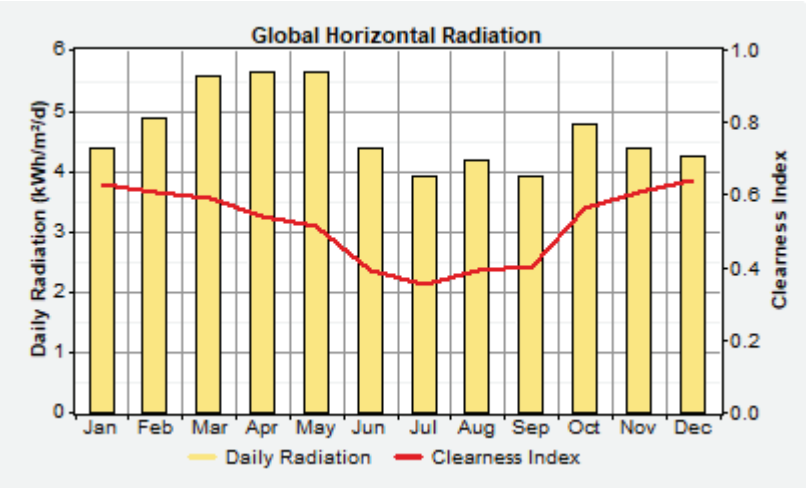
Option for Renewable Energy Resources at Bhasan Char Island

Solar, Wind and Biomass energies are considered as renewable energy sources option for producing electricity at Bhashan Char Island. However, as the island is a low tide elevation so producing kinetic energy through water flow like the Kaptai Hydraulic project using the Dam is impossible. Hence energy produced through water flow to turn the turbine is not considered. To find out the most viable option from solar, wind and biomass energy the data of these resources at the island were collected from various sources. Further these data were put to test with Homer software for the viability of producing electricity[9]. A nutshell description of the said available energies at Bhashan Char Island is discussed in the subsequent paragraphs.

Solar Energy

Most clean and widely available renewable energy among all the renewable energy resources is solar energy. HOMER software needs the solar irradiation to calculate the solar energy produced by the solar panels. Hence, monthly average direct normal radiation from 'Surface Meteorology and Solar Energy' web site Sponsored by NASA's Applied Science Program is collected.[10] The baseline data is the set of 8,760 values which represents the average global solar radiation on the horizontal surface. The base line data is expressed in kWh/m2, for each hour of the year. HOMER is used to display the monthly average radiation and clearness index of the baseline data in the solar resource table and graph.

Figure 3. Daily Radiation and Clearness Index



Source: https://ieeexplore.ieee.org/document/8679484

Figure 3 depicts the maximum irradiation is on the month of April having radiation of 5.636 kWh/m2/day and in July the radiation is at minimum having radiation of 3.899 kWh/m2/day. Hence, solar radiation proves to be resourceful for the study.

Wind Resources

Coastal area of Bangladesh has a strong south/south western monsoon wind flow from the Indian Ocean which travels through the Bay of Bengal. This wind blows over Bangladesh with a monthly average speed of 3 ms-1 to 9 ms-1 at various heights from March to September. Bangladesh observes high wind flow during monsoon[11] i.e. 7 months, March-September. However, the wind speed remains either calm or too low in rest of the months from October to February. Bangladesh observes the peak wind flow from June to July.[12] A small turbine for generating power requires a typical cut in speed of 3.5m/s for its rotation.

Figure 4. Monthly Average Wind Speed in Bhashan Char

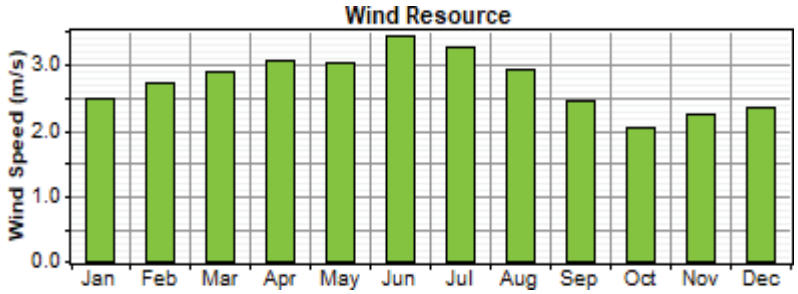


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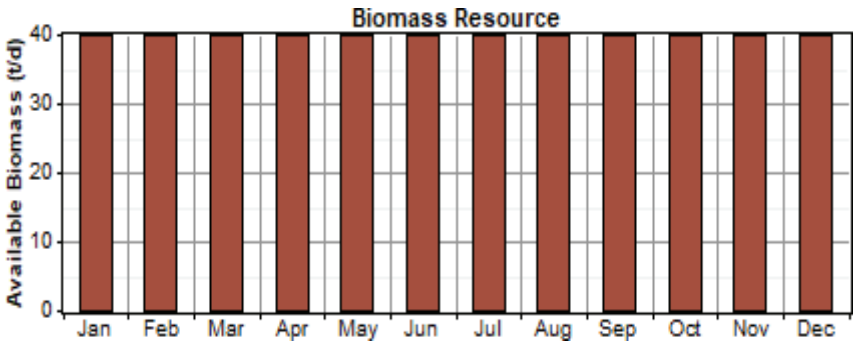
Figure 4, depicts that in June the highest wind speed is around 3.4m/s which is below the cut-in speed to produce power. Hence, it can be deducted that generating power from wind is not a viable option at Bhashan Char Island.

Biomass Energy

Bhashan Char Island has rich biomass sources like forest and human residue. Bangladesh Forest Authority in coordination with Bangladesh Navy has planted lot of trees for forestation at Bhashan Char Island since 2010. The diversity of plantation has given an opportunity to discover wide variety of plants for the Biomass resources. Most of the plants in the island are highly productive for biomass fuel. Human wastes can also be accumulated from the habitants of the Island i.e. Rohingya people, natives and various agencies as biomass resource. Presently at the Rohingya camp area the human wastes are being used to produce Biogas for cooking purpose. It is expected that at least 40 ton of bio-plants per day may be accumulated along with human wastes. The fig.5 depicts the input of Biomass resources for simulation in HOMER which is 40 ton of bio-plants per day. The human wastes are not considered as the Island is yet to be inhabitant at its full capacity to produce the desired human wastes for biomass fuel for energy production.

Figure 5. Biomass Resources

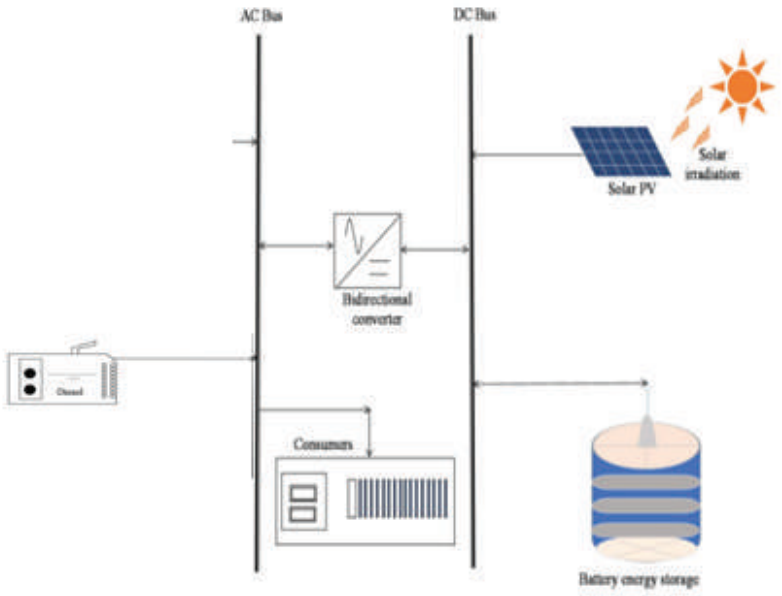


Source: https://ieeexplore.ieee.org/document/8679484

Proposed Microgrid (Mg) Modelling for Bhasan Char Island

The national Grid cannot be connected with Bahashan Char Island. Hence Micro Grid is a viable solution for power distribution in the island. A proposed Micro Grid (MG) HOMER frame work is shown in Figure 6. Further, simple block representation of proposed MG along with its various components and their mutual relations is presented in Figure 7. The proposed MG shall comprise with converter module, diesel generator (DG) solar panels, storage units, and different loads. The battery storage and solar PV modules shall provide Direct Current (DC) power in the MG. However, the DC supply would be converted in to Alternating Current (AC) by using inverter (DC/AC) before being connected with the AC busbar. So the battery storage and solar PV is directly connected with AC busbar via inverter after voltage conversion. Again the AC loads are directly fed to the AC busbar and the exclusive DC loads are directly connected to the DC busbar. To have a smooth bidirectional AC/DC conversion Voltage Source Controller (VSC) is connected with the AC/DC converter[13]. In the subsequent paragraphs various components of a MG that can be modeled using HOMER software are described.

Figure 6. Proposed Microgrid System

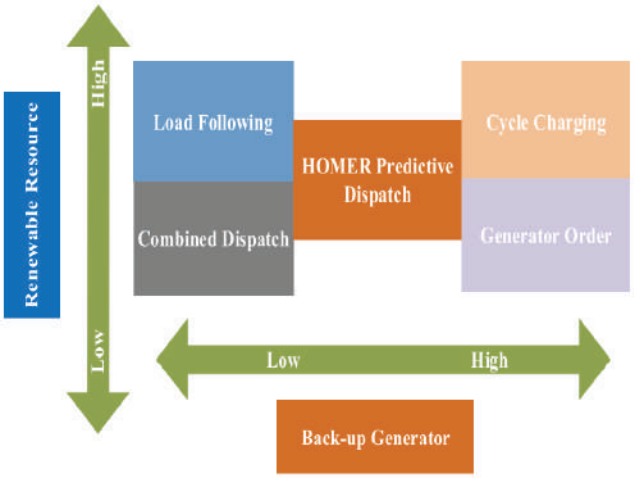


Source: https://ieeexplore.ieee.org/document/9749090

Dispatch Strategies of Proposed Microgrid for Bhashan Char Island

A dispatch strategy is set of rules that are used to control the generators and storage bank operation whenever there is a scarcity of renewable energy supply. Five different power dispatch technique is considered basing on the influence of backup generator and renewable energy sources in electricity generation. The dispatch techniques for the proposed MG are depicted in the Figure 7. The techniques are Combined Dispatch (CD), Load Following (LF), Generator Order (GO), Predictive Dispatch (PS) and Cycle Charging (CC). The strategy of utilizing the generator as backup plays a significant role when there is a sudden change in availability of renewable sources and load demand in these five dispatch techniques. Dispatch strategies provide a guideline in optimizing the size and shape along with power management criteria in a standalone MG.

Figure 7. Impact of Diesel Generator and Renewable Energy Resources according to 05 dispatch technique for microgrid.



Source: https://ieeexplore.ieee.org/document/9438699

Load Following (Lf)

In this strategy the generator with enough capacity is used to satisfy the primary load demand when the renewable sources fail to fulfill the load demand[14].

Cycle Charging (CC) are Implemented for Optimization

In this strategy generator is operated at its full capacity at whatever point it is needed. Further, surplus power generated is used to charge the storage devices.

Combined Dispatch (CD)

In this strategy the present net load is calculated to assume the future load requirement. Charging of storage devices with generator is planned basing on the future load requirement evaluation. In this technique generator is used the least when the load demand is low. The CD strategy chooses the least costly optimal combination of MG components in order to decide whether to choose LF or CC strategy in every time step[15].

Generator Order (GO)

In this strategy a predefined combination of generator order is used to fulfill the load demand. The load demand is fulfilled by accepting the generator combination that first meets the operating capacity. In special circumstances the battery unit usage is permissible. In comparison with GO and LF it is observed that LF strategy has the highest influence on renewable energy resources whereas GO has the best impact on the backup generator.

HOMER Predictive Dispatch (PS) Strategy

In this strategy the HOMER software is used to predict the upcoming probable electric and thermal load demand along with the availability of the upcoming renewable energy resources (solar irradiation and wind speed). This strategy is used to reduce MG system's overall operating cost.[16]

Conclusion

Bhashan Char is a low tide elevation and is separated from the mainland. Hence power from national grid is not an option for power distribution in that island. The island was created by Bangladesh Government to relocate Rohynga people located at various camps at Cox Bazzar. Presently, the Island is inhibited by Rohynga people, various government agencies, local and foreign NGOs along with UN agencies. Electricity generation from renewable energy has become a popular option around the globe. Bangladesh Government is also venturing in renewable energy for power generation to mitigate energy crisis in the country.

The concept of independent microgrid for Bhashan Char Island is found to be a viable option to provide the increasing load demand. Research shows that wind energy is not a viable option to produce electricity due to lack of cut off wind to rotate the turbines. Hence solar PV and Biomass is the only renewable energy source for power generation. Presently, Biomass is only being only used for cooking at the island due to lack of estimated human waste generation and unable to cut the trees for land wash due to tidal surge. As such standalone solar power is presently used in the camp area for low LCOE and generators are used separately to provide major power supply.

The proposed microgrid with 05 dispatch strategy is expected to fulfill the increasing electricity demand at the island. HOMER MG software provides an optimal operational MG combination for the island, which shall not only ensure Net Present Cost (NPC) but also Levelized Cost of Energy (LCOE) for the five dispatch technique. Overall, the proposed MG is a very lucrative for its low cost and 100% renewable fraction for power generation and distribution system for Bhashan Char Island. The Island is yet to be inhibited, however, with further research the proposed MG may be set up for 1000,000 or more people's energy demand.

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Commander Mohammad Naushad Bin Abdullah, (L), psc, BN was born on 12 December 1977. From early childhood he had dreamt of following the footsteps of his late grandfather Lt Commander Imam Husain and becoming a naval officer. He joined Bangladesh Navy in June 1997 and was commissioned on 01 January 2000 in Electrical Branch. He obtained his BSc Engineering Degree in Electrical and Electronic Engineering from Chattogram University of Engineering and Technology (CUET). He is an ex cadet of Cumilla Cadet College. In his service career, he has served in various capacities both at ship and establishments notably: BNS MADHUMATI, PADMA, ABU BAKR, BNS ALI HAIDER, BN Dockyard and NHQ as Staff Officer. He did his UN Mission at Bangladesh Force Marine Unit as Contingent Electrical Officer at UNMISS, South Sudan. He has completed several courses like Long Electrical Course from BNS SHAHEED MOAZZAM, Staff College from DSCSC Mirpur Cantonment Dhaka and Fiber Optic Gyrocompass Maintenance Course at Italy. He is presently pursuing his masters in Electrical and Electronic Engineering at CUET. Currently he is appointed as Officer in Charge Electrical School at BNS SHAHEED MOAZZAM. He is a widely travelled person and travelled to many countries like UK, France, Italy Serbia, Bulgaria, Greece, Switzerland, USA, Egypt, and several other countries of Africa. He is married to Farjana Khanam Diti and blessed with one daughter.

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