



Amid Evolving Geo-Strategic & Environmental Dynamics, Hydrographic Challenges for Sustained Communication with Saint Martin's Island

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Abstract

Saint Martin's Island (SMI) is the southern-most island of Bangladesh with unique coral ecosystem. The island is a vital outpost for various maritime activities in the Bay of Bengal and due to the evolving geo-strategic & environmental dynamics, the importance as well as vulnerability of this island has increased significantly. SMI is connected to the mainland only via sea and therefore, ensuring safe & efficient navigational route is imperative. To ensure sustained communication with SMI, BN Survey Team conducted hydrographic survey and proposed two routes: a permanent northward navigational route from SMI to BN Inani Jetty or BIWTA Nuniachara Jetty and an alternative eastward navigational route from SMI to Shahporir Dwip Jetty. The proposed alternative navigational route was immediately inaugurated, but the northward navigational route is yet to make headway due to numerous challenges of seaward transportation and loading/unloading. Under prevailing circumstances, failing to ensure uninterrupted communication with SMI will not only ensure the failure of island-based economic and environmental activities, but may threaten the supply chain and as a consequence, the very existence of Bangladesh's unique coral-bearing island. Amid evolving geo-strategic & environmental dynamics, this paper highlights the hydrographic challenges related to safe & efficient navigational route for sustenance of SMI.

Keywords: Hydrographic Survey, Navigational Route, Bathymetry, Topography, Coral Ecosystem, Marine Protected Area, Geo-Strategic Dynamics

Introduction

Bangladesh is part of the Bay of Bengal Large Marine Ecosystem (one of the world's largest marine ecosystems) and endowed with mangroves, coral reefs, estuaries, marine animals and fish breeding areas (BOBLME, 2015). Since

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independence, Bangladesh has made considerable progress and all socio-economic indicators have testified its graduation from Least Developed Country to Low Middle Income country. Being one of the most densely populated countries with acute shortage of land-based resources, Bangladesh has been systematically working to make the coastal areas and islands as engines for sustainable economic growth. To reap the benefits from hard-earned development gains, sustainable maritime resource management without detrimental effects on the environment needs to be ensured (PMO, 2017).

Saint Martin's Island (SMI) is the southern-most island of Bangladesh (9 km from Teknaf peninsula and 8 km from Arakan coast). Despite covering a limited area of only 8 km², SMI is regarded as a vital outpost for controlling maritime traffic and monitoring various activities in the Bay of Bengal. Due to the evolving geo-strategic dynamics in the Indo-Pacific region, the importance of SMI is on the rise. Recent unrest conflict in the neighbouring State has further increased its importance as well as vulnerability (Siddiqui, 2024). The island's coral reef-based ecosystem teems with biodiversity, offering refuge to endangered marine species like dolphins, sharks and sea turtles. In 1999, the Dept of Environment declared the island as Ecologically Critical Area (DoE, 2006). These valuable ecosystems and biodiversity are facing increasing threats not only from pollution & other anthropogenic activities, but also from natural calamities and global warming (Akther, 2019).

Since 2004, the island has been connected to mainland through tourist ferries and thus, SMI has emerged as a popular tourist destination (Saif, 2010). For last two decades, roughly 3,000 - 8,000 tourists visited the island every day during tourist season (October to March). The buoyant tourism industry has generated numerous economic activities and improved livelihoods of its 7,000 residents (Tourism Board, 2025). However, it also brought considerable challenges for the island and its marine environment. Uncontrolled tourism and their unsustainable practices were beyond the hosting capacity of this 8 km² tiny island (IUCN, 2010). Realising the vulnerability of fragile coral ecosystem and endangered wildlife, Bangladesh Forest Dept declared in January 2022 Saint Martin's adjoining 1,743 km² area as Marine Protected Area (MPA) (Haque & Karim, 2022). Bangladesh Navy (BN) and Coast Guard ships & boats have been conducting regular patrols around the island to enforce MPA through monitoring vessel traffic, fishing and tourism activities (Forest Dept, 2022).



Figure 1: Saint Martin Marine Protected Area

Due to the on-going unrest in eastern neighbouring State and indiscriminate firing from rebel factions on all moving boats in the Naf River, boat transportation to/from SMI has been suspended since June 2024, causing fear and anxiety among the islanders (Rizve, 2024). During such national emergency, Bangladesh Navy was assigned to establish alternative navigational route for restoring the life-line of SMI for sustenance of SMI (AFD, 2024). Amid evolving geo-strategic and environmental dynamics, this paper aims to highlight the challenges faced during practical hydrographic survey in siltation-prone Naf estuary for sustained communication with SMI.

Literature Review

The island is connected to the mainland only via sea and therefore, establishing safe & efficient navigational route to/from SMI is imperative for its sustenance (Das et al., 2022). Starting at the land boundary terminus in Naf River mouth, the southward equidistance line between Bangladesh and Myanmar demarcates country's Territorial Sea (BD-MN, 1974). Due to shallow depth and constant siltation in the Naf river mouth, both Bangladesh and Myanmar vessels have traditionally been navigating along International Maritime Boundary Line (IMBL). For safety of navigation, the ships of both countries are allowed to take passage through neighbour's waters under Bangladesh-Myanmar Maritime Agreement 1974 and endorsed by the verdict of International Tribunal for Law of the Sea (ITLOS, 2012). Therefore, the practice of enjoying freedom of navigation

in the Naf river by the vessels of both countries have continued for half a century (1974-2024) without any major issue.

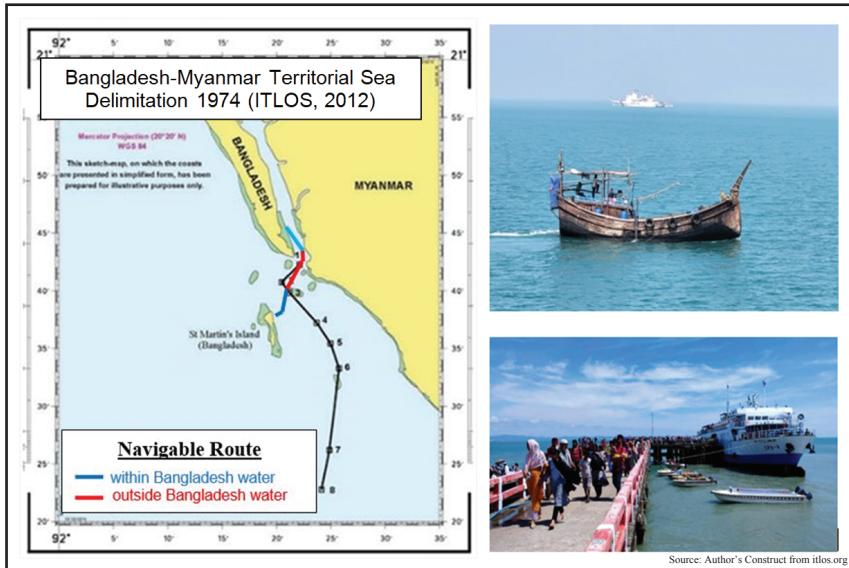


Figure 2: Territorial Sea Delimitation and Navigable Route (Saint Martin - Teknaf)

However, due to the ongoing unrest in neighbouring Rakhine State of Myanmar and Arakan Army's emergence as the de-facto ruler of Rakhine State, vessels moving in the Naf River are frequently coming under indiscriminate attack from various fighting factions. For the safety of passengers and crew onboard, boat transportation to/from SMI has been suspended since June 2024, causing serious concerns among the islanders and adversely impacting their livelihoods (Rizve, 2024). During such national urgency, Bangladesh Government tasked Bangladesh Navy Hydrographic Service to conduct hydrographic survey and propose alternative navigational route for sustenance of SMI.

As a part of literature review, efforts were made by BN Hydrographic & Oceanographic Centre (BNHOC) to evaluate all previous studies related to maritime communication with SMI. However, though numerous studies were publicly available on SMI's environment & marine ecosystems and their rapid degradation due to excessive tourism, not a single study could be found on its maritime communication and associated hydrographic challenges. Having no other available options, the archives of BNHOC published charts (2001, 2006, 2013, 2020) were consulted to assess the change in navigability between mainland and SMI. Regarding the chronological change in Coastline, Google Earth Satellite

Images (2005, 2010, 2013, 2016, 2020, 2024) were the only references available to assess the accretion/erosion in the Naf river and off Shahporir Dwip. Thus, having no available previous literature to review, all available references were critically analysed to identify literature gap and this paper is a pioneer endeavour on 'Hydrographic Challenges for Sustained Communication with SMI'.

Bathymetric Survey

Responding to the national requirement, BN Survey Team was immediately deployed on 16 June 2024 via BN ship for assessing alternative navigational options between SMI and Mainland. After installing Tide Gauge and conducting vertical datum transfer, the team tried to proceed to Shahporir Dwip Jetty without crossing international maritime boundary. However, due to the emerging drying heights (char), their survey boat remained aground for several hours until the next high tide allowed the boat to float back and return to SMI.



Figure 3: Hydrographic Survey for Alternative Navigational Route

The local fishermen gave an important clue that there is a navigable channel south of Shahporir Dwip where they lay nets for fishing. Equipped with this valuable input, BN Survey Team conducted bathymetric survey and confirmed the existence of a narrow navigable channel between Shahporir coast and Bular Char through which medium-sized boats can pass during high tide. The followings were unveiled during this survey:

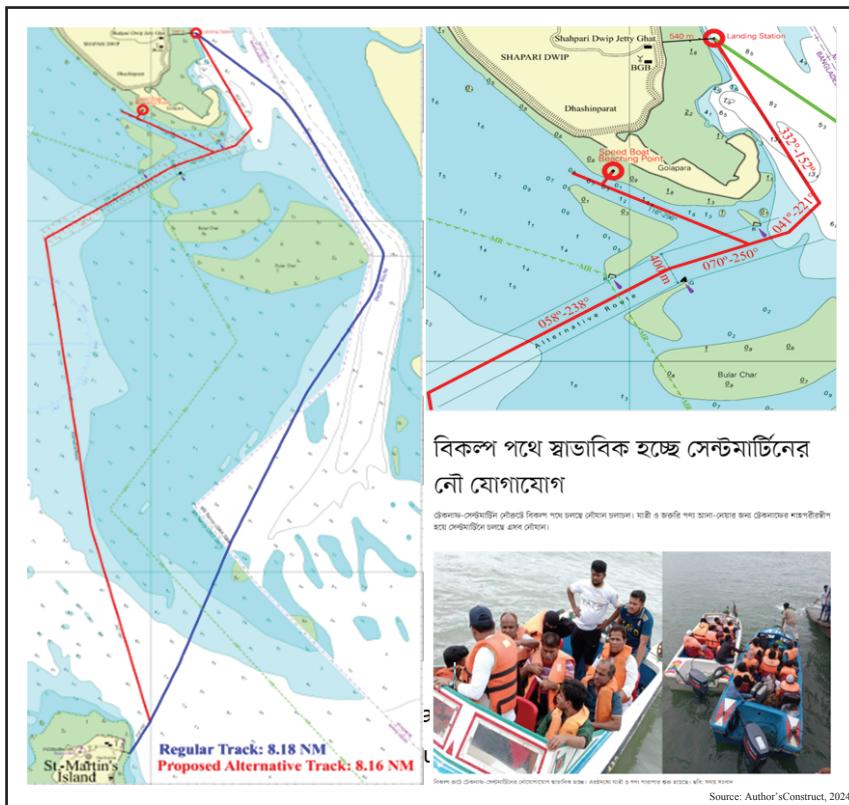


Figure 4: Proposed Alternative Navigable Route for Saint Martin's Island

Regular Navigational Route. During peace time, the regular navigational route in the Naf river rests along IMBL and the distance from SMI to Shahporir Dwip is 8.18 nautical mile (NM). However, the only navigable route between $20^{\circ}43'N$ and $20^{\circ}44'N$ lies on the Myanmar side.

Transporting Passengers by Speed Boat. In calm sea, speed boats can beach at Golapara, south-west of Shahporir Dwip for quick transportation of personnel to/from SMI.

Alternative Navigational Route. During crisis period when regular navigation in the Naf River is not safe, Bangladeshi boats may use the identified 8.16 NM narrow channel south of Shahporir Dwip (Figure 4) as alternative navigational route. BN Team immediately communicated this newly identified alternative route to all Bangladeshi vessels and thus, the logistic supply chain to/from SMI could have been restored (Somoynews, 2024).

Tidal Height (Metre): June 2024						Remarks
16 June		24 June		31 June		Tidal Height at Saint Martin Jetty varied between 0.98 m & 5.26 m
Time	Tidal Height	Time	Tidal Height	Time	Tidal Height	
0058	1.97	0039	4.63	0545	4.03	
0715	4.04	0644	0.98	1154	1.93	
1341	2.22	1256	5.26	1757	4.28	
1921	3.81	1929	1.02	-	-	

Table 1: Tidal Heights at Saint Martin Jetty

Actual Height of Water. The tidal heights shown in Table 1 indicates that in June 2024, the actual height of water varied from 1.48 m (adding July's lowest low water 0.98 m to charted depth 0.5 m) to 7.16 m (adding July's highest high water 5.26 m to charted depth 1.9 m). Therefore, taking advantage of the high tide, vessels (≤ 2 m draught) should be able to navigate through this alternative route. During crisis period, the country boats may use this 8.2 NM long route as a viable alternative navigational route, provided they can navigate cautiously in the shallow area between two drying heights (01 NM long, 400 m wide and 0.5-1.9 m deep) (shown in Figure 4).

Topographic Survey

As all the existing landing stations in Teknaf peninsula are on the eastern coast and within random firing range, local boats occasionally feel threatened even while navigating in this alternative navigational route. To assess the feasibility of an alternative landing station for boats to dock on the western coast, a topographic survey was conducted from the southern tip of Shahporir Dwip to Katabunia Canal. During this topographic survey, the following topographic peculiarities were identified:

Complexity of Direct Sea Exposure. With direct exposure to the Bay of Bengal, establishing alternative landing stations on the west coast is a colossal task, requiring ocean engineering knowledge, environmental consideration and massive investment.

Blockage of Canal Mouth. Being naturally connected to the sea, the canal separating Shahporir Dwip from mainland could have been an ideal spot for establishing landing station. However, during the construction of Marine Drive,

numerous stones, boulders, tetra pots have been placed along the coast, making the mouths of all canals inaccessible from the sea.

Results & Discussion

Through analysis of bathymetric data, satellite images and comparing them with historical data sets, the following results have been derived:

Analysis of Bathymetric Data. Through analysis of in-situ bathymetric data (2024-25) and comparing them with historical data sets of 2005-06, 2012-13 & 2018-19, preserved in BN Hydrographic Centre, it is evident that the depths have generally decreased (maximum decrease of -6.8 m at Point 13) along the Naf river mouth. On the contrary, depths have remained steady or marginally increased along the identified navigable channel (maximum increase of 1.3 m at Point 8).

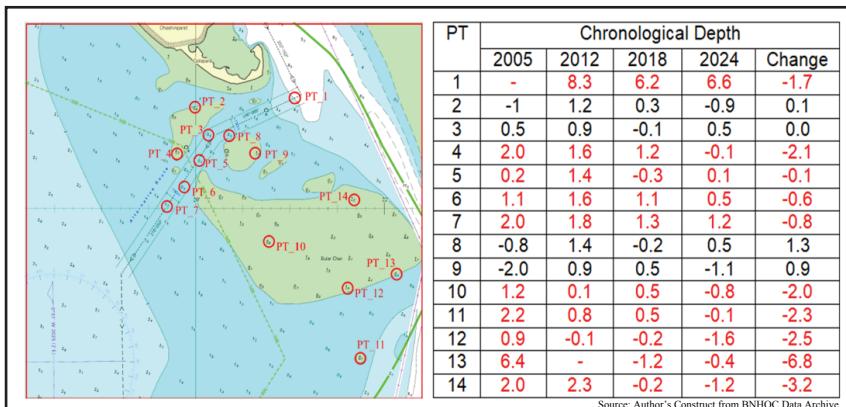


Figure 5: Chronological Change in Bathymetry off Shahporir Dwip

Analysis of Satellite Images. Through analysis of current satellite images and comparing them with previous images, it is evident that over last two decades, the southern & eastern portion of Shahporir Dwip have generally eroded and new islands/chars have emerged along Naf river mouth.



Figure 6: Chronological Change in Coastline off Shahporir Dwip

Analysis of 'Bular Char'. To assess the siltation mechanism, Sediment Trapper was placed at SMI Jetty where 2 & 3 cm sediments were deposited in 24 hours. However, only two isolated sediment deposition readings in two consecutive days were considered insufficient for any effective deduction. Therefore, predicting the future development of 'Bular Char' would require

long-term study by Subject-Matter-Experts. Taking into consideration of all relevant factors, this study may suggest limited maintenance dredging to optimize channel's navigability and land reclamation without adversely impacting on marine biodiversity. For desired land reclamation, science-based proven methodology with due regard to environmental conservation may be considered. Mangrove plantation is regarded as the optimal nature-based solutions for mitigating coastal erosion and facilitating land reclamation.

Analysis of Topographic Features. The construction of any landing station on the western coast will require detailed engineering & environmental study and considerable investment. At present, no canal on the western part of Shahporir Dwip is accessible from the sea for placement of man-made obstructions to protect the Marine Drive.

The analysis of bathymetric and associated topographic features suggests Majherpara and Sabrang Tourism Park as suitable sites for alternative landing station. To access the sea from the Marine Drive, appropriate Jetty may be constructed for loading/unloading of passengers and goods to/from SMI. Due to direct exposure to Bay of Bengal, this jetty may not be suitable for use during rough sea. For all weather access of sea-going boats, Marine Drive Bridges at the mouth of Majherpara or Katabunia canal may be elevated to adequate height. In addition, periodic dredging might be required to mitigate the effects of natural siltation and keep the canal mouth navigable.

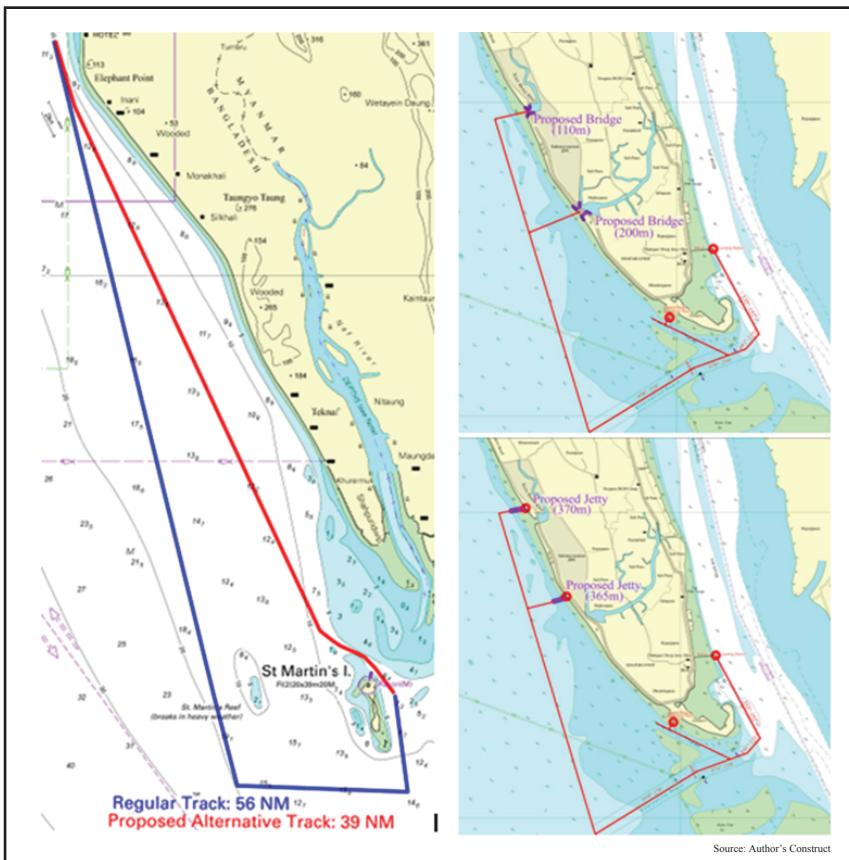


Figure 7: Alternative Navigational Route and Proposed Landing Sites on West Coast

Special Navigational Chart. Based on the findings of this Special Survey, BN Hydrographic Service has published Special Chart SPL-44 and Bangladesh Inland Water Transport Authority (BIWTA) placed two red & one green navigational buoy for ease of navigation (BIWTA, 2024). Having draught ≤ 2 m, the country boats plying between SMI and Shahporir Dwip have been able to navigate through this buoy-demarcated alternative navigational route without difficulty, restoring SMI's lifeline within two weeks of communication crisis.

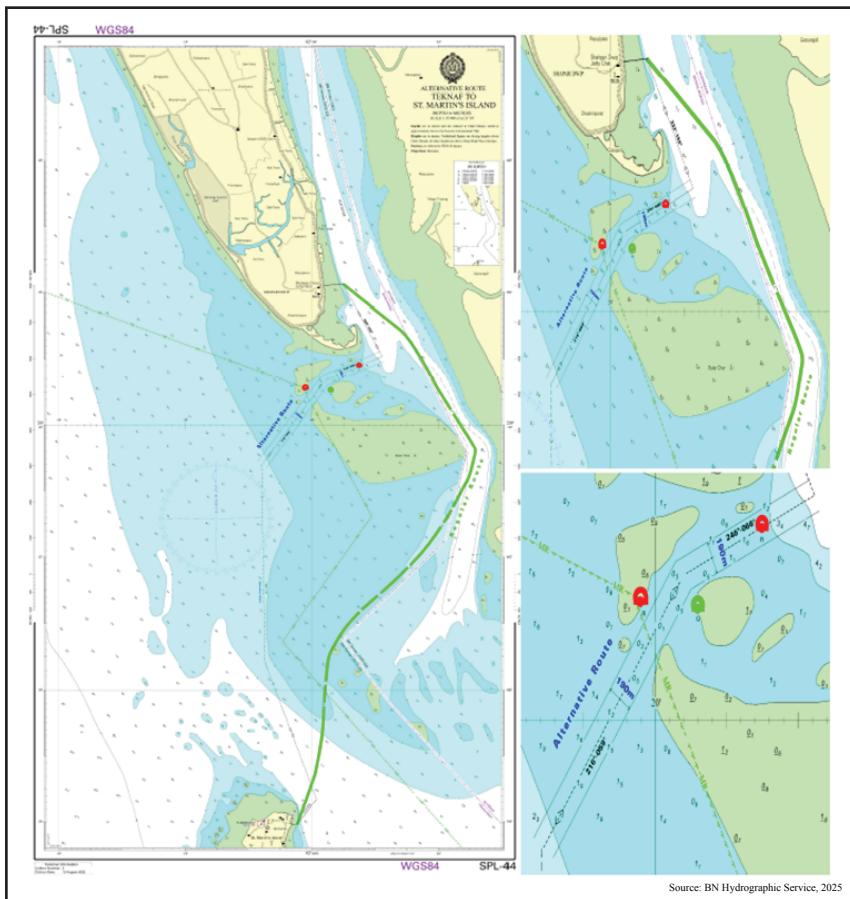


Figure 8: Published Special Chart (SPL-44) with Alternative Navigational Route

Alternative Navigational Route from Inani/Nuniachara, Cox's Bazar.

BN Hydrographic Service has further examined the feasibility of alternative navigational route from SMI to BN Jetty in Inani or BIWTA Jetty in Nuniachara, Cox's Bazar. A safe northward navigational passage (3.8 NM long, 375 m wide and minimum 5.3 m deep) has been proposed (Figure 7) bypassing the coral colonies of SMI.

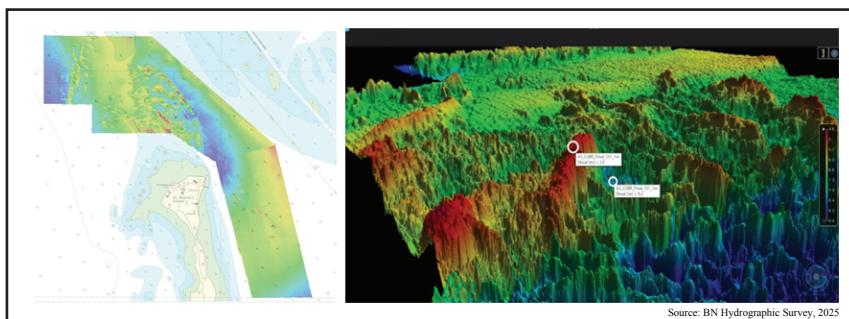


Figure 9: Coral Colonies to the North of Saint Martin's Island

Comparison of Standard/Alternative Navigational Route. Through this newly proposed 39 NM northern channel (instead of traditional 56 NM southern route), all Bangladeshi ships upto 5 m draught should be able to navigate from mainland to SMI, saving journey time, cost and the unique coral reef-based ecosystems of Saint Martin MPA. If the country boats are unable to follow neither this northern route due to rough sea or the traditional 8.18 NM Naf mid-channel route due to security issues, the proposed alternative 8.16 NM route (between Bular Char) may be used during high tide to ensure the logistic sustenance of SMI.

	Navigational Route			
	To/from Inani		To/from Shahporir Dwip	
	Traditional (Southern)	Alternative (Northern)	Traditional (Naf Mid Channel)	Alternative (Between Chars)
Length (NM)	56	39	8.18 (01 NM lies in Myanmar water)	8.16 (01 NM lies between two chars)
Width (m)	-	375	3,000	400
Depth (m)	$7+0.98=7.98$	$5.3+0.98=6.28$	$2+0.98=2.98$ $2+5.26=7.26$	$0.5+0.98=1.48$ $1.9+5.26=7.16$

Table 2: Comparison Summary (Standard & Alternative Navigational Route)

Conclusion

Being an important outpost for maritime activities in the Bay of Bengal, ensuring safe navigational route is imperative for SMI's sustenance. The evolving geo-strategic & environmental dynamics have further increased the importance as well as vulnerability of this island. To fulfill the national requirement of sustained communication with SMI, BN Survey Team proposed two options: a permanent northward navigational route from SMI to BN Inani Jetty or BIWTA Nuniachara

Jetty for ships upto 5 m draught and an alternative eastward navigational route adjacent to newly emerging 'Bular Char' for boats upto 2 m draught. The proposed alternative navigational route (marked with two red & one green buoy) was immediately inaugurated to revive the logistic lifeline while keeping away from the fighting factions in Rakhaine State. However, the proposed permanent navigational route is yet to be inaugurated due to the inherent complexity of seaward transportation and landing station construction.

The comparison of satellite images with historical data sets indicates that the southern & eastern portion of Shahporir Dwip have generally been eroding over the last two decades while new islands/chars have been emerging along the Naf river mouth. The analysis of in-situ bathymetric data (2024-25) and historical data sets of 2005-06, 2012-13 & 2018-19 have further testified this trend of decreasing depths along the river mouth. To optimize channel navigability and land reclamation while minimizing the impact on marine environment, limited maintenance dredging may be conducted through a comprehensive cost-benefit analysis. However, the assessment on future development of 'Bular Char' could not be ascertained due to insufficient data on siltation mechanism.

The volatility in regional geo-politics and deterioration of law & order situation in Eastern Neighbouring State may multiply the existing threats and make similar national crisis more frequent in the coming days. Therefore, Bangladesh needs appropriate contingency plan to mitigate these challenges. Because, failing to ensure unhindered communication with SMI will not only ensure the failure of all island-based economic and environmental activities, but may ensure the collapse of logistic supply chain with fatal consequences upon this coral-bearing island with growing geo-strategic and environmental importance.

Recommendations

Based upon the findings of this hydrographic survey, the following recommendations may be considered:

- **Communication with Teknaf (Eastern Route).** For sustained navigation to/from SMI, all Bangladeshi vessels may:

* Peace Time Regular Navigational Route. Continue using the regular navigational route between SMI & Teknaf along International Maritime Boundary Line.

* Crisis Time Alternative Navigational Route. Use proposed alternative navigational route during high tide for vessels upto 2 m draught.

• **Alternative Landing Station.** In order to establish an alternative landing station on the west coast,

* Construction of Jetty. BIWTA may conduct a feasibility study for the construction of appropriate Jetty on the west coast to allow loading/unloading of passengers/goods from the Marine Drive.

* Construction of Bridge. Roads & Highways may conduct a feasibility study for the construction of Marine Drive Bridge at Majherpara or Katabunia canal mouth with adequate height to allow easy access of sea-going boats.

• **Communication with Cox's Bazar/Inani (Northern Route).** To reduce journey time, cost & pollution, all Bangladeshi ships (upto 5m draught) may be encouraged to use the newly proposed northern navigational route from SMI to Inani/Nunuachara, Cox's Bazar.

• **Periodic Survey.** For ascertaining the navigability and adjusting the location of buoys of this alternative channel, BN Hydrographic Service may conduct required bathymetric & topographic survey at regular interval.

• **Maintenance Dredging.** To trade-off between channel navigability, land reclamation and environmental protection, a detailed study by the Subject-Matter-Experts on 'Bular Char' and adjoining area may be conducted.

• **Mangrove Plantatiion.** For natural protection of SMI and desired land reclamation of 'Bular Char', planned mangrove plantation and other nature-based environment-friendly solutions may be considered at the earliest.

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