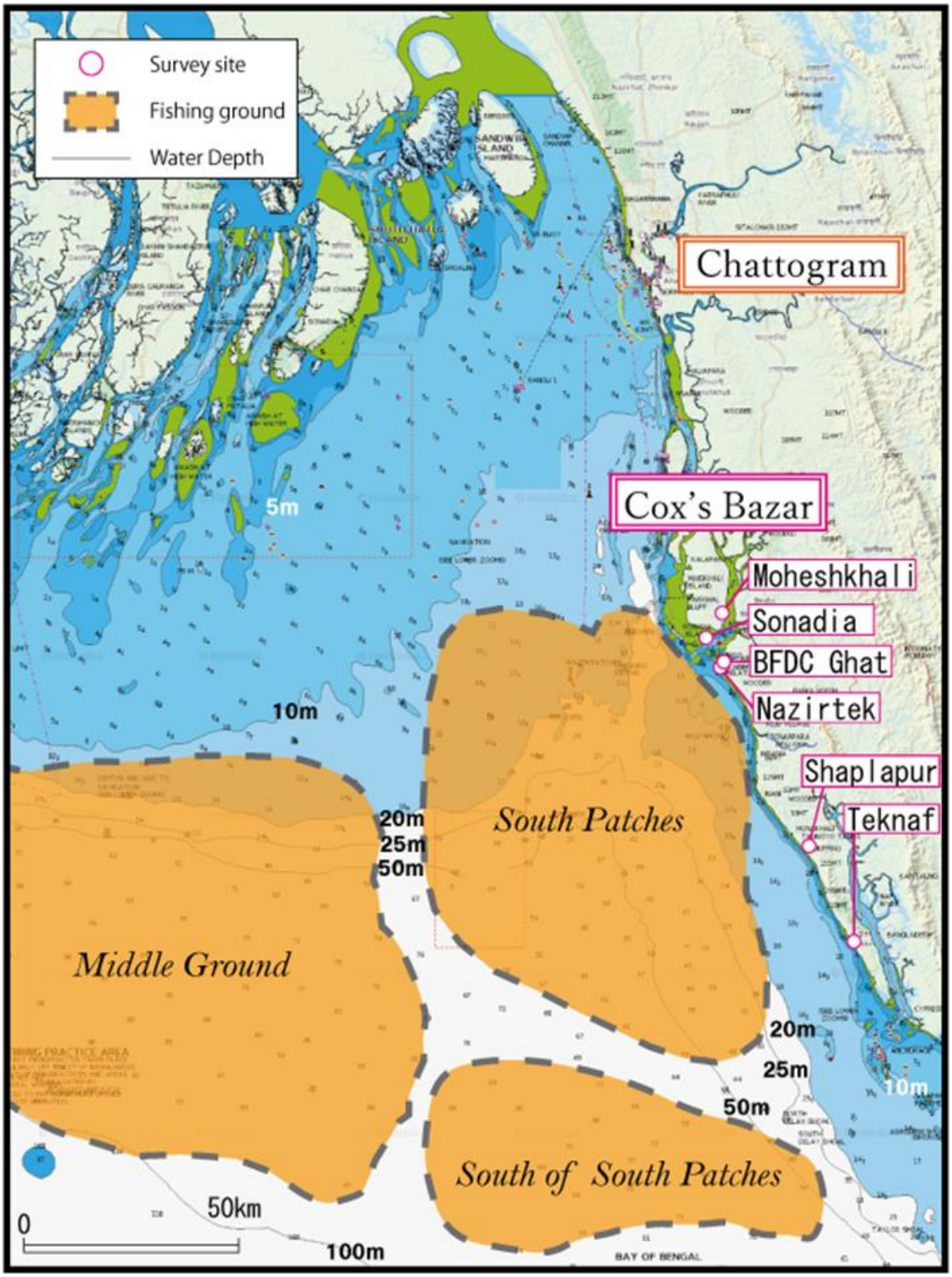
PEOPLE'S REPUBLIC OF
BANGLADESH

DATA COLLECTION SURVEY ON FISHERIES VALUE CHAIN INFRASTRUCTURE DEVELOPMENT IN SOUTH CHATTOGRAM REGION IN THE PEOPLE'S REPUBLIC OF BANGLADESH
FINAL REPORT

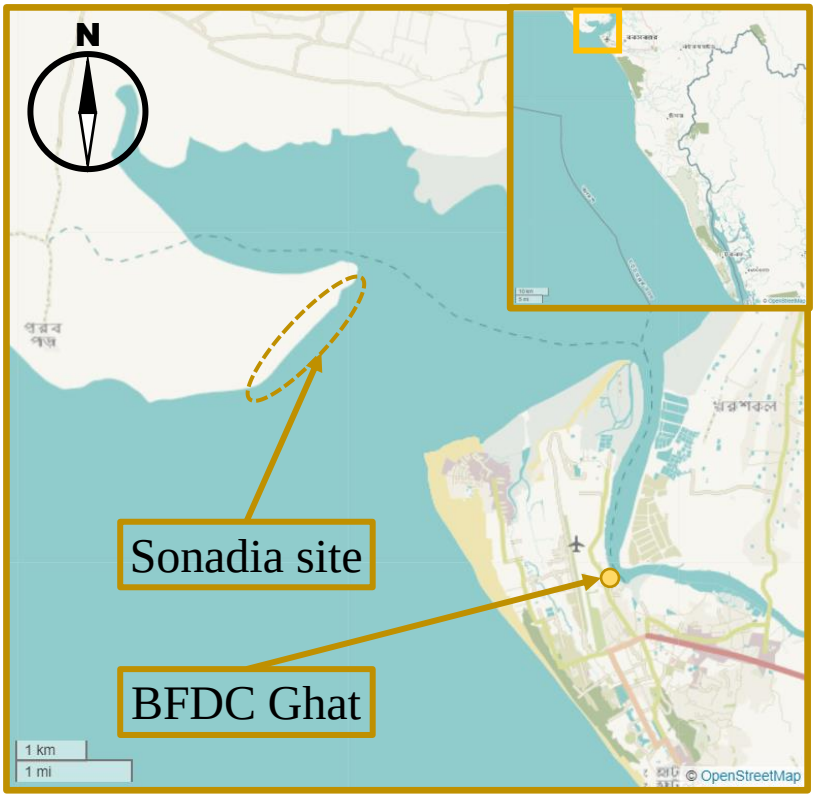
FEBRUARY, 2022

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

FISHERIES ENGINEERING CO., LTD.



Site Location Map



Project Site Location Map

	
Cox’s Bazar BFDC Ghat (Existing Pontoon)	Cox’s Bazar BFDC Ghat (Fish handling shed with collapsed north quay)
	
Shaplapur Landing Site (Beached fishing boats)	Shaplapur Landing Site (Shipping shed for landed fish along access road)
	
Sonadia Landing Site (View from Moheshkhali Channel)	Sonadia Landing Site (Hinterland dried fish processing yard)

	
Teknaf City Ghat	Gorokghata Landing Site
	
Gotibanga landing Site	Fish Market in Teknaf
	
Nazirtek Landing Site	Ice plant in Shaplapur

Summary

① Country Overview

The People's Republic of Bangladesh (hereinafter referred to as "Bangladesh") is located at the eastern end of the Indian subcontinent in the Bengal Delta, which is formed by the Ganges, Brahmaputra, and Meghna rivers that flow from the Himalaya mountains to the Bay of Bengal in the Indian Ocean. Most of the country is lowlands at an elevation of 10 m above sea level or less, and is subtropical. During the monsoon season from June to October, cyclones cause frequent floods and other weather-related disasters, resulting in erosion, deforestation, and soil degradation. However, river overflow during the rainy season makes the soil fertile, providing agricultural land that can be cultivated for two or three cropping seasons. It also contributes to rich fishing grounds in the vast inland waters, with an area of about four million hectares. Of the 164,000 km^2 of their exclusive economic zone (EEZ), about 66,440 km^2 is considered continental shelf, but the coastal areas of Bangladesh are shallow, with 24,000 km^2 of ocean area less than 10 m deep. Nineteen districts in the southern part of Bangladesh (about 30% of the country) have coastline along the Bay of Bengal and are blessed with rich fishing grounds due to high primary production during the northwest monsoon season.

The fisheries sector in Bangladesh accounted for 3.49% of the GDP in 2019, and 18 million people, or about 11% of the population, are engaged in this sector. However, 23.9% of the fisheries workers live in poverty and 13.2% live in extreme poverty. The production volume of fisheries was about 4.38 million tons per year in 2018-2019. Fish is an important food source, accounting for 66% of the animal protein consumed by the Bangladeshi people. The export value of fish and fishery products is about 54 billion yen, which is the second largest source of foreign currency after the textile industry. The annual production volume of inland water fisheries in rivers and lakes is 1.24 million tons, which is the third largest in the world after China and India. However, production at inland water fisheries is stagnant due to the decline of resources, caused by over-fishing and the degradation and loss of fish habitats due to development. Meanwhile, inland aquaculture has increased production more than 2.5-fold in about 15 years, against a backdrop of spreading aquaculture technology and increased domestic demand due to economic growth. This has made Bangladesh the fifth largest aquaculture producer in the world with a volume of 2.49 million tons. However, there are fears that the growth of inland aquaculture may reach a plateau due to the increasing salinity of inland waters caused by decreasing river flow, as well as the difficulty in securing suitable land for aquaculture. Expectations have thus been lowered for both of these sectors, which have supported the growth of Bangladesh's marine industry. For this reason, the Government of Bangladesh expects marine fishery to be the next source of growth, as they are underdeveloped compared to other fishery sectors and account for only 15.1% of the national fishery production, with a production volume of 660,000 tons. They are working to promote marine fisheries by placing top priority on protecting, preserving, and ensuring the diversity of coastal marine resources.

② Background, history and overview

The artisanal fisheries account for a dominant share in marine fisheries, and in the Chattogram Division, notably Cox's Bazar and Teknaf, the activities of artisanal fisheries are lively due to their proximity to major fishing grounds in the Bay of Bengal.

While the growth of inland fisheries and aquaculture, which had supported the evolution of the fisheries sector, have been moderate, marine fisheries is expected to be developing considerably, constrains in developing artisanal fisheries in the Bay of Bengal are depletion of marine resources due to overfishing, post-harvest losses at various stages of distribution channels and inadequate fisheries infrastructure. Thus, it is an urgent need to improve infrastructure in the fisheries value chain (Fishing → Landing → Storage and Distribution → Processing and Sales) to increase the value of fish catch.

Under these circumstances, the Governments of Japan and the Governments of Bangladesh confirmed in the Japan-Bangladesh Comprehensive Partnership signed in May 2019 that they will support the host communities with a view to ensuring regional stability, taking into account the impact of the influx of refugees from Myanmar into Cox's Bazar District since August 2017.

Based on the partnership, JICA has decided to dispatch a study team as data collection survey of fisheries value chain to confirm the need in fisheries value chain infrastructure improvement, expecting synergy with the above existing projects.

③ Summary of Survey Results

Artisanal fisheries in the south Chattogram region are facing difficult conditions due to a lack of basic social infrastructure such as water supply and sanitation, as well as erosion and deteriorating resources. In terms of hard components in the fisheries value chains, at each stage of the process from catching the fish to delivery of fishery products to the consumer, there are infrastructures such as fishing boats and gear at the catch stage, landing facilities, roads and transport vehicles, ice making and cold storage facilities, fish market facilities, and fish processing facilities. However, facilities are aging or deficient, traditional wooden fishing boats do not have adequate holding capacity, and traditional processing facilities are not hygienic. As there has not been adequate maintenance and development of this infrastructure, it has not been sufficiently modernized. This is believed to be hindering the improvement of the fisheries value chain, and there are many challenges that need to be addressed.

Especially for landing sites, since there are no fishery facilities in most of the landing sites, involuntary inefficient landing operations are obliged, and there are problems in handling catch in terms of freshness and hygiene. The existing few landing facilities do not meet the landing demand due to the aging facilities and/or damaged by natural disasters, which lead to a decline in landing capacity and not able to supply a demand. In addition, there is a difficulty to develop landing infrastructure because the tidal range is large and risks of natural disasters.

As an effort to address issues regarding soft components of the fisheries value chains, in the area of catching fish, laws and regulations are being established and educational activities related to fishery management are being conducted with the aim of conserving fishery resources. In addition to the introduction of a closed season and the strengthening of segregation of fishing areas from industrial fisheries, fisheries resource surveys are also being conducted by government-own research vessel.

In the area of maritime safety, training is being conducted for fishers, with additional help from the Coast Guard. In the post-landing stages, educational activities are being conducted to improve the handling of fresh fish to reduce post-harvest losses. In the processing stage and sales of processed products, food safety is

being addressed through regulations on the use of harmful chemicals. However, these efforts related to soft components are not effective because they are implemented without the sufficiently developed facility infrastructure related to hard components. Some stakeholders also say these soft components are not taking root.

Therefore, the development and improvement of landing sites are the most urgent issues, and have the highest level of priority. Efforts to improve the landing sites in this region will secure and improve its functionality as a supply area, ensure the safety of marine products as food, increase the amount of marine products distributed to consumers, without compromising the original value of the products, and reduce the labor of fishers involved in distribution. In addition, the reduction of post-harvest losses will improve the income of fishers and contribute to poverty reduction, thus contributing to regional economic development. Since the landing sites become a shared production base for the community's fishers, it can also serve as a platform for community-based coastal fisheries management.

【Proposal for landing Infrastructure】

When selecting suitable landing sites for infrastructure development from among those surveyed, the characteristics of the landing site were classified into three categories, and proposals for landing infrastructure development plans were made for each.

(1) Landing sites important to communities livelihood

Landing sites important to communities livelihood are spotted along the coastal sandy beaches of the Bay of Bengal near communities. At these landing sites, nearby residents fish along the bay in shallow water as subsistence fishing.

Although these sites do not handle large volumes of fresh fish, fishery activity is one of limited options for local community members to make a living as a means of securing food. Also, as the neighboring villages are host communities, landing activity serves as an important local employment opportunity.

Shaplapur landing site lands 915 tons—a relatively large volume compared to other landing sites. Lying at the crossroads of a national road (Marine Drive) and an inland road, Shaplapur has developed rapidly over the last two years and is close to the refugee camp. At the time of interviews for the survey (October 2021), approximately 300 fishing boats were being unloaded, with daily landing volumes of 20 to 50 tons and peak loads exceeding 50 tons. Along the access road to the beach stand about 20 fish trader buildings for sorting, rinsing, and shipping the fish, as well as a private ice plant with a capacity of making 30 tons/day. It is progressively developing into a base of distribution for fish to retail markets. Due to growing demand for ice, another ice plant of the same capacity is under construction and is scheduled to be completed within the year. Of the landed fresh fish, 20% is consumed locally, including in the refugee camp, and 80% is shipped to distant retail markets in Cox's Bazar, Chattogram, Dhaka, and other markets, as well as to export processing plants in Cox's Bazar. The market has already surpassed the level of subsistence fishing. It is increasing its landing capacity and seems to be the landing site along the Bay of Bengal with the most potential for distribution base development.

The facilities required for the Shaplapur Landing Center (tentative name) are: a collection, rinsing, and sorting workspace, a packaging and shipping workplace, a deep well and water storage tank, an ice storage, cold storage, a packaging warehouse, an administrative office, a fisheries cooperative office, a fish trader cooperative office, meeting rooms, a community assembly hall, a Monitoring post for Coast Guard, nighttime light beacons, a fishing gear storehouse, a rescue boat, a trailer for the rescue boat, a boat garage for the rescue boat and trailer, a disaster equipment storehouse, a rescue and safety equipment storehouse, and an access road.

The development of landing center facilities is expected to keep the landed fish clean, streamline shipping, reduce the currently substantial quality loss during landing and shipping, reduce post-harvest loss and, as a result, to increase fisher's income. The increased landing activity is expected to revitalize the regional economy, to boost employment opportunities, which should help to improve employment and household incomes in a host community that has been impacted by job competition since the massive inflow of refugees. Also, it should help to ensure the safety of community people in the event of cyclones.

(2) Distribution base for consumer market landing sites

BFDC Ghat is the largest distribution base in Cox's Bazar, with the highest landed volume, number of fishers, and number of fishing boats. It current lands an average 32 tons of fish per day, with 40% consumed locally and 60% shipped to distant retail markets.

BFDC Ghat was established in 1965/66, with the landing facilities, ice plant, and office building updated in 2001/02. However, in a cyclone in 2012, four jetties connected to the landing facilities by stairs were lost, the northern quay wall collapsed, and the landing facility building itself was slanted.

BFDC tried to repair it but was unable to restore the facilities. The building was demolished after collapsing in 2015. The floor slab on the north end of the former landing facility remains sloped, and the quay is still collapsed. Since then, a roof has been put on the pillars on the south end remnants and used as a makeshift landing facility. However, with the area handling increased landing volumes, the landing site footprint is much too small.

With BFDC Ghat unable to handle the increased landing demand, because of its insufficient handling capacity due to the damaged and disrepair landing facilities, fishing boats are forced to stand by for hours to unload their catches, and then proceeding to auction and handling their catches in unhygienic manners in congested and chaotic conditions.

The best solution is to demolish the collapsed north end landing building, then build new landing buildings and landing piers befitting of the current landing volumes and restore the riverbank to withstand disasters.

BFDC Ghat will require the following new facilities: An auction site, cold storage, a packaging and shipping workspace, a packaging warehouse, a deep well and water storage tank, an auctioneer office, a fish trader office, a BFDC office, a parking lot, landing piers and gangways.

Repairing the BFDC Ghat will shorten landing wait times for fishing boats and streamline landing work, which will in turn improve the freshness of landed fish and enable hygienic handling of fish. This will lead to improved quality of fish in distribution and supply consumers with superior, safer seafood in higher

quantity. This will also mean that there will be no fishing boats that are compelled to go to Chittagong for landing their catch after waiting in vain at BFDC Ghat for a long time for landing. Shorter waiting times for landing and streamlined landing work will also reduce the burden on fishers in unloading the fish catches.

(3) Raw fish for drying landing sites

Located on the western tip of Sonadia Island at the southern end of Moheshkhali Upazila, Sonadia is conveniently located for artisanal fishing boats to sail into the Bay of Bengal, and many fish drying operators come to Sonadia during the dry season, which is suitable for drying fish.

Although seasonal, Sonadia has the second largest processing production scale after Nazirtek, which is Bangladesh's largest producer of dried fish.

Prosper in dried fish, although a relatively low amount is distributed as fresh fish, the catches unloaded here are distributed to fish drying operators in the hinterland.

There is great need for landing site development. the production is large in scale, and there are significant economic losses from degraded fish quality due to the poor landing site.

The Sonadia Landing Center (tentative name) will require the following facilities: A collection, rinsing, and sorting workspace, primary processing facilities, a deep well and water storage tank, a product storehouse, a packaging warehouse, an administration office, a fisher’s cooperative office, meeting rooms, a community assembly hall, nighttime light beacons, a fishing gear storehouse, and access road.

Development of Sonadia Landing Center facilities is expected to prevent the landed fish from degrading in quality, leading to production of quality dried fish, as well as to reduce quality loss during storage, shorten distribution times, reduce distribution costs and, as a result, to increase fisher's income.

The site will also serve as an alternative site for repairing and drying fishing nets due to the relocation of Nazirtek, which is expected to promote employment of workers involved in such work.

Contents

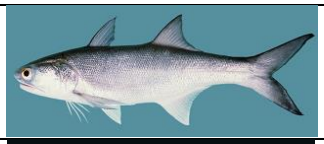
Appendix：

Contents of Tables and Figures

Abbreviations

BDT	Bangladesh Taka
BFDC	Bangladesh Fisheries Development Corporation
BFRI	Bangladesh Fisheries Research Institute
BJMSS	Bangladesh Jatio Matshyajibi Samabay Samity
BS	Beach seine
BWDB	Bangladesh Water Development Board
CGIAR	Consultative Group on International Agricultural Research
COVID-19	Coronavirus disease 2019
DoF	Department of Fisheries
ECMWF	European Centre for Medium-Range Weather Forecasts
EEZ	Exclusive Economic Zone
ESBN	Estuarine Set Bagnet
FAO	Food and Agriculture Organization of the United Nations
FIQC	Fish Inspection and Quality Control
FRSS	Fisheries Resources Survey System
GDP	Gross Domestic Product
GPV	Grid Point Value
GN	Gillnets
HAT	Highest Astronomical Tide
ICT	Information and Communication Technology
JICA	Japan International Cooperation Agency
LAT	Lowest Astronomical Tide
MHWS	Mean High Water Springs
MHWN	Mean High Water Neaps
MLWN	Mean Low Water Neaps
MLWS	Mean Low Water Springs
MMD	Mercantile Marine Department
MoFL	Ministry of Fisheries and Livestock
MSBN	Marine Set Bagnet
MSL	Mean Sea Level
MT	Metric Ton
NOAA	National Oceanic and Atmospheric Administration
SPARRSO	Bangladesh Space Research and Remote Sensing Organization
TK	Bangladesh Taka
UKHO	United Kingdom Hydrographic Office
US$	United States Dollar

List of Major Marine Fish

1.English Name 2.Local Name *3.Scientific Name*	Image	1. English Name 2, Local Name *3, Scientific Name*	Image
1,Hilsa Shad 2,Hilsa *3,Tenualosa ilisha*		1,Sea catfish 2,Sea catfish *3,Plicofollis dussumieri*	
1,Chinese Pomfret 2,Chinese Pomfret *3,Stromateus chinensis*		1,Black Pomfret 2,Black Pomfret *3,Parastromateus niger*	
1,Scabbard fish 2,Ribbon fish *3,Lepturacanthus savala*		1,Less Tiger-tooth Crocker 2,Poa *3,Otolithes ruber*	
1,Indian Salmon 2,Indian Salmon *3,Eleutheronema tetradactylum*		1,White sardine 2,Sardine *3,Escualosa thoracata*	
1,Indian mackerel 2,Mackerel *3,Rastrelliger kanagurta*		1,Goldspotted grenadier anchovy 2,Anchovy *3,Coilla dussumieri*	
1,Croakers 2,Jewfish *3,Johnius argentatus*		1,Bombay duck 2,Bombay duck *3,Harpadon nehereus*	
1,SeaBass 2,Koral *3,Lates calcarifer*		1,Paradise threadfin 2,Tapasi *3,Polynemus paradiseus*	
1,Giant tiger prawn 2,Shrimp (Tiger shrimp) *3,Penaeus monodon*		1,Tuna 2,Tuna *3,Katsuwonus pelamis*	
1,Indian white prawn 2,Prawn (Indian white prawn) *3.Penaeus indicus*			

Source: Fish Base

Chapter 1 Background and Objectives

1-1 Background

The People's Republic of Bangladesh (hereinafter referred to as "Bangladesh") is located at the eastern end of the Indian subcontinent in the Bengal Delta, which is formed by the Ganges, Brahmaputra, and Meghna rivers that flow from the Himalaya mountains to the Bay of Bengal in the Indian Ocean. Most of the country is lowlands at an elevation of 10 m above sea level or less, and is subtropical. During the monsoon season from June to October, cyclones cause frequent floods and other weather-related disasters, resulting in erosion, deforestation, and soil degradation. However, river overflow during the rainy season makes the soil fertile, providing agricultural land that can be cultivated for two or three cropping seasons. It also contributes to rich fishing grounds in the vast inland waters, with an area of about four million hectares. Of the 164,000 km^2 of their exclusive economic zone (EEZ), about 66,440 km^2 is considered continental shelf, but the coastal areas of Bangladesh are shallow, with 24,000 km^2 of ocean area less than 10 m deep. Nineteen districts in the southern part of Bangladesh (about 30% of the country) have coastline along the Bay of Bengal and are blessed with rich fishing grounds due to high primary production during the northwest monsoon season.[1]

The fisheries sector in Bangladesh accounted for 3.49% of the GDP in 2019, and 18 million people, or about 11% of the population, are engaged in this sector. However, 23.9% of the fisheries workers live in poverty and 13.2% live in extreme poverty.[2] The production volume of fisheries was about 4.38 million tons per year in 2018-2019. Fish is an important food source, accounting for 66% of the animal protein consumed by the Bangladeshi people. The export value of fish and fishery products is about 54 billion yen, which is the second largest source of foreign currency after the textile industry.[3] The annual production volume of inland water fisheries in rivers and lakes is 1.24 million tons, which is the third largest in the world after China and India. However, production at inland water fisheries is stagnant due to the decline of resources, caused by over-fishing and the degradation and loss of fish habitats due to development. Meanwhile, inland aquaculture has increased production more than 2.5-fold in about 15 years, against a backdrop of spreading aquaculture technology and increased domestic demand due to economic growth. This has made Bangladesh the fifth largest aquaculture producer in the world with a volume of 2.49 million tons. However, there are fears that the growth of inland aquaculture may reach a plateau due to the increasing salinity of inland waters caused by decreasing river flow, as well as the difficulty in securing suitable land for aquaculture. Expectations have thus been lowered for both of these sectors, which have supported the growth of Bangladesh's marine industry. For this reason, the Government of Bangladesh expects marine fishery to be the next source of growth, as they are underdeveloped compared to other fishery sectors and account for only 15.1% of the national fishery production, with a production volume of 660,000 tons. They are working to promote marine fisheries by placing top priority on protecting, preserving, and ensuring the diversity of coastal marine resources.[4]

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[1] Sustainable Management of Fisheries Resources of the Bay of Bengal, March 2010, Bangladesh Fisheries Research institute (BFRI)

[2] Bangladesh Sustainable Coastal and Marine Fisheries Project (BSCMFP) World Bank, 2018

[3] Bangladesh Statistics 2019

[4] Statistical Yearbook Bangladesh 2020

Marine fishery is mainly conducted by traditional artisanal fishing boats (about 68,000 boats), in waters under 40 m deep within the Bay of Bengal. There are only 253 large commercial trawlers in total, and catches by artisanal fishing boats accounting for 84% of the marine fisheries production.[5] In the south Chattogram region, where there are many hills and relatively little inland water and land suitable for cultivation, there is a large dependence on marine fisheries for food production and employment. Most of the fishers engaged in marine fisheries are artisanal fishermen, who do not have production capital such as fishing boats, are vulnerable to environmental changes, and have high poverty levels. Many of these artisanal fishermen live in remote coastal areas far from urban centers. They do not have many alternative employment opportunities or means of earning cash income, especially during the 65-day fishing ban in the Bay of Bengal from May to July, when many fishing households are unemployed and living in poverty.

Taking into the consideration the impact of the large number of the Refugees pouring into Bangladesh's Cox's Bazar district from neighboring Myanmar since August 2017, in the Japan-Bangladesh Comprehensive Partnership signed in May 2019, the Governments of Japan and Bangladesh confirmed that they will support displaced people and host communities, with a view to ensuring stability in the region. Based on this partnership, JICA has implemented a project for Fisheries Development Advisors from FY 2020 as a part of support for host communities, and is planning to implement the "Bay of Bengal Coastal Area Fisheries Village Development Project." Prior to the formation of these projects, JICA commissioned the WorldFish Center, an affiliate of the Consultative Group on International Agricultural Research (CGIAR), to conduct a study on strengthening the resilience of marine fishermen by improving their livelihoods in areas severely affected by the influx of displaced people. According to the results of the survey, the issues surrounding artisanal fishermen include the depletion of marine resources in the Bay of Bengal due to overfishing, post-harvest losses at each stage of distribution, and lack of infrastructure and awareness among stakeholders to ensure appropriate quality maintenance and food safety and hygiene during distribution[6]. In particular, the landing sites and distribution networks of artisanal fisheries are not well developed, and this is one of the factors contributing to post-harvest losses. The post-harvest loss rate of marine fisheries is higher than that of inland water fisheries and aquaculture, and it has been reported that approximately 7-16% of fishery products are lost during the distribution process.[7] In addition, in the value chain of artisanal fishery products, the cost of post-landing distribution is significant, and is a major impediment to improving the income of fishers. In order to improve the livelihood of fishers, it is necessary to increase the added value of fishery products by improving the infrastructure for fishery product distribution in the fisheries value chain (catch, landing, storage, distribution, processing, and sales).

In the Bangladesh Delta Plan (BDP 2100), a comprehensive national plan enacted in 2018, the Government of Bangladesh has set as its goals for the fisheries sector as maintaining a sustainable

[5] Statistical Yearbook Bangladesh 2020

[6] Strengthening resilience of coastal fisher communities (Host communities) in Cox's Bazar for improving livelihood ecologically and economically, WorldFish Bangladesh, 2019

[7] Post-harvest Loss Reduction in Fisheries in Bangladesh: A way Forward to Food Security

environment through integrated, innovative strategies and equitable resource management, ensuring "safe and reliable animal protein for all citizens" and food security through safe marine products, as well as achieving robust economic growth by exporting surplus products. In the Eighth Five-Year Plan (2020-2025), the Government advocates a "blue economy" that aims to achieve economic growth through the utilization of the country's abundant marine resources. The first priority of the program is to conserve and manage fisheries for the benefit of present and future generations as a means of poverty reduction, food and nutrition security, climate change adaptation, and sustainable and inclusive livelihoods. In addition, the spread of novel coronavirus infections (hereinafter referred to as "COVID-19") has resulted in unemployed workers in the cities flowing back to the villages, and the country as a whole is experiencing a decline in consumption, which is resulting in lower incomes and renewed poverty in the villages. This has given rise to the need to create jobs by developing infrastructure in rural areas.

1-2 Objectives

The purpose of this survey is to provide an overview of the overall fisheries sector in Bangladesh and to collect and confirm information to formulate a grant aid project for infrastructure development related to the artisanal marine fisheries value chain in the south Chattogram region.

1-3 Target Regions

Chattogram District, Cox's Bazar District

1-4 Survey Methodology and Work Plan

Existing relevant materials, information and data were collected and organized to analyze and review the overview of the Bangladesh fisheries sector, including basic indicators of the marine fisheries sector, fisheries administration, fish production, fish distribution and post-harvest losses, marine fish processing, marine product trade, fish consumption and nutrition, fisheries-related organizations and groups, fisheries human resource development, fisheries-related assistance by Japan, and assistance by other donors.

In the South Chattogram region, four sites, namely, Nazirtek, Bangladesh Fisheries Development Corporation (BFDC) landing center at Cox's Bazar (BFDC Ghat), Teknaf, and Moheshkhali, which are the major landing sites in Cox's Bazar district, were selected for the study. The study assessed the distribution patterns for fish (fresh, dried, salted, etc.) from the landing sites to the consumer markets, the distance between the landing sites and the markets, and the handling throughout landing and distribution, as well as the impacts of these factors on the quality and price of fish at the landing and wholesale stages. Project proposals for the development of infrastructure for the fisheries value chain were examined and candidate sites were selected.

The projects implemented, progress of them, and planned projects of other donors in the artisanal fisheries sub-sector in the target area, as well as relevance to this project were confirmed.

The current status of the site, including the development plan, basic infrastructure, land tenue, and existing fisheries-related facilities, were assessed to determine the appropriate scale of the facility, and

issues were identified and analyzed.

Existing data on natural conditions (weather and sea conditions, ground and landform changes (drifting sand, erosion and siltation)) were collected and studied. In particular, natural disaster risks such as cyclones (storm surges, tidal waves), tsunamis, tidal bores and floods were investigated.

The project components and scale were confirmed, including the Department of Fisheries and BFDC, which are assumed to be the implementing organization, and the Department of Environment, which is in charge of environmental impact assessment. The organization in charge of the environmental impact assessment procedures were confirmed.

For the proposed candidate sites, use of the sites were checked, alternatives were compared, and issues put in order. The proposed assistance measures were confirmed and scoped based on the environmental checklist (fisheries sector) of the JICA Guidelines for Environmental and Social Considerations (2010), taking into account the project overview and site environment.

The construction conditions necessary to implement the project and estimated construction costs were studied. Quantitative and qualitative indicators that measure the direct and indirect effects of the development of the fisheries value chain infrastructure were studied.

1) First field survey

The work schedule was planned to start in late March 2021 with the first field survey.

Due to the worsening of the COVID-19 situation in Bangladesh during the survey implementation stage (from March to April, 2021), a survey of landing sites conducted by local hires was just barely completed. However, the consultant team members were not able to conduct a field survey, and returned to Japan after holding only remote meetings for discussion once a lockdown in Bangladesh was issued.

2) Second field survey

The second field survey was planned to be conducted from mid-June to mid-July 2021, but due to the deterioration of the COVID-19 situation in Bangladesh, the schedule was changed to mid-September to mid-October 2021 (for two team members: Project Manager/ fishing village development/socioeconomic analysis and the team member in charge of fisheries value chain/fish processing) and mid-October to mid-November 2021 (for two team members: member in charge of fisheries infrastructure plan and civil engineering/project costs estimation and member in charge of environmental and social considerations).

The landing sites in the survey area, the actual situation during the no-fishing season at the sites and the development of infrastructure related to fishing activities within and around the sites were studied.

Actual marine product distribution was to be studied by conducting visits to major distribution centers such as dried fish processing plants in Cox's Bazar city and wholesale and consumer markets in Cox's Bazar.

3) Preparation of Draft final report and explanation to the relevant agencies

Interim Report were submitted to JICA at the end of October 2021, and delivered to the relevant agencies in Bangladesh, comments from the relevant agencies were studied and subsequently reflected

in the Draft Final Report, which included the results of the field survey and future JICA assistance measures (proposed) and were compiled in early December 2021. The contents were explained to and discussed with the relevant agencies in Bangladesh.

4) Preparation and submission of Final report

After receiving comments on the Draft Final Report from the relevant agencies in Bangladesh and JICA, the Final Report submitted in February 2022.

1-5 Organizations cooperating in the survey

【Governmental Organization】

・Ministry of Fisheries and Livestock
・Department of Fisheries
・Bangladesh Fisheries Development Corporation
・Bangladesh Fisheries Research Institute
・Bangladesh Oceanography Research Institute
・Local Government Division
・Local Government Engineering Department
・Bangladesh Water Development Board
・Department of Environment, Ministry of Environment, Forests & Climate Change

【Academic institution】

・Bangladesh Agriculture University

Chapter 2 Overview of the Fisheries Sector

2-1 Basic Guidelines of the Fisheries Sector

Bangladesh's GDP has been growing steadily at an average annual rate of 6.5% since 2010, and the share of households below the poverty line (< US$1.9) has declined significantly from 44.2% in 1991 to 13.8% in 2016.[8] The average annual growth rate of the fisheries sector since 2010 has been 6.2%, which is much higher than the 2.7% of the agriculture sector (Figure 2-1), with the fisheries sector accounting for a 3.49% contribution to the GDP in FY 2018-19.

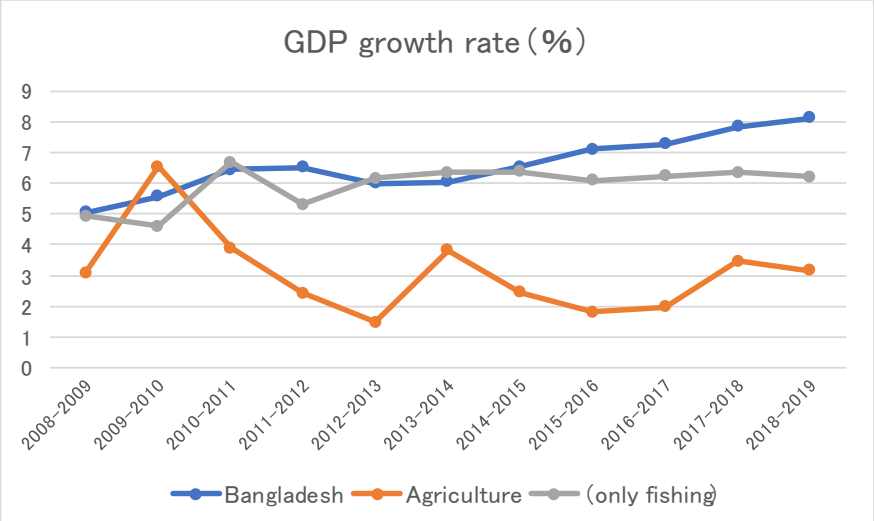


Figure 2-1 GDP Growth Rate of Agriculture and Fishery

Source: Statistical Yearbook Bangladesh 2019

2-2 Basic Indicators of the Fisheries Sector

The basic indicators of the fisheries sectors are shown in Table 2-1.

Table 2-1 Basic Indicators of Fisheries Sector (2018-2019)

Inland Close Water (Culture)	797,851 ha	
Inland Open Water (Capture)	391,753 ha	
Marine		
Territorial waters area	2,680 sq. nautical mile	
EEZ	41,040 sq. nautical mile	
Continental shelf area	24,800 sq. nautical mile	
Coastal line Length	710 km	
Total Fisheries Production	4,384,221 MT	
Inland Capture Fisheries	1,235709 MT	(28.18% of Total Fisheries Production)
Inland Culture Fisheries	2,488,601 MT	(56.76% of Total Fisheries Production)
Marine Fisheries	659,911 MT	(15.05% of Total Fisheries Production)

[8] Project Appraisal Report, Sustainable Coastal and Marine Fisheries Project, World Bank, 2018

Marine Fisheries (Industrial)	107,236 MT	2.44% of Total Fisheries production 16.25% of Marine Fisheries
Marine Fisheries (Artisanal)	552,675 MT	12.60% of Total Fisheries Production 83.74% of Marine Fisheries
GDP (Fisheries Sector)	742,747 million BDT	
GDP contribution rate	3.57%	
GDP contribution rate (Agricultural Sector)	23%	
Number of Fishermen	1.5 million people	Source : Kleih et al. 2003
Number of workers related fisheries sector	11 million people	Source : Kleih et al. 2003
Rate of Number of work forces related fisheries sector (including fishers)	More than 11% of total population in Bangladesh	Source : Kleih et al. 2003
Fish consumption per capita	21.9kg／year	Almost 60% of National animal protein source
Fish Export Volume	68,936 MT	
Fish Export value	43,099.4 million BDT	1.5% of total export value (Clothing and textiles account for 95.14% of the export value)

Source: Yearbook of Fisheries Statistics of Bangladesh 2018-2019 and Bangladesh Statistics 2019

2-3 Fisheries-Related Administration

In Bangladesh, the Ministry of Fisheries and Livestock (MoFL) is in charge of fisheries. Their main duties are the conservation of fishery resources, meeting the country's demand for animal protein, improving socio-economic conditions for fishers, creating job opportunities for unemployed and underemployed people in rural areas, earning foreign currency by exporting fish and fishery products, and developing new technologies by researching fisheries development and storage technologies.

Figure 2-2 below shows an overview of the organizations related to fisheries-related administration.

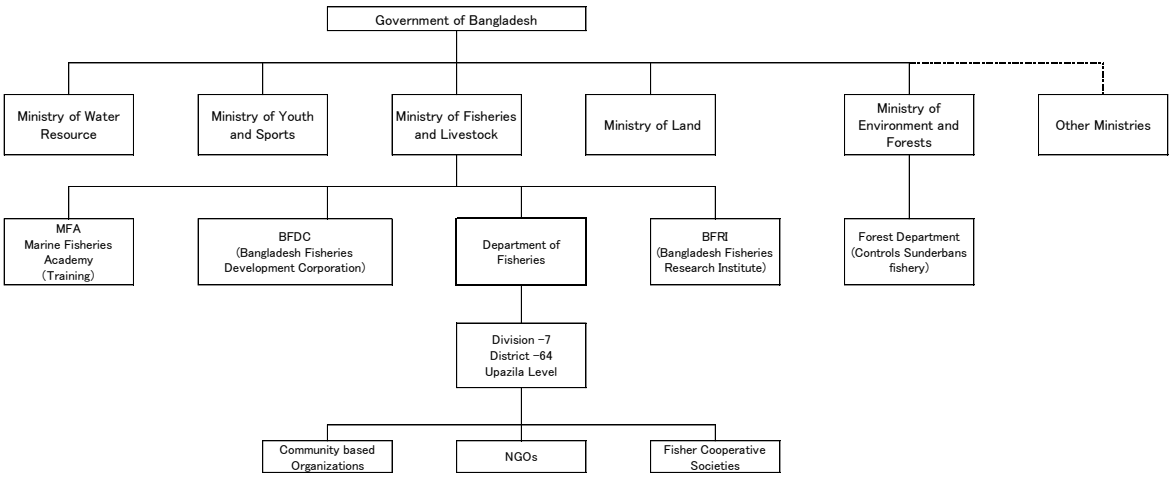


Figure 2-2 Outline of Related Fisheries Sector Organization Chart

Source : (BDP2100 p121)

The Department of Fisheries (DoF) is under the administrative control of MoFL and focuses on fisheries-related administration. Its duties include nationwide fisheries management, fisheries development, dissemination, training, conservation and protection, quality control, policing, making policy recommendations, and gathering information. DoF is also responsible for ensuring the sustainable growth of fish and shrimp production for domestic consumption and export. It manages fishery resources in shared waters through community participation, so that the benefits gained are fairly distributed for optimal economic and social growth.

Under the Director General, there are three Directors heading wings for Inland Fisheries, Marine Fisheries, and Training. There are also two Principal Scientific Officers in charge of the Fisheries Resources Survey System (FRSS) and Fish Inspection and Quality Control (FIQC). At the local administrative level, there are Deputy Directors allocated to divisions, District Fisheries Officers for districts, and Upazila Fisheries Officers for upazilas (sub-districts). In addition to this, there are also three Fish Inspection and Quality Control Stations, as well as the Marine Fisheries Station, Fisheries Training Academy, Fisheries Training and Extension Centers, and Fish Hatcheries, employing a total of 4,227 technical officers and staff members. In 2017/2018, the operating budget was 2.597 billion taka[9] and the development budget was 3.496 billion taka. [10]

Figure 2-3 below shows the Outline of DoF Organization Chart.

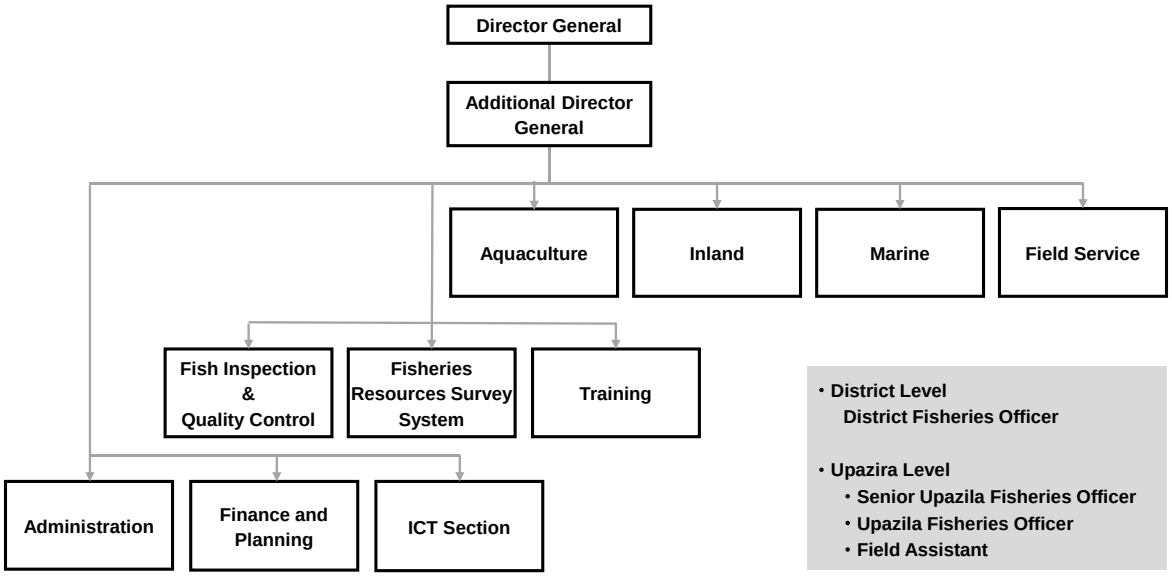


Figure 2-3 Outline of DoF Organization Chart

Source: DoF

BFDC was established in 1964 as an independent corporation under the supervision of MoFL with broad authority in the management and promotion of fisheries. BFDC's core business is fish distribution, processing, and sales. The company owns and operates fishing ports, landing sites, distribution centers,

[9] The exchange rate of Bangladeshi Taka (1BDT) to Japanese Yen is approximately 1.28 Yen (September 2021)
[10] Annual Report 2018 DoF

ice plants, fish markets, and processing plants throughout the country in locations such as Chattogram, Cox's Bazar, Khulna, Mongla, Barishal, Hatia, Galachipa, Rangamati, Mymensingh, and Dhaka.

Figure 2-4 below shows the Outline of BFDC Organization Chart.

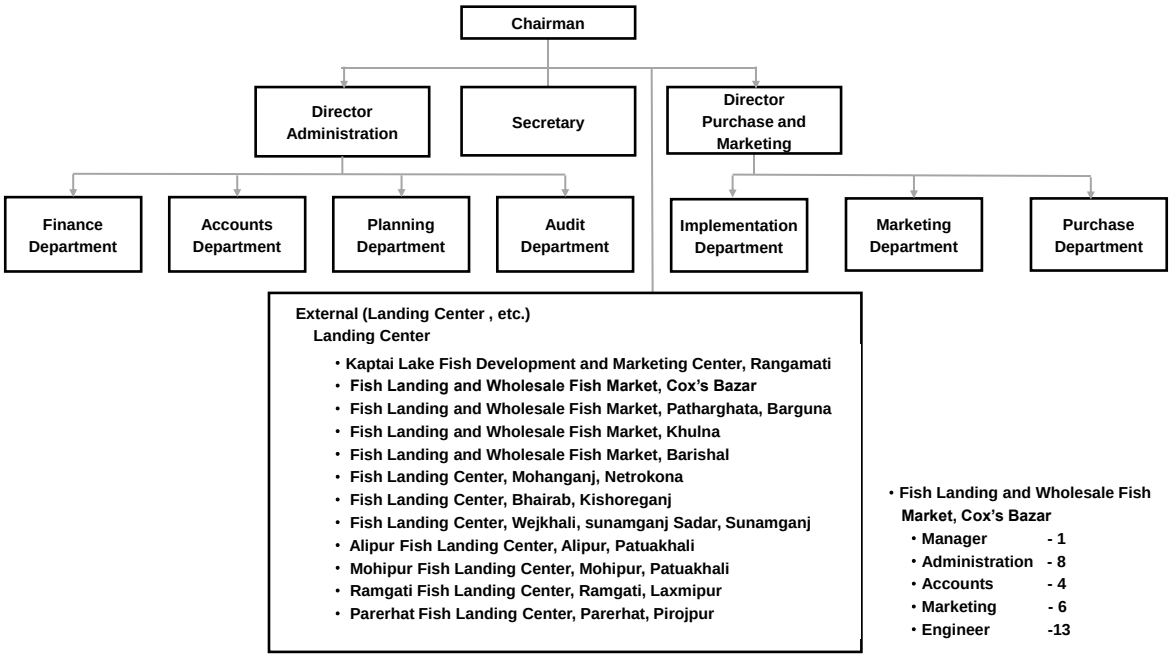


Figure 2-4 Outline of BFDC Organization Chart

Source: BFDC

Bangladesh Fisheries Research Institute (BFRI), established in 1984, is an independent corporation under the supervision of MoFL. It has stations in Mymensingh, Chandpur, Rangamati, Cox's Bazar, Bagherhat, and Paikgacha (Khulna), and sub-stations in Santahar, Jessore, Barishal, and Saidpur. In these research facilities, basic and applied research on freshwater aquaculture, inland fisheries management, lake management, fish diseases, marine fisheries, brackish water aquaculture, and selective breeding, etc. are conducted and the results are disseminated by DoF.

In addition, the Ministry of Local Government, Rural Development and Cooperatives is involved in fisheries cooperatives and the comprehensive development of agricultural and fishing villages. Relevant departments in the Ministry of Land and the Ministry of Water Resource are involved in fisheries administration pertaining to the use and development of rivers and lakes.

The National Fisheries Policy, enacted in 1996, sets out the following as its primary objectives:

a. Enhancement of fisheries production;
b. Poverty alleviation through creating self-employment and improvement of socio-economic conditions of fishers;
c. Fulfill the demand for animal protein;
d. Achieve economic growth through earning foreign currency by exporting fish and fisheries

products; and

e. Maintain ecological balance, conserve biodiversity, and ensure public health-provided recreational facilities.

Bangladesh's long-term development plan, Vision 2021, targets the achievement of food self-sufficiency and has focused on food security. As a sector with tremendous potential to drive the growth of the national economy, the fisheries sector has maintained a long-term policy of becoming self-sufficient in fisheries in the near future. Furthermore, Vision 2041 aims to eradicate poverty and reach Upper Middle-Income Country (UNIC) status by 2031 and a High-Income Country (HIC) status by 2041. Since the fisheries sector has been one of the most productive and dynamic sectors in the country as a contributor to the growth of the national economy and employment, the Government will implement a plan for sustainable fisheries management through innovation and dissemination of environmentally friendly fishing technologies. In addition, the long-term strategy will include the development of the added value of fishery products, reduction of post-harvest losses, and the pursuit of maximum economic output from marine fisheries.

The main laws and regulations related to fisheries resources conservation, fisheries, aquaculture, and fish processing in Bangladesh are stated below. In addition, the Industrial Marine Fisheries Management Plan, for sustainable resource use by industrial fisheries and Marine Protected Area Management Plan are under formulating.

Table 2-2 Main laws and regulations related to fisheries

Laws and regulations	Outline
The Protection and Conservation of Fish Act, 1950 (as amended in 1988)	Authority to enact laws and regulations related to the conservation of fishery resources, etc.
Pond Development Act, 1939 (as amended in 1986)	Use of ponds in inland aquaculture, etc.
Marine Fisheries Ordinance, 1983 (as revised in 2020)	Marine fishery permits, registration, supervision, etc. (Revision of the introduction of registration system for trawlers and penalties for fishing vessels.)
The Fish and Fish Products (Inspection and Quality Control) Ordinance, 1983 (as revised in 2020)	Marine products processing, inspection, export, etc. (Revision of penalties for the use of hazardous chemicals in the sale and export of fish and fish products.)
Shrimp Culture Tax Act, 1992	Taxes on shrimp farms, etc.
Territorial Water and Maritime Zone Act, 1974	Territorial waters of Bangladesh, etc.

In 2006, DoF formulated the National Fisheries Strategies for fisheries development, in anticipation of changes in the fisheries sector over the next 10 years. It aims to implement policies that focus on decentralization of fisheries administration, participation by fishery stakeholders, poverty reduction, and gender equality. DoF’s sub-strategy objective is to ensure sustainable management of marine fisheries through the allocation of fishing rights and its management to communities and relevant fishing groups. This will be done by first, controlling the number of fishing vessels and fishers entering the fishery sector by providing a regulatory framework for fishing rights and fishermen's registration, and then by providing

fishery financing and credits to fishers so that they can break away from the dominance of commercial capital in the distribution of fishery products. It also seeks to prevent new entrants into artisanal coastal fisheries through support for alternative income activities. Fisheries management is being promoted by designating fishing gear, operating areas, and prohibited areas, including the protection of breeding areas. Fishing activities are prohibited up to a depth of 5 m or within 5 km from shore. Coastal waters up to 10 km from the shore are dedicated to artisanal fishing, and the operation of industrial fishing vessels is prohibited. The management of the coastal fisheries are being decentralized, and with the goal of community-based management, monitoring and surveillance are conducted on each landing site; industrial fishing vessels are required to use the landing sites designated by DoF, and are monitored by operation logs and landing certificates. Trawlers are strictly regulated in terms of the waters they operate in, the gear they use, etc., and they are required to keep the dumping of trash fish to minimum[11].

The actual state of IUU fishing in Bangladesh waters is unclear, as monitoring and control are scarcely done, despite the provisions set forth in various laws (Maritime Zones Act 2019, Coast Guard Act 2016) [12]. Piracy has become a major problem for both industrial and artisanal fishing vessels, and according to the International Maritime Bureau, 20 trawlers were victims of piracy in the waters of Bangladesh between 1995 and 2006. Small fishing boats are easy targets for pirates, and it is said that most of the targeted fishing boats were boat length of 10-12ft and engine power of 15-45PS. Although it is believed that piracy will further impoverish artisanal fishermen by compelling them to take on more debt to repurchase their fishing gear and other equipment, which was procured through debt, little of control is being done to crack down on piracy[13].

In the Eighth Five Year Plan (2020 to 2025), the fisheries sector aims to increase fishery production in both inland and marine fisheries. In the inland fisheries sector, production efficiency (yield) will be improved through technological development, and in the marine fisheries sector, resource management will be strengthened through the use of VMS (vessel monitoring systems). Meanwhile, the strategy also calls for the development of fisheries targeting bottom fish and tuna species at depths of 50 meters or more, the introduction of ICT and human resource development to improve the fisheries value chain, and responses to climate change[14].

Fisher licenses are categorized into industrial fisheries and artisanal fisheries, with industrial fisheries being handled by the Marine Fisheries Office, DoF and artisanal fisheries being handled by the respective Upazilas. The fishermen's license system by the Department of Fisheries was introduced in January 2012 from the perspective of fisher’s livelihood security and resource management. A survey has been conducted on the license ID possession rate, but the possession rate is not high, so efforts are being focused on increasing the license possession rate.

The following table shows the results of the survey on the percentage of fisher's ID cards held in nine locations across the country and in Cox's Bazar.

[11] Marine Fisheries Sector Sub-Strategy (Draft), DoF, 2006

[12] Illegal fishing and laws of Bangladesh, Rahman, 2020

[13] Maritime Piracy in Southeast Asia and Bangladesh 1992-2006, Liss, 2007

[14] 8th five year plan july 2020-june 2025, General Economics Division Bangladesh Planning Commission, December 2020

Table 2-3 Status of Fisher's ID Card in 9 locations

Location	Yes	No
Shyamnagar (Khulna)	0%	100%
Khulna	66%	34%
Sarankhola (Khulna)	2%	98%
Patharghata (Barishal)	0%	100%
Barishal	2%	98%
Char Fasson (Barishal)	12%	88%
Cox's Bazar (Chattogram)	48%	52%
Chattogram	30%	70%
Shitakundu (Chattogram)	38%	62%

Source: Labour of Fishing Section of Bangladesh, Karim et al. 2015

Table 2-4 Status of Fisher's ID Card in Cox's Bazar

Location	Yes	No
Moheshlhali	41%	59%
Ukhia	8%	92%
Cox's Bazar Sadar	68%	32%
Kutubdia	34%	66%
Teknaf	38%	62%

Source: Strengthening resilience of coastal fisher communities (Host communities) in Cox's Bazar for improving livelihood ecologically and economically, WorldFish Bangladesh, 2019

Fishing vessel registration is currently limited to industrial trawlers and mechanized fishing vessels and is handled by the Mercantile Marine Office.

In the Cox's Bazar region, the fisher license acquisition rate is relatively high at 70% in the Cox's Bazar Sadar, but low in Teknaf and Ukhia, at 40% and 10%, respectively. The low rate of license usage may be due to procedural problems and the fact that fishers do not understand the benefits of holding a license.

The merits of acquiring a fisher license include to have the right to receive support from the Government such as rice supply during the 65-day closed season, and support for fishermen's households, including a lump sum grant in the event of the decease of the fisher. However, in order to issue IDs to unregistered fishermen, the fisher list must be prepared by local DoF staffs in each Upazila, in cooperation with fishermen leaders, and then approved by Upazila committee consisting of local administrative staff, and the DoF.

2-4 Marine Fishery Resources

Bangladesh's EEZ is bordered by India to the west and Myanmar to the east. The boundaries with India and Myanmar were established in 2014 and 2012, respectively. This EEZ, which forms an acute angle, covers an area of 164,000 km^2 (Figure 2-5 shown on the right). The numbers (1)-(4) in the figure show the main fishing grounds of Bangladesh, which are described later in Table 2-6.

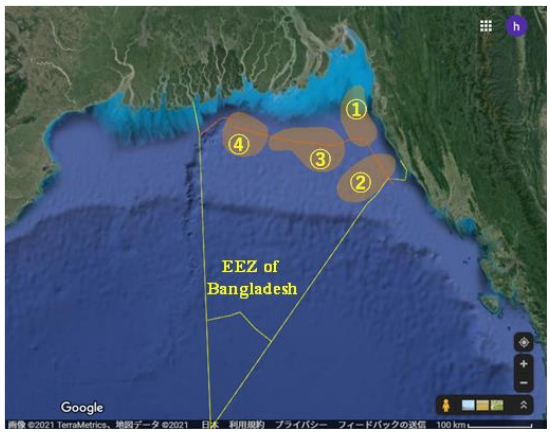


Figure 2-5 EEZ of Bangladesh

Source： Initial Measures of the Economic Activity Linked to Bangladesh's Ocean Space, and Implications for the Country's Blue Economy Policy Objectives

The depth of the continental shelf within the Bangladesh EEZ in the Bay of Bengal is relatively shallow, with 49% of the continental shelf area at a depth of less than 24 m (Table 2-5).

Table 2-5 Water Depth Distribution in the Continental Shelf Area in Bangladesh

Water depth range	Area (sq.km)	Area ratio (%)
Water depth up to 10m	24,000	36
10-24m	8,400	13
25-49m	4,800	7
50-74m	3,580	8
75-99	13,410	20
100-199	10,250	16
Total	66,640	100

Source: THE IMPACT OF SHRIMP TRAWLING FISHERIES ON LIVING MARINE RESOURCES OF BANGLADESH

The operation of trawlers on the continental shelf slope is difficult and especially at depths of 180 m or more, their operation is said to be impossible.[15]

As the catch of hilsa, a socio-economic and culturally important fish species in Bangladesh, has been declining since the 1990s, DoF has implemented the Hilsa Fishery Management Action Plan (HFMAP). In addition, with assistance from USAID, the DoF and WorldFish jointly implemented Enhanced Coastal Fisheries in Bangladesh (ECOFISH-Bangladesh), which is a cooperative resource management program between DoF and fishing communities for protecting Hilsa, managing juvenile fish, and controlling illegal fishing gear. This has resulting in more Hilsa catches, increased catch sizes, and increased income for fishers.[16]

[15] AA Khan et al, Status of the Demersal Fishery Resources of Bangladesh, 2003

[16] Hilsa fishery management in Bangladesh, Rahman et al. 2020

The ocean current in the Bay of Bengal flows clockwise, and is accelerated during the monsoon season. However, in the coastal areas, the inflow of large amounts of river water causes complex currents. During the dry season, the wind blowing from land to the sea creates a cortex current, and the upwelling current from the ocean trenches causes mixing of the water in the upper and lower layers, resulting in seawater temperatures of 23°C to 29°C in the eastern part of the Bay and 22°C to 28°C in the western part of the Bay, which is ideal for fish migration. In particular, the inflow of a large amount of inland water from the rivers causes seawater with a salinity of less than 32‰, which is considered to be a condition for shrimp habitats, to spread offshore, and the rising river water and monsoon cause the seawater to become turbid, creating environmental conditions suitable for shrimp habitats. According to a joint survey by Bangladesh and FAO, the fishery resources in the Bay of Bengal are estimated to be 475 species of fish in 138 families, with demersal fish resources of 264,000 to 373,000 tons.[17]

There are four major fishing grounds in Bangladesh waters (shown as numbers (1)-(4) in Figure 2-5 above and Table 2-6 below).

Table 2-6 Main Fishing Ground in Bangladesh Water

Name of fishing ground	Location	Depth	Area
① South Patches	From 10km West of Cox's Bazar	10-40m	3,400 sq.km
② South of South Patches	From 5km Southwest of Teknaf	10-100m	2,800 sq. km
③East of Swatch of No Ground	From 30km South of Hatia	10-100m	4,600 sq. km
③ Swatch of No Ground	From 29km South of Dubla Island	10-100m	3,800 sq. km

Source: A Background Paper for Bangladesh Fisheries Value Chain Study, MD. Alam, Mar.2011

Of these, the South Patch is a small trench west of Cox's Bazar, which is a good fishing ground of 3,400 km^2 that starts 10 km from the shore. To the south of that is the 2,800 km^2 South of South Patch, which begins 5 km south of Teknaf. These areas are very close to Cox's Bazar and Teknaf, making them important fishing grounds for artisanal fishermen.

[17] General situation and fishery related situation in Bangladesh (II), Overseas Fishery Cooperation Foundation of Japan, 1985,3

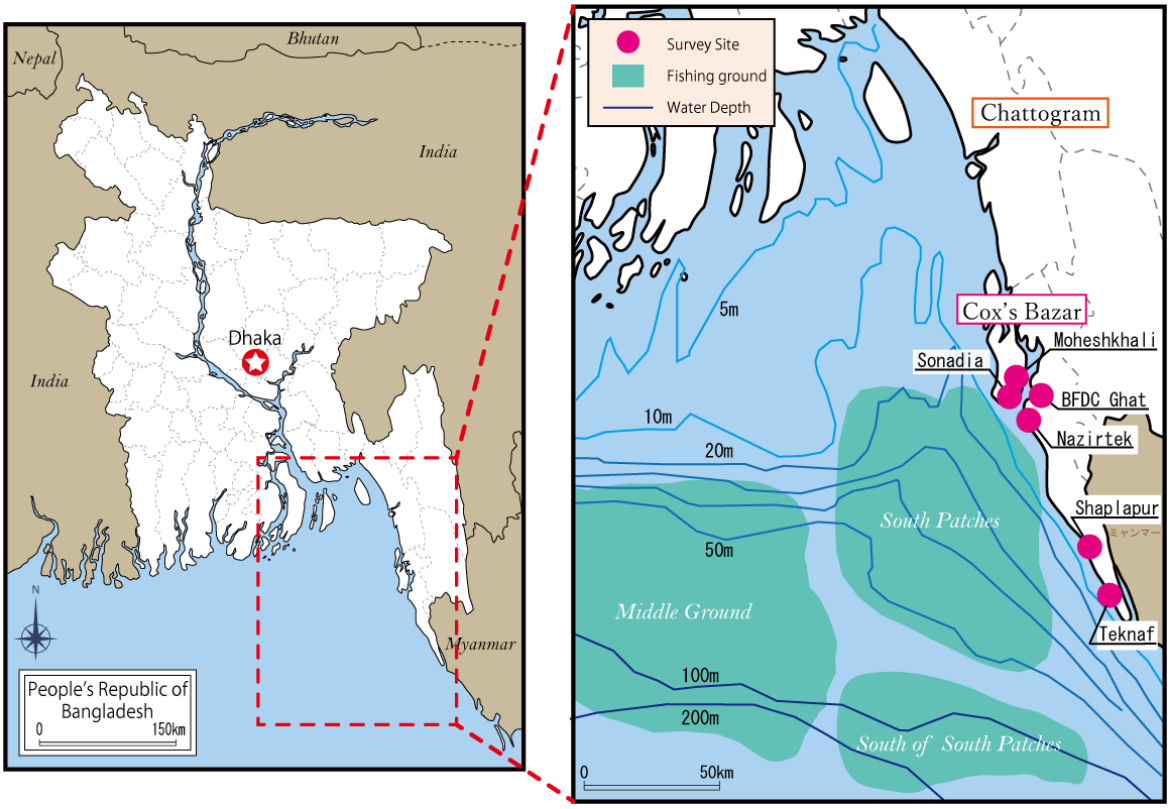


Figure 2-6 Main Fishing Ground in Bangladesh Water

Source : Nazrul et al. Trend of Fisheries Catch in South-Eastern Coast of Bangladesh, Nov 2018

The Bay of Bengal has not been surveyed for an extended period of time since the bottom trawl surveys in the 1980s, but according to the Marine Fisheries Survey Reports and Stock Assessment 2019[18], which is DoF's most recent report on marine resources, stocks of larger, more commercially valuable fish species are declining, while stocks of miscellaneous fish species that are not targeted by fishers are not declining. Furthermore, the vessel used for research is the 37.8 m long R/V Meen Shandhani (built in 2015) purchased from Malaysia, but as the vessel is not suitable for installing scientific fish-finder, the stock survey consists of a trawl survey and acoustic survey. A total of 13 surveys have been conducted between 2016 and 2019, including three shrimp resource surveys, three demersal fish resource surveys, two experimental pelagic fish resource surveys, and five equipment testing and training sessions. All the surveys were conducted in waters between 10m and 200m, the sounding survey line length was only 1,700km, and the survey of floating fish resources was still in the experimental stage because the research vessels were not designed for scientific echo sounder surveys, the survey method was still in the experimental stage, and the survey members had not enough experience[19]. Further research is needed to establish data collection methods and to accumulate data [20]. Although this is still considered an experimental survey, the overall catch of all species in the Bay of Bengal may well maintain or increase, despite intensive fishing. However, the situation may vary depending on the species, i.e., the population

[18] Marine Fisheries Survey Reports and Stock Assessment 2019, Department of Fisheries, June 2019

[19] https://defence.pk/pdf/threads/research-vessel-rv-meen-sandhani-will-survey-bay-of-bengal-from-november.462153/

[20] Marine Fisheries Survey Reports and Stock Assessment 2019, Department of Fisheries, June 2019

of large, slow-growing species such as Indian Salmon shows a declining trend, while smaller, fast-growing, and more reproductive species such as sardines and mackerel scads (Carangids) are increasing. It is believed that fishing pressure has led to smaller species continuing to replace larger ones, which require more time to grow. Since these small species are generally the forage base supporting larger predatory species, it is believed that an increase in these small fish will eventually lead to an increase in larger fish. However, if this alteration to the ecosystem does not occur, the ability to rebuild stocks of larger, more commercially valuable species may be severely impaired.

2-5 Fisheries Production

Bangladesh's total fisheries production in FY 2018/19 was 4.384 million tons. Of this, inland culture fisheries production accounted for 57% or 2.488 million tons, followed by inland captures fisheries at 28% or 1.235 million tons, marine capture artisanal fisheries at 13% or 552,000 tons, and marine capture industrial fisheries at 2% or 107,000 tons (Figure 2-7). Of Bangladesh's fish catch, 85% comes from inland waters, while only 15% is caught at sea, including by both artisanal and industrial fisheries.

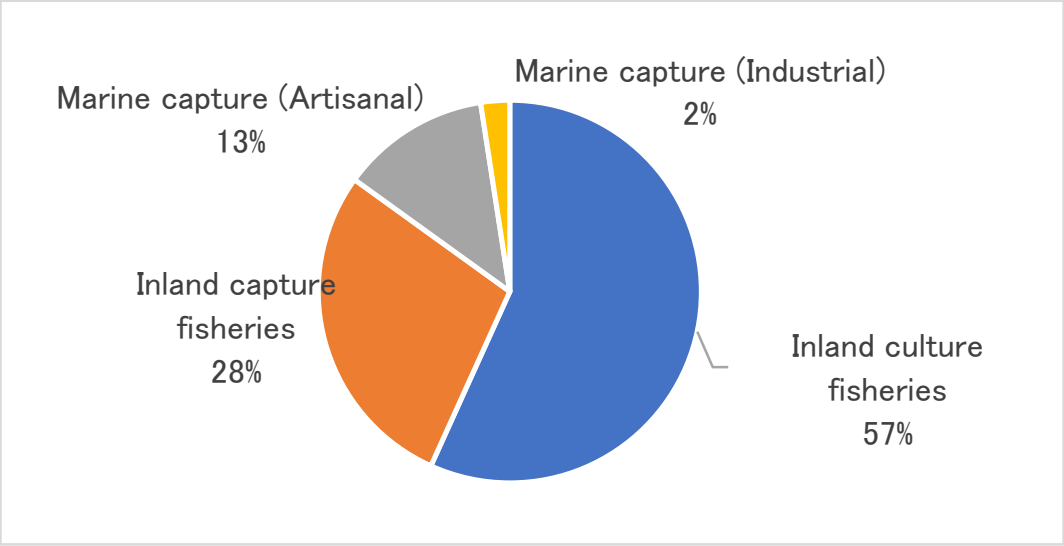


Figure 2-7 Fisheries Production Ratio by Fishery

Source: Fisheries Statistical Yearbook 2018-19

As shown in Figure 2-8 below, inland culture and inland capture fisheries have grown by 18% and 16% respectively from 2014/15 to 2017/18, while marine fisheries have only grown by 9% to 650,000 tons.[21]

[21] Statistical Yearbook Bangladesh 2019, BBS, May 2020

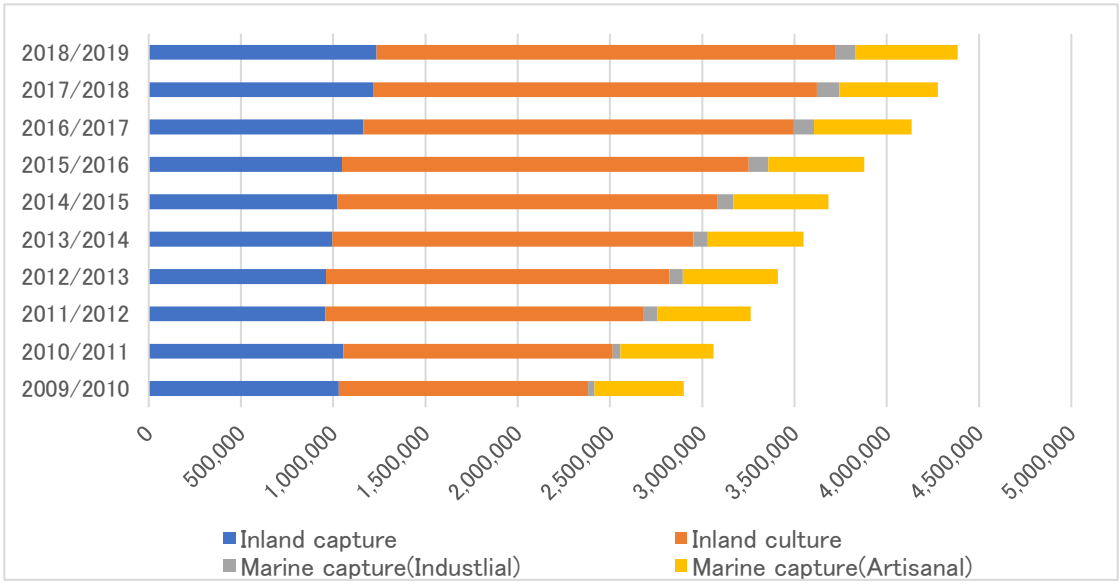


Figure 2-8 Annual Fish Production Trends by Fishery

Source: Statistical Yearbook Bangladesh 2020

2-6 Characteristics of Fisheries by District

As shown in Figure 2-9, marine capture fisheries are active in areas (7) Chattogram and (4) Barishal, which are adjacent to the Bay of Bengal, but inland water fishery is also conducted in both districts. Meanwhile, in the inland districts, inland water fisheries are active, with (2) Mymensingh using inland capture fisheries and inland culture fisheries, (3) Khulna using inland culture shrimp/prawn farms, and (6) Rajshahi and (8) Sylhet using inland water fisheries as their main form of fishery.

District	Area	Type of fishery
②Mymensingh	Kishoreganj	Inland culture and capture
	Mymensingh	Inland culture and capture
	Netrokona	Inland culture and capture
③Khulna	Khulna	Inland culture Shrimp & Prawn farm
	Jessore	Inland culture Shrimp & Prawn farm
④Barishal	Bhola	Marine capture and Inland capture River
	Barguna	Marine capture and Inland capture River
⑥Rajshahi	Natore	Inland capture Beel
⑦Chattogram	Cox's bazar	Marine capture
	Chattogram	Marine capture
	Chandpur	Inland capture River
	Daudkandi	Inland capture Flood
	Kaptai lake	Inland culture
⑧Sylhet	Sunamganj	Inland capture Haor

Figure 2-9 Characteristics of Regional Fisheries by District

Source: Present Scenario of Landing and Distribution of Fish in Bangladesh（2013）

The number of major landing sites and fish markets in each district is shown in Table 2-7. Dhaka, Mymensingh, Barishal, and Chattogram are the four districts with the largest number of landing sites and fish markets, with Dhaka having the largest number of fish markets, by far.

Table 2-7 Number of Landing Sites and Fish Markets by District

District	Number of landing site	Number of fish market
①Dhaka / ②Mymensingh	50	2099
③Kuluna	12	465
④Barishal	65	267
⑤Rangpur	2	496
⑥Rajshahi	16	969
⑦Chattogram	76	809
⑧Sylhet	16	335
Total	237	5440

Source: Present Scenario of Landing and Distribution of Fish in Bangladesh, Rahman et al

(1) Inland capture fisheries

Catch statistics for inland capture fisheries are categorized into rivers and estuaries, Sundarbans (World's largest mangrove forest facing the Bay of Bengal), beels (lake-like wetland), Kaptai Lake (an artificial lake for hydropower generation with a total area of 12,866 km^2 in the southeastern Chattogram hills of Bangladesh), and floodplain. Of the 1.235 million tons of inland capture fisheries production in 2018/19, floodplains accounted for 781,000 tons or 63%, followed by rivers and estuaries with 26% or 325,000 tons, and beels with 8% or 99,000 tons (Figure 2-10).

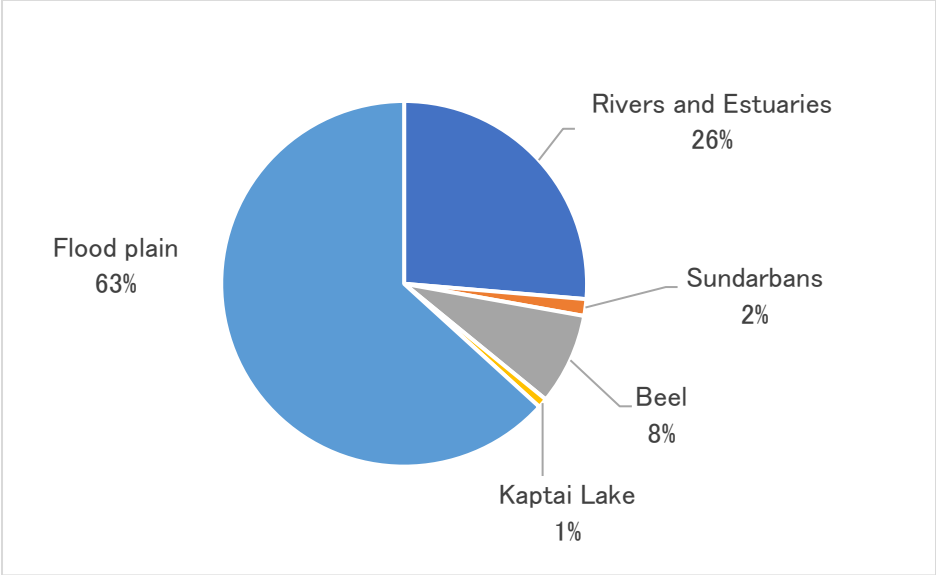


Figure 2-10 Fish Production Ratio of Inland Capture Fisheries by Fishing Ground

Source: Statistical Yearbook Bangladesh 2020

The trend of inland water fisheries production (Figure 2-11 below) shows overall moderate growth, with production increasing 2.62-fold in 25 years, from 471,000 tons in 1983/84 to 1.235 million tons in 2018/19. Of inland water fisheries, floodplain catches increased 3.9-fold, from 200,000 tons in 1983/84

to 781,000 tons in 2018/19, while rivers and estuaries have increased 2.3-fold, from 207,000 tons to 325,000, acting as the driving force behind the growth of inland capture fisheries. In particular, rivers and estuaries have shown a significant growth of 186% over the 25 years, from 1983/84 to 2018/19, compared to 107% for floodplains.[22] However, due to the deterioration of the natural environment for freshwater fish growth[23] caused by river sedimentation, the construction of agricultural irrigation facilities in line with the modernization of agriculture, water pollution, and the widespread use of pesticides, the growth of fish catches has declined in recent years. With the exception of 4.2% for Kaptai Lake, year-on-year growth rates for 2018/19 were weak at 1.5% for rivers and estuaries, 0.3% for Sundarbans, 0.7% for beels, 1.7% for floodplains, and 1.6% for inland water fisheries as a whole.

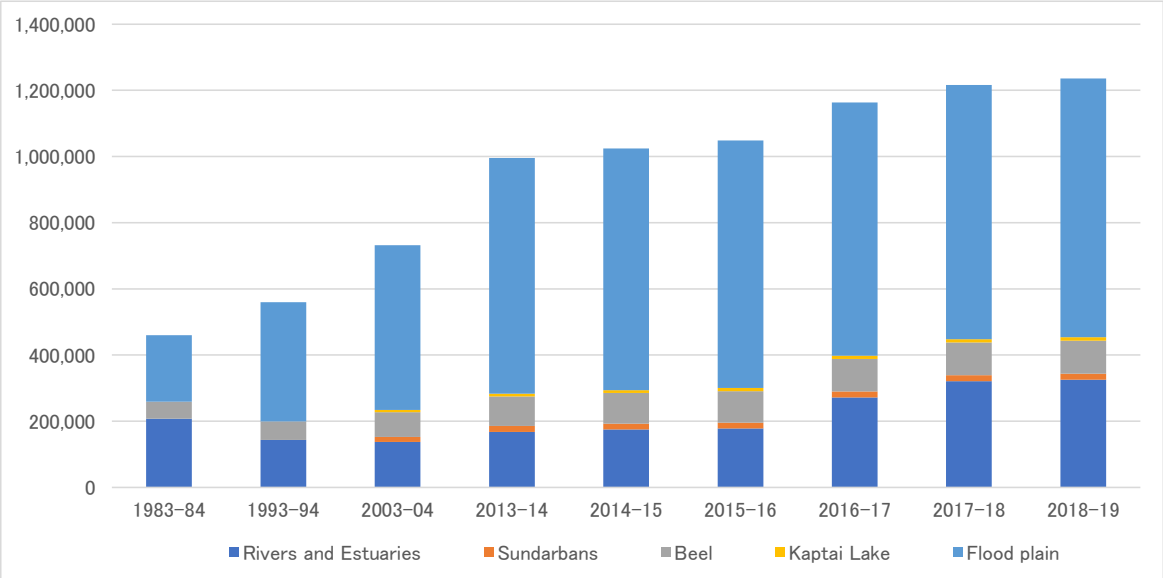


Figure 2-11 Fish Production Trends by Inland Capture Fisheries（1983-2019）

Source: Fisheries Statistics 2019

The breakdown of inland water fishery types for all of Bangladesh is shown in Figure 2-12 below. The orange areas of the pie chart show the annual production of inland culture fisheries, while the light gray areas show the annual production of inland capture fisheries. Although inland culture fisheries account for approximately 33% of the total production, or 1.235 million tons, the production volume for inland capture fisheries is about twice as large, at about 2.488 million tons.

[22] Yearbook of Fisheries Statistics of Bangladesh 2018-19

[23] BDP 2100

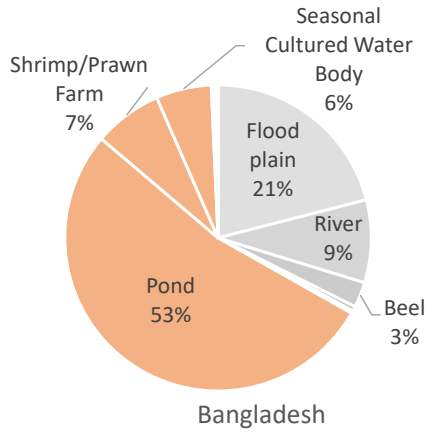


Figure 2-12 Breakdown of the types of Inland Water Fishery in Bangladesh

The breakdown of the types of the inland water fishery by distinct is shown in Figure 2-13 below. The orange areas of the pie chart show the inland culture fishery and the light gray areas show the inland capture fishery.

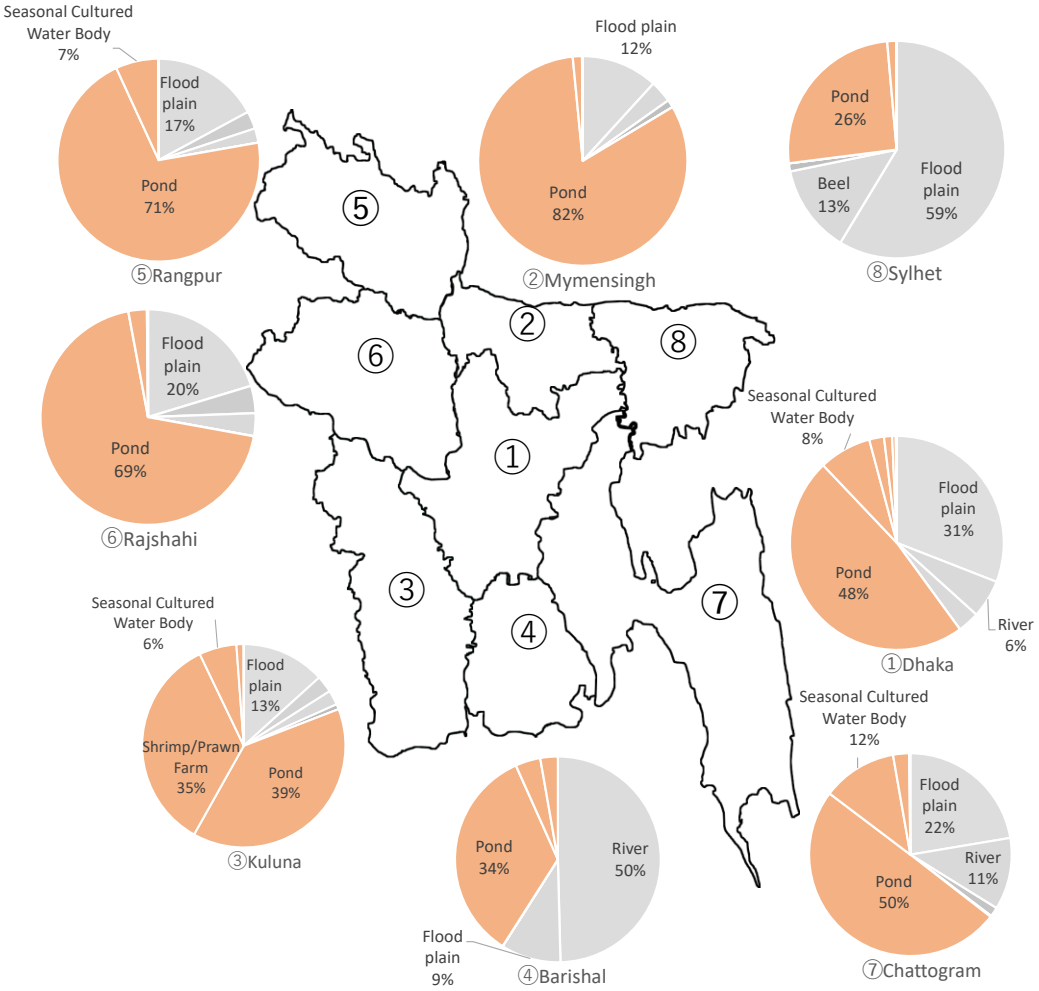


Figure 2-13 Breakdown of Inland Capture Fisheries and Inland Culture Fisheries by Districts

Source: Statistical Yearbook Bangladesh 2020

In Figure 2-13 above, the districts of (3) Khulna, (5) Rangpur, and (2) Mymensingh have a higher percentage of inland culture fisheries than other districts. In terms of the type of aquaculture, ponds constitute a high percentage in most of the districts, but only (3) Khulna has a high percentage of shrimp/prawn farms. The reason for this is that (3) Khulna is geographically blessed with bodies of saltwater, brackish water, and freshwater, as well as an abundance of mangrove forests, and has developed as cultivation site for both saltwater and freshwater shrimp. In terms of shrimp/prawn farming in Bangladesh, (3) Khulna accounts for 80.44% of the total production, followed by (7) Chattogram with 17.23%.

On the other hand, (8) Sylhet and (4) Barishal are the only districts with a high percentage of inland capture fisheries, with floodplain and river fisheries respectively accounting for high percentages. However, considering the fact that inland aquaculture accounts for almost 70% of the total inland fishery production, it is not that Sylhet and Barishal have grown their inland capture fisheries, but instead, aforementioned trend appears as a result of their lack of development of inland aquaculture. One reason for this is that in Barisal, saltwater infiltration from rivers makes it unsuitable for freshwater aquaculture.

In the breakdown of inland fisheries production by species, Carp, Pangasius, and Tilapia are the major species, accounting for 1.47 million tons (approx. 39%), 460,000 tons (approx. 12.3%), and 390,000 tons (approx. 10.5%), respectively. Table 2-8 below shows a breakdown of the production of inland fisheries by species.

Table 2-8 Fish Production of Inland Fisheries by Species

Fish species	Fish Production (ton/year)	%
Major Carp	875,624	23.5%
Exotic Carp	476,762	12.8%
Pangas	458,307	12.3%
Tilapia	390,559	10.5%
Hilsa	242,479	6.5%
Shrimp/Prawn	197,106	5.3%
Live fish	152,242	4.1%
Other Carp	116,130	3.1%
Sarpunti	95,649	2.6%
Snake head	75,147	2.0%
Other Cat fish	69,636	1.9%
Crab	12,084	0.3%
Other inland fish	562,585	15.1%
Total	3,724,310	100%

Source: Statistical Yearbook Bangladesh 2020

(2) Inland culture fisheries

Inland culture fisheries production is categorized into ponds, seasonal cultured water bodies, baors, shrimp/prawn farms, crab farms, and pen/cage culture. Of the 2.488 million tons of aquaculture production in 2018/19, ponds strongly held the top position with 79%, followed by shrimp/prawn farms with 10%, and seasonal cultured water bodies with 9%. Although pen/cage culture production, which has been growing in recent years, has surpassed that of baors, it still accounts for only about 1% of aquaculture production at 12,000 tons (Figure 2-14 below).

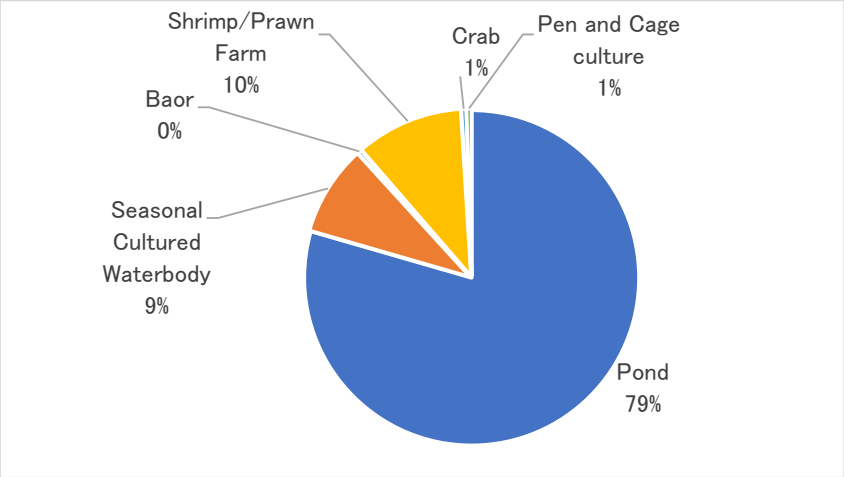


Figure 2-14 Ratio of Fish Production by Inland Culture Fisheries by Water Body

Source: Statistical Yearbook Bangladesh 2020

As shown in Figure 2-15 below, inland culture fisheries production, which had grown at a high rate of 214% over the 11-year period from 2003/2004 to 2013/14, has slowed in recent years due to increasing salinity in inland waters caused by decreasing river flows, insufficient feed supplies, and difficulty in securing suitable areas for aquaculture, as well as juvenile fish with good bloodstock.

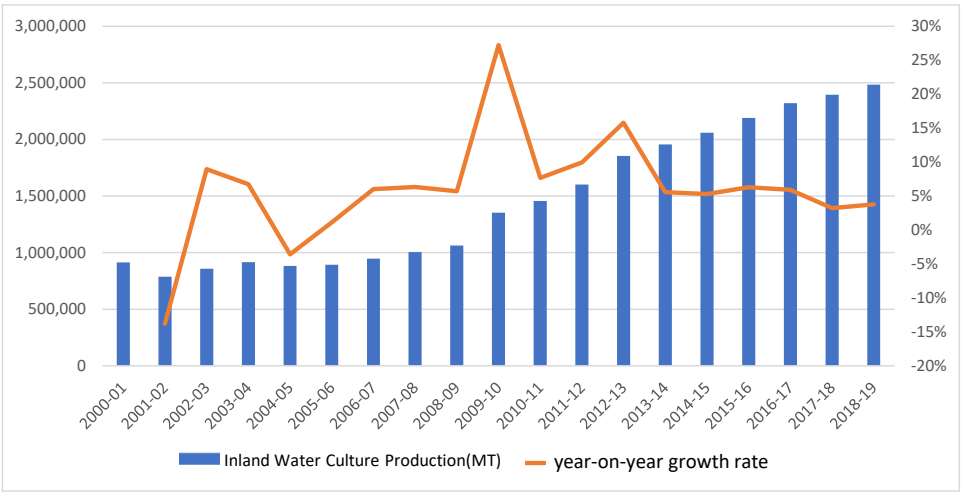


Figure 2-15 Trends in Inland Water Culture Production and Growth Rates (2000-2018)

Source: Statistical Yearbook Bangladesh 2020

Since 2015/16, the year-on-year growth rate of inland water culture production has been steadily declining, with a growth rate of 3.9% in ponds, 1.4% in shrimp/prawn farms, 0.5% in seasonal cultured water bodies, and 3.8% for inland culture as a whole in 2018/19 (Figure 2-16).

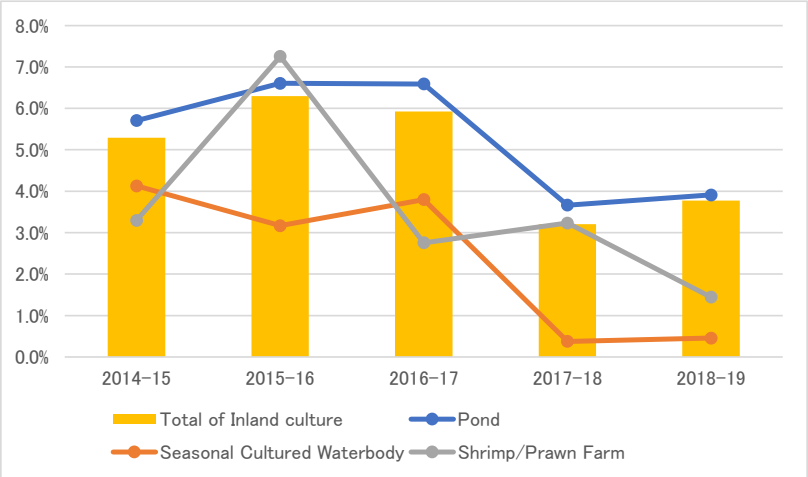


Figure 2-16 Trends of Fish Production in the Year-On-Year Growth Rate by Inland Culture Fisheries

Source: Statistical Yearbook Bangladesh 2020

The productivity of inland water fisheries is shown in the following table. The productivity of inland water culture is higher than that of inland capture fisheries, with the highest productivity of 4,946 kg/ha in ponds. Because most inland water culture is extensive, productivity is low overall. Intensive pond culture has a high level of production (8.92 tons/ha), but accounts for only about 40% of the total culture production, with the remainder being semi-intensive (3.57 tons/ha) or extensive culture (1.3 tons/ha).[24]

Regarding the evaluation of the productivity of inland water culture fishery as a whole, in India, the second largest aquaculture production country in the world, it is about 3.60 ton / ha[25] while in Bangladesh[26], it is about 3.02 ton / ha and the productivity remains still low.

Table 2-9 Productivity of Inland Fisheries

Inland fisheries type		Productivity	
Inland Capture	Flood plain	292	Kg/Hectare
	River	381	Kg/Hectare
	Beel	875	Kg/Hectare
	Sundarban	103	Kg/Hectare
	Kaptai lake	154	Kg/Hectare
Inland Culture	Pond	4,964	Kg/Hectare
	Shrimp/Prawn Farm	998	Kg/Hectare
	Seasonal Cultured Water Body	1,507	Kg/Hectare
	Pen Culture	1,953	Kg/Hectare
	Baor	1,824	Kg/Hectare
	Cage Culture	22	Kg/Cubric meter

Source: DoF Statistics 2020

[24] Aquaculture Sector Study Bangladesh Larive International & LightCastle Partner 2021
[25] https://dof.gov.in/inland-fisheries
[26] Statistical Yearbook Bangladesh 2020

(3) Marine fisheries

The growth of inland water fisheries and inland culture fisheries, which have driven the growth of the fisheries sector to date, is threatening to reach a plateau. Therefore, the Government of Bangladesh expects marine fisheries to be the next source of growth as it has the greatest development potential,[27] and has made protection, conservation, and securing diversity in coastal marine resources a top priority.

The breakdown of fish species in marine fisheries production (Table 2-10 below) shows that Hilsa is the most abundant, accounting for about 43.5% (284,000 tons) of the total, followed by Bombay duck, Shrimp, Sardine, and Jew fish.

Table 2-10 Fish Production of Marine Fisheries by Species

	Name of Fish	Fish production volume (ton/year)	%
1	Hilsa	284,500	43.5%
2	Bombay duck	75,085	11.5%
3	Shrimp	48,847	7.5%
4	Sardine	41,486	6.3%
5	Jewfish	35,427	5.4%
6	Pomfret	11,899	1.8%
7	Sea catfish	9,455	1.4%
8	Sharks,Skates & Rays	3,974	0.6%
9	Indian Salmon	487	0.1%
10	Other	143,527	21.9%
	Total	654,687	100.0%

Source: DoF Statistics 2018

Marine fisheries production (Table 2-11 below) showed an increasing trend until around 2013, but that increase has since slowed, with a production volume of about 650,000 tons annually in recent years. Looking at the breakdown of industrial fisheries and artisanal fisheries, the production of artisanal fisheries accounts for more than 80% of the total, and although the percentage of industrial fisheries is low, their production volume increased 3.7-fold compared to 2003.

Table 2-11 Trends of Fish Production by Marine fisheries (Industrial and Artisanal) (1983-2018)

Year	Industrial fisheries(ton)		Artisanal fisheries(ton)		Total(ton)
1983-84	14,500	8.1%	164,882	91.9%	179,382
1993-94	12,454	4.7%	253,044	95.3%	265,498
2003-04	32,606	7.2%	422,601	92.8%	455,207
2013-14	76,885	12.9%	518,500	87.1%	595,385
2015-16	105,348	16.8%	521,180	83.2%	626,528
2016-17	108,479	17.0%	528,997	83.0%	637,476
2017-18	120,087	18.3%	534,600	81.7%	654,687

Source : Bangladesh Industrial Marine Fisheries Management Plan(Draft) (DoF2020)

[27] World Bank op. cit.

1) Industrial fisheries

In Bangladesh, commercial trawling began in 1972. It is said that BFDC started bottom trawling commercially with a fleet of ten trawlers provided by the then Soviet Union. In the mid-1970s, domestic and foreign investors became interested in investing in the fishing industry in the country's waters. In addition to government-approved trawlers, trawlers from by local companies and joint ventures with the Kingdom of Thailand also began operating in Bangladeshi waters. Declared an “open industry” by the Government, trawl fishery was thus developed. However, illegal fishing by unauthorized trawlers placed a heavy burden on marine fishery resources, and the Government responded by promulgating the Marine Fisheries Ordinance[28] and Marine Fisheries Rules[29] to protect these marine resources. In 1985, the total number of trawlers authorized by the Government was 73[30], but now 235 industrial trawlers are known to be in operation (Table 2-12), with mid-water trawlers, demersal trawlers, shrimp trawlers, and trawlers on trial trips being the most common types of boats, in that order.

Table 2-12 Number of Marine Fisheries (Industrial) Fishing Boats

Trawler Type	Active	Inactive	Total
Shrimp trawler	35	2	37
Fish trawler(demersal)	49	10	59
Fish trawler(mid-water)	122	0	122
On trial trip(demersal)	29	10	39
Total	235	22	257

Source: Bangladesh Industrial Marine Fisheries Management Plan(Draft)(DoF2020)

Changes in catch per unit effort (CPUE) of industrial fisheries are shown in the following figure. The CPUE for shrimp trawlers has remained almost unchanged since 2010-2011, while fish trawlers and mid-water trawlers have decreased since 2012-2013, partly due to an increase in the number of industrial fishing vessels.

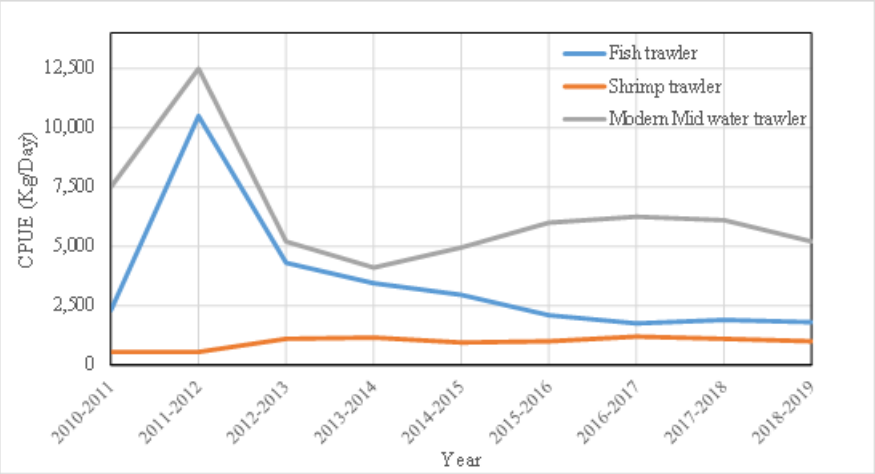


Figure 2-17 Changes in CPUE of Commercial Fisheries

Source: Bangladesh Industrial Marine Fisheries Management Plan(Draft) (DoF2020)

[28] The Marine Fisheries Ordinance 1983

[29] The Marine Fisheries Rules 1983

[30] THE IMPACT OF SHRIMP TRAWLING FISHERIES ON LIVING MARINE RESOURCES OF BANGLADESH、Md. Masudur Rahman

DoF is concerned that the stock of some fish species in the Bay of Bengal, such as shrimp and Indian salmon, is declining due to over-fishing by industrial fishing vessels and will soon be irreversible. Although the catches of industrial fisheries are gradually increasing, CPUE is gradually decreasing, and the species composition is shifting from large fish to small fish such as Sardines. In the breakdown of species caught by industrial fisheries (Table 2-13 below), Sardine is the most prevalent, accounting for approximately 34% of the total, followed by Hilsa at 9.2% and Bombay duck at 5.0%, with these three species accounting for about half of the total catch.

DoF has drafted a marine industrial fisheries management plan that with pillars for reducing the power of industrial fishing vessels, improving monitoring and control systems, strengthening fisheries management, preventing conflicts with artisanal fisheries, eradicating destructive gear fishing methods, maintaining scientific catch data, and preventing deterioration in the quality and loss of value of catches. Legislation for this plan is currently under consideration.

Table 2-13 Target Species by Marine Fisheries (Industrial) Fishing Boats

	(Ton/year)	%
Saridine	40,936	34.1%
Hilsa	11,060	9.2%
Bombay duck	6,050	5.0%
Jewfish	3,862	3.2%
Shrimp	3,682	3.1%
Catfish	2,735	2.3%
Pomfret	849	0.7%
Sharks,Skates,Rays	549	0.5%
Other Marine Fish	50,364	41.9%
Total	120,087	100.0%

Source: Bangladesh Industrial Marine Fisheries Management Plan(Draft) (DoF2020)

2) Artisanal fisheries

In the estuarine and coastal areas of Bangladesh, traditional fishing boats had been used until the mid-1960s, when two organizations, the Bangladesh Fisheries Development Corporation (BFDC) and Bangladesh Jatio Matshyajibi Samabay Samity (BJMSS), imported and introduced marine engines, thereby advancing the mechanization of fishing boats. According to a survey conducted by DoF in 1984-85, a total of 17,331 artisanal fishing boats were confirmed, including both non-mechanized and mechanized boats. Of these, 3,317 were mechanized boats and the remaining 14,014 were considered to be non-mechanized boats. However, according to a 2017-18 survey, about half of the 67,669 artisanal fishing boats in Bangladesh were found to be mechanized boats.[31] There are three types of traditional fishing boats (non-mechanized boats): “Dingi" (6-7 m long), “Chandi” (10-15 m long), and “Balam” (10-20 m long). They are propelled by oars or sails and operate mainly with estuarine set bag nets and gill

[31] Bangladesh National Report to the Scientific Committee of the Indian Ocean Tuna Commission, 2018, DoF

nets. Most of the mechanized fishing boats are 7-8 gross tons, powered by 9-33 horsepower engines, with crews of 6-10 people, operating with drift gillnets, marine set bag nets, and longlines.

In the artisanal fisheries, Hilsa make up most of the catch at 44%, followed by Bombay duck (10%), Shrimp (7%) and Sardines (4%) (Figure 2-18 below).

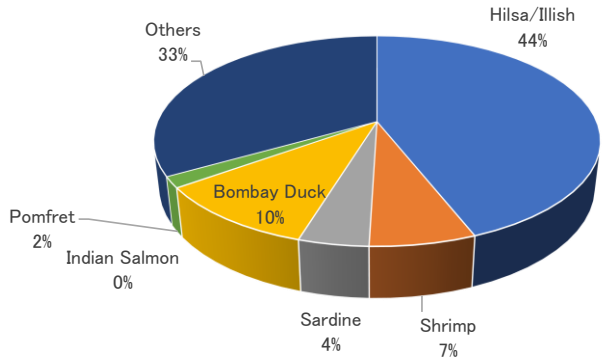


Figure 2-18 Fish Production Ratio of Marine Fisheries (Artisanal) by Species
Source: YEARBOOK OF FISHERIES STATISTICS OF BANGLADESH 2019-20

There are five types of gill nets (drift gill net, fixed gill net, large mesh gill net, bottom gill net, and mullet gill net) and two types of set bag nets (estuarine set bag net (ESBN) and marine set bag net (MSBN)). Many other types of nets are used at the coast and estuaries, including trammel nets, bottom trawl nets, and beach seine nets.

Among artisanal fishing boats, gill nets boats are used the most, accounting for 55%, followed by set bags net boats (31%) and longline boats (5%), with these three types of fishing boats accounting for 91% (Figure 2-19).

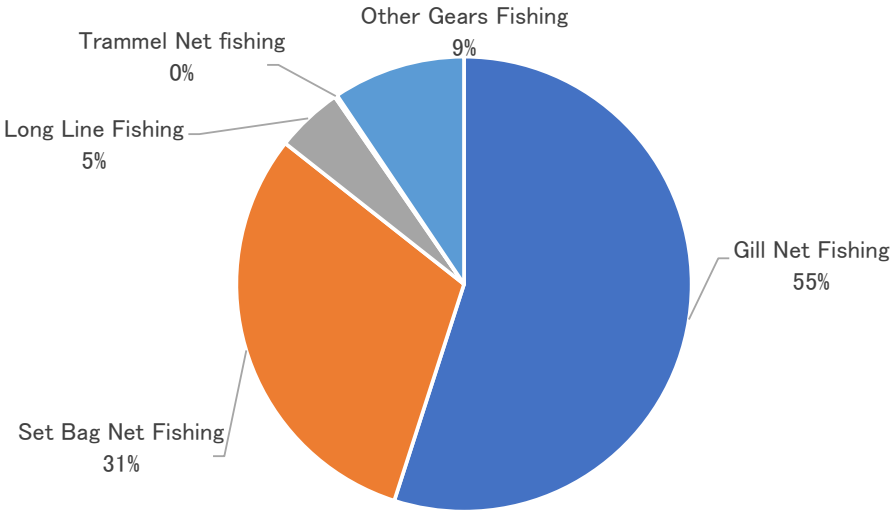


Figure 2-19 Fishing Boats Ratio of Marine Fisheries (Artisanal) by Fishing Gear
Source: YEARBOOK OF FISHERIES STATISTICS OF BANGLADESH 2019-20

Similar to a bottom trawling net, an estuarine set bag net (ESBN) has a conical net fixed to the bottom of the net, which consists of four panels. It has a mesh size of 20-140 mm at the mouth, 5-22 mm at the cod end, a length of 8.5-41 m, and an opening of 2-7 m. The nets are mainly operated by non-mechanized boats in estuaries with water depths of 3-10 m.

Marine set bag nets (MSBN) have the same structure as ESBN and are similar in operation, but with a slightly larger mesh size. The length of the net is 10-40 m, with a mesh size of 12-25 mm at the cod end, and it is operated in the dry season in sea waters 10-30 m deep.

A beach seine net (BS) is an encircling net that is operated in shallow water from the beach and is used along the coast, especially in the area from Teknaf to Cox's Bazar.

For gill nets (GN), drift gillnets are used. The average mesh size is 90 mm, and are used in water depths ranging from 15 to 40 m. The main catch is Hilsa, accounting for 49% of the total catch of marine products. In contrast, the average mesh size of large mesh gill nets is 200 mm, and they are used at depths ranging from 15 to 40 m. The target species for their catch is Indian salmon, with Grunter, Shark, Tuna, and Mackerel also caught as bycatch.

Trammel nets are used to target penaeid shrimp drifting on the seabed. The introduction of these nets is relatively new and its use is concentrated along the coasts of Cox's Bazar and Teknaf. The mesh size of these nets is 40-45 mm.

Bottom trawl nets are used at depths of 20-30 m and at a distance of least 20 km from the coastline.

Looking at the catch volumes by fishing gear, gill nets are used to catch Hilsa and other fish, while bag nets are used to catch fish and shrimp (Figure 2-20).

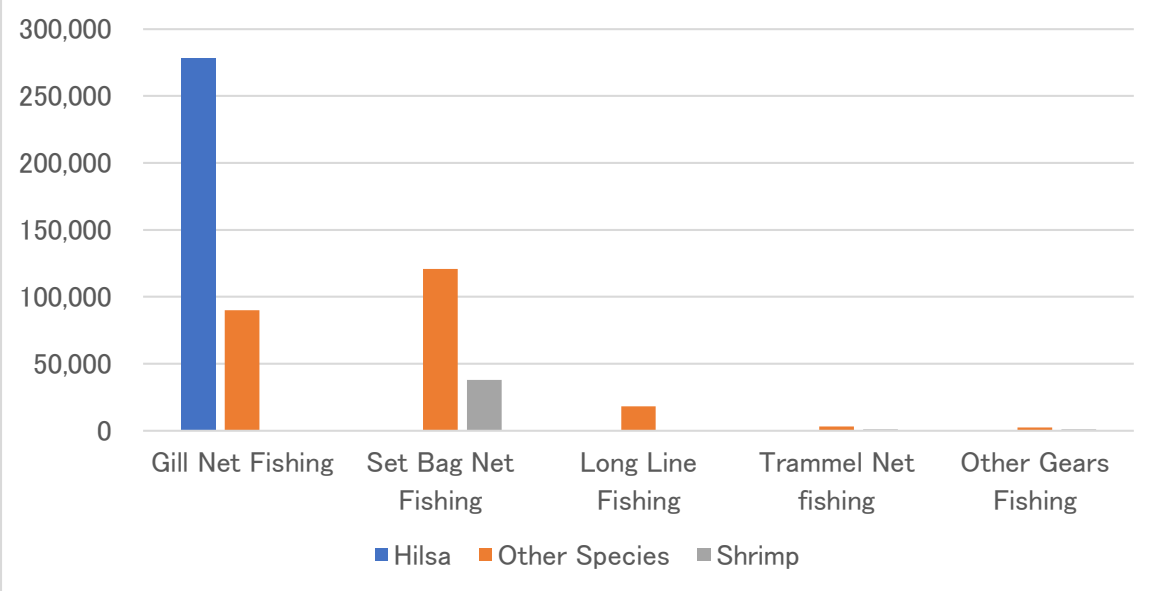


Figure 2-20 Fish Production of Marine Fisheries (Artisanal) by Fishing Gear（MT）

Source: YEARBOOK OF FISHERIES STATISTICS OF BANGLADESH 2019-20

(4) Preferences in fish consumption

In terms of fish consumption trends in Bangladesh, in the coastal areas south of Chattogram, there are few inland water bodies, so they depend on the supply of marine fish. Inexpensive dried or fresh small marine fish are widely available to coastal consumers with low incomes. These fresh small fish are ground and cooked with vegetables, while these dried small fish are chopped and eaten as soup. Many of the more expensive marine fish are distributed to out-of-region. In contrast, people in inland areas tended to prefer freshwater fish, mainly because their supply was limited to such, and it was culturally rooted in their daily lives. However, in recent years, expensive marine fish such as Pomfret, Sea bass, Grouper have penetrated the high-income inland areas. Low-income people in inland areas are also consuming frozen small fish caught by industrial fisheries, and dried small marine fish such as anchovies that distribute inexpensive. As a result, the demand for marine fish is increasing throughout the country. Meanwhile, Hilsa is widely enjoyed in both inland and coastal areas, and is so culturally important that it is considered a national fish. It has a high demand in both freshwater and marine production.

2-7 Fisheries Distribution and Post-harvest Loss

As shown in Figure 2-21 below, according to the categorized percentages of fisheries distribution in Bangladesh, fresh fish distribution accounts for approximately 60%, but a large proportion of catches are processed after unloading. Of the processed fisheries, dried fish, and otherwise processed fisheries (salted, fermented, etc.) account for approximately 30% of all fisheries.

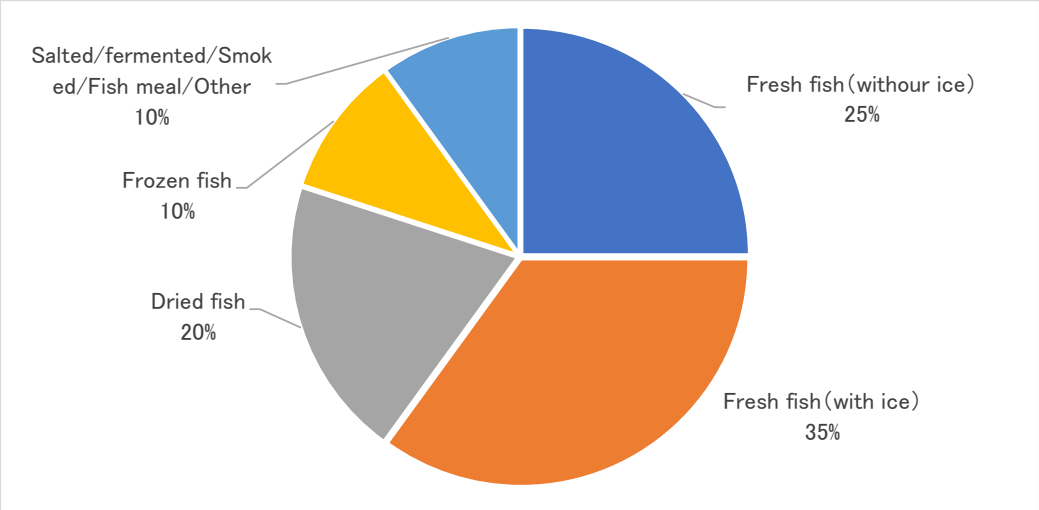


Figure 2-21 Fisheries Distribution in Bangladesh
Source: Post-harvest Loss Reduction in Fisheries in Bangladesh: A way Forward to Food Security

2-7-1 Distribution Channels for Fresh Fish

Fishing boats do not have enough space in the hold to haul fish there, so smaller boats will keep ice boxes or simple fish containers on deck, however traditional non-powered boats do not keep ice boxes

or ice on hand. Large fishing boats (10-ton scale) will stay out to sea for about 7 days, and small fishing boats (0.5 to 2-ton scale) for about 2 to 4 days. With insufficient ice supplies, the ice in the hold is mostly melted by the time the boats come to the landing site, and the landed fish are often warmer than 10°C. In addition, improper handling of the fish makes the catches spoil even faster. Fishing boats will moor 15-20 m offshore, and then the fish will be hauled out of the hold in bamboo baskets and tossed down into baskets with two carriers waiting in the waters on the starboard side of the boat. As the fish carriers take the catch to shore, it gets dragged through seawater and is finally landed on bamboo mats on the shore. From there, the carriers tie two bamboo baskets on either end of a bamboo rod and haul them on their shoulders to the wholesale market or processing plant[32].

Other than the BFDC Ghat, none of the other coastal landing sites are well equipped. Most of the landing sites have no facilities. Catches are sorted and collected on the beach, with the fresh fish handled in poor, non-sanitary environments.

Fisheries are usually packaged on ice in bamboo baskets or crude linen, packed in polyethylene sheets or vegetable fiber mats and nets, and loaded onto a truck bed, freight train, or the trunk of customer vehicles with little insulation, then transported for 1-2 days. As all the ice melts during transport, more ice should be added during transport but normally is not[33].

Figure 2-22 below shows the rate of ice usage during distribution of fresh fish by species.

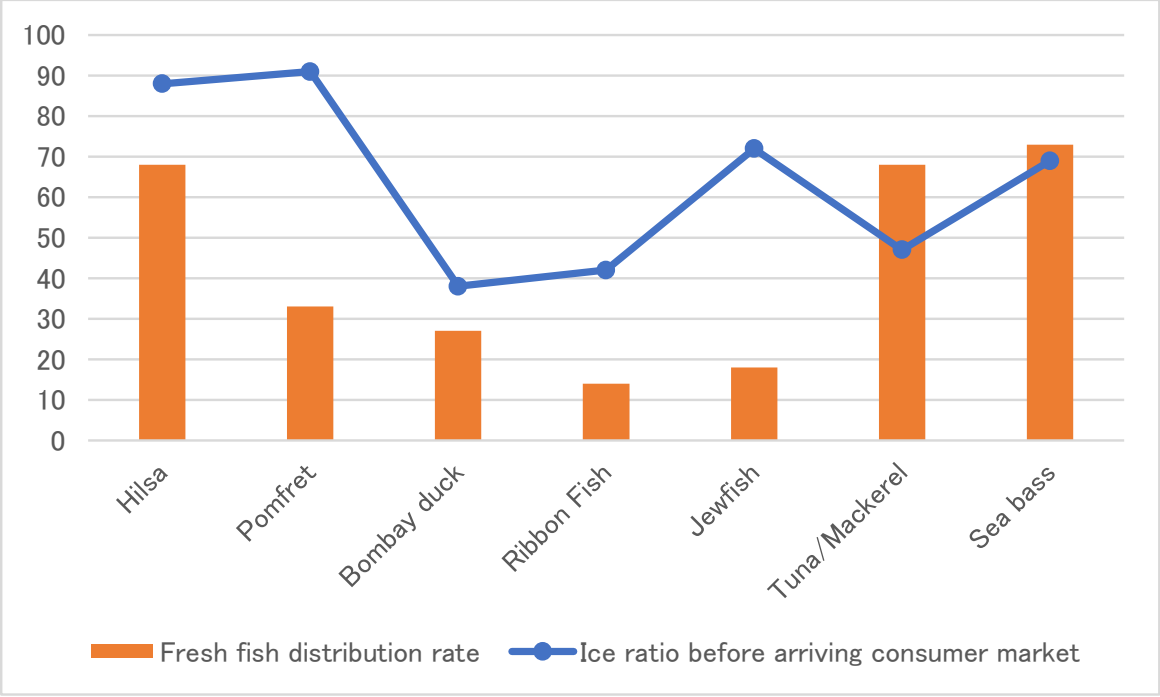


Figure 2-22 Rate of Ice Usage during Distribution of Fresh Fish by Species

Source: Post-harvest Loss Reduction in Fisheries in Bangladesh, Nowsad, 2014

[32] Nowsad, op. cit.

[33] Same as above

2-7-2 Distribution Patterns and Ice Usage

Insufficient ice making capacity and trouble in distributing ice to remote fishing villages have resulted in a chronic shortage of ice, which is one factor keeping fishers unaware of the importance of keeping their catches fresh. The further worsened quality of fresh fish due to shortage in ice production is a major issue in fish product distribution.

After being unloaded, 60% of fish are transported fresh, 20% is dried, 10% is frozen, and the remaining 10% is salted, fermented, smoked, used for fish meal, or otherwise processed. Although fresh fish distribution takes precedence, 25% of catches are distributed fresh without ice. Ice usage is quite low with only 35% of catches distributed fresh on ice.

Among the fish categories, a high proportion of Hilsa, Seabass, and Tuna are distributed fresh, whereas Bombay duck, Ribbon fish, and Jewfish are mostly processed. Although the amounts of ice used for cooling are insufficient, ice is at least used until arrival at retail market for most Hilsa, Seabass, Tuna, and Shrimp, which sell at higher prices.

Fresh fish is packed in various container types during transport. When transported from local wholesale market to distant major distribution sites, fresh fish is either packed in polyethylene bags on the conventionally used bamboo baskets and loaded on trucks or, in some cases, in bamboo baskets surrounded with bamboo support rods to reinforce and expand capacity of the baskets. Other packing methods include placing the fresh fish in resin or styrofoam containers. The packing method used depends on the type of fish, although higher-priced fish tend to be shipped in styrofoam containers as they protect fresh fish from damage in shipping. In contrast, lower-priced fish tend to be shipped in bamboo baskets and sustain more damage in shipping than higher-end fish. Ice usage during transport also differs by fish type. Shrimp and fresh Hilsa tend be put on ice more than lower-priced fish.

A diagram of the standard fresh fish distribution channels is shown in Figure 2-23 below. After being bought by fish traders at landing sites, unloaded catches are traded at wholesale markets and both distributed to local retail markets and shipped to major retail markets. Some is also exported. Fish distributed to major retail markets is resold at distant wholesale markets in the major market for distribution to retail markets. Distribution channels and destinations will differ by fish category.

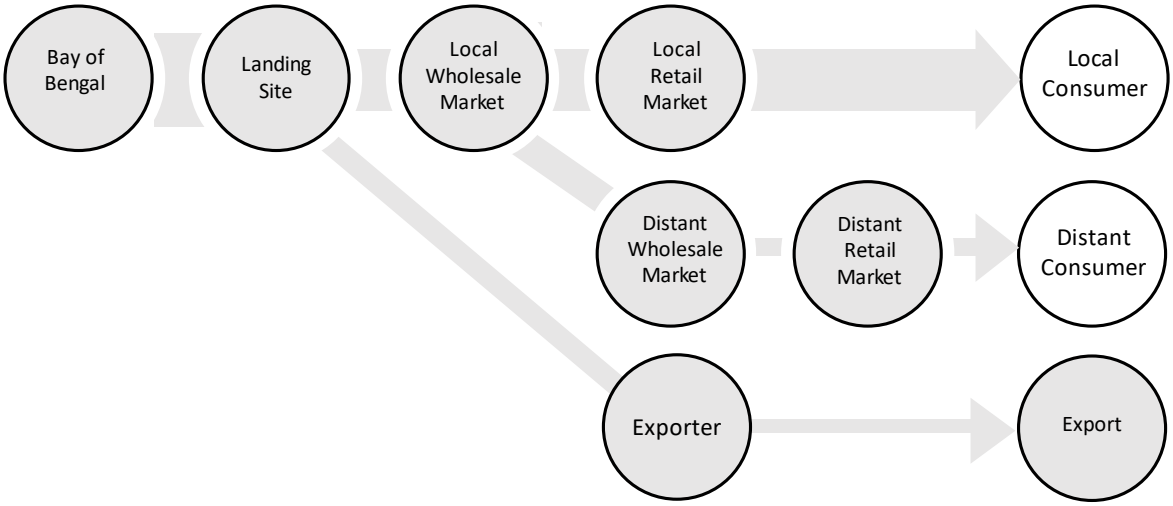


Figure 2-23 Outline of Fish Distribution Channel of Fish Catch by Marine Fisheries

Source: Survey Result

Various studies have been conducted on the quality loss of fresh fish during the stages of distribution.

In the past documentation and other sources, the widely used method of qualitative evaluation for quality loss of fisheries during distribution is to calculate post-harvest loss. This method involves setting a freshness score to comprehensively quantify the sensory evaluation results of fish freshness and a freshness limit for what is considered fresh fish.

The post-harvest loss rates in distribution for each fish category are shown in Table 2-14 below.

Table 2-14 Post-Harvest Loss Rates in Distribution for Fresh Fish (%)

Fish	Landing		Aratder I		Transpoter		Aratder II		Retailer		Fishe vendor	
Hilsa	2.0	±0.4	5.0	±2	-		7.0	±2	9	±2	19.0	±4
Rolu					4.0	±2	6.0	±0.4	16.0	±4	19.0	±3
Catla					3.0	±2	4.0	±3	12.0	±3	17.0	±2
Mrigel					6.0	±1	7.0	±1	11.0	±3	16.0	±2
Kakibaush					4.0	±1	8.0	±2	9.0	±2	12.0	±3
Grass Carp					3.0	±2	12.0	±3	12.0	±2	14.0	±0.5
Silver Carp					3.0	±0.1	4.0	±2	13.0	±3	15.0	±3
Tilapia					5.0	±2	11.0	±0.5	16.0	±2	13.0	±3
Pungas					-		4.0	±2	7.0	±3	10.0	±4
Bombay duck					11.0	±1	17.0	±2	19.0	±2		
Ribbon fish					20.0							
Pabda			2.0	±0.6	4.5	±2	9.5	±2	13.0	±2	-	
Bele			2.5	±0.3	5.3	±1	11.2	±2	19.0	±3	35.0	±3
Golsha					3.0	±2	8.0	±2	11.0	±2	13.0	±2
Bata					2.6	±0.6	5.4	±3	9.5	±0.8	9.0	±2
Baim					2.5	±0.3	3.5	±0.3	11.0	±2.3	16.0	±3.5
Air					3.0	±1	8.6	±0.5	10.3	±2	-	
Boal					-		4	±0.8	8.7	±2	13.0	±1
Shol					-		-		12.0	±2	17.0	±2
Kajali					2.0	±1	7	±2	13.0	±4	17.0	±4
Batashi					4.0	±1	6.5	±1	12.0	±2	14.0	±3
Mola					3.0	±1.5	7.4	±0.7	19.0	±0.3	24.0	±2
Prawn/ Shrimp					2.0	±0.3	5	±0.5	7.5	±2	9.5	±2
Rupchada			4.0	±1	6.0	±1	9.5	±2.2	19.0	±3	-	
koral					2.0	±0.4	6.5	±2	8.5	±0.5	-	
Persy							4.5	±1	7.5	±2	9.0	±1

Source: Post-harvest Loss Reduction in Fisheries in Bangladesh, Nowsad

The post-harvest loss rates progressively increase toward the end stages of distribution (to the right in Table 2-14 above). At the retailer stage, where consumers purchase fresh fish, post-harvest loss rates of 10% to 20% are observed in most fish categories. Loss rates also vary greatly between fish categories. Loss is lower in shrimp and catfish but higher in Bombay duck, Ribbon fish, Bele, and Mola. These loss rate differences between fish categories are impacted by the packaging and ice usage during the stages of distribution. Compared to lower-priced fish categories, the handling of high-end fish at distribution tends to be more controlled, including ice usage.

Many wholesale and retail markets sell fresh fish without ice, and post-harvest losses due to decreased freshness in the sales process have also been confirmed. Degradation in quality is also evident at the wholesale and retail markets themselves due to their handling fresh fish under non-hygienic conditions, including insufficient drainage in their facilities.

The stakeholders for distribution of artisanal fisheries in the target areas are as shown in Table 2-15 below. Various distribution stakeholders are involved through the stages of distribution, from landing site to consumer, and the stakeholders split the different roles up among themselves. However, the distribution channels for fresh fish are not uniform; they may differ by factors including the fish category, the transaction, or landing site. For example, local fish traders purchase fresh fish at the landing site to trade on the wholesale market, but wholesalers with the capital purchase catches from specific boatowners with preferred status.

Table 2-15 Fisheries distribution stakeholders

Distribution stakeholder	Duties
Boat owner	They own fishing boats and gears, and hire captains and crew to fish.
Captain / Majhi	Hired by Boat owner and goes fishing as the captain.
Fishermen	Hired by Boat owner to work on fishing boat.
Fishing laborer	Hired by Boat owner to assist in beaching fishing boats and pulling in fishing nets.
Auctioneer / Aratdar	Own wholesale facilities and rent them to traders or use these facilities themselves to trade in landings. They collect fees from traders and other users of the facilities.
Trader Big Transporter	Transport fish landings to distant consumption areas.
Fish bidder / Koyal	Conduct auctions at wholesale markets.
Collector / Foria	They act as intermediaries between the fishermen and the merchants and transporters at the landing sites, and earn commissions. In some cases, they buy fish themselves.
Fishermen retailer	Being a fisherman and runs his own retail business.
Local transporter / Bepari	Buy landing fish from fishermen at the landing site and sell them at the local wholesale market.
Non fisher retailer	Mainly engaged in retail.
Vendor-men	Buy fish at retail markets and sell them to consumers.
Water supplier	Sell water to fishermen and others.
Fish cutter	Cut fish at retail markets, etc.
Market cleaner	Cleaning the market.
Porter	Unloading of catches and beaching fishing boats

Distribution stakeholder	Duties
Rohingya worker	Refugees from neighboring Myanmar doing artisanal fisheries-related work.
Rohingya Fishermen	Female Refugees from neighboring Myanmar doing artisanal fisheries-related work.
Traditional fish processor	Doing traditional fish processing such as Sun drying.
Traditional fish processing worker men	Worker in a traditional fish processing yard, such as sun-drying and salting
Traditional fish processing worker women	Women worker in a traditional fish processing yard, such as sun-drying and salting
Processing plant worker-men	Worker in a processing plant with dryers and hygienic fish processing.
Processing plant worker-women	Women worker in a processing plant with dryers and hygienic fish processing.
Others Fish meal & Ngapi processing worker	Workers in processing plant for fishmeal or seasonings.

Source: Survey Team survey results

2-7-3 Distribution Channels for Processed Fish

(1) Fish processing

Dried fish is the leading category of processed fish. In addition to traditional methods of sun drying and salt preservation, some fish are dried with modern methods such as drying treatment with dryers.

Other methods include spreading the fish out to dry on drying racks and hanging the fish on drying rods. Smaller fish caught in volume are dried on racks, and larger fish are hung on rods. The dried fish reach about 30% of their original weight. The fish are rinsed with water during drying, although often the process is not hygienic enough. Also, insects can get on the fish during drying and, while officially prohibited, the use of harmful insect-repelling chemicals is reported[34]. Once dried, the products are packed and shipped. Products are warehoused for long periods until shipped. If any signs of mold or insects are found during storage, the product is left in the sun again to dry for several days.

Hilsa is the most commonly salted fish. Oxidation from the drying process will severely degrade the quality of Hilsa due to its high fat content, and so the fish is salted instead of sun dried. Caught both in the Bay of Bengal and in rivers, the Hilsa used for salted product is considered to be relatively low in value as fresh fish. There are two salting methods used: first cleaning the fish and then salting whole, or salting cuts of the fish. The first method is called dry salting and the second is called wet salting. Male Hilsa and Hilsa damaged when caught are wet salted.

Other small fisheries, such as shrimp and sardines, are ground and fermented.

Figure 2-24 below shows the regions with active fishery processing industries. In the figure, the white circles are for saltwater fish processing centers, and the red circles represent freshwater fish processing centers. Saltwater fish processing is concentrated in the Cox's Bazar area of Chattogram Division along the Bay of Bengal to its southwest, and freshwater fish are concentrated near the Mymensingh-Sylhet border.

[34] Traditional fish drying in coastal villages of Bangladesh: Practices, constraints and scope for improvements

Figure 2-24 Processing Areas (Dried fish)
Source: Preliminary rapid appraisal of dried fish value chains in Bangladesh

(2) Processed marine product distribution

How the processers get their raw fish depends on the size of business. Smaller processers buy fresh fish from fishermen at the landing sites, while larger processer have established systems to accept catches from either their own fishing boats or contracted fishing boats.

Just as with fresh fish, the plants distribute processed marine products via wholesale markets to three channels: local retail, distant retail, and exports (Figure 2-25).

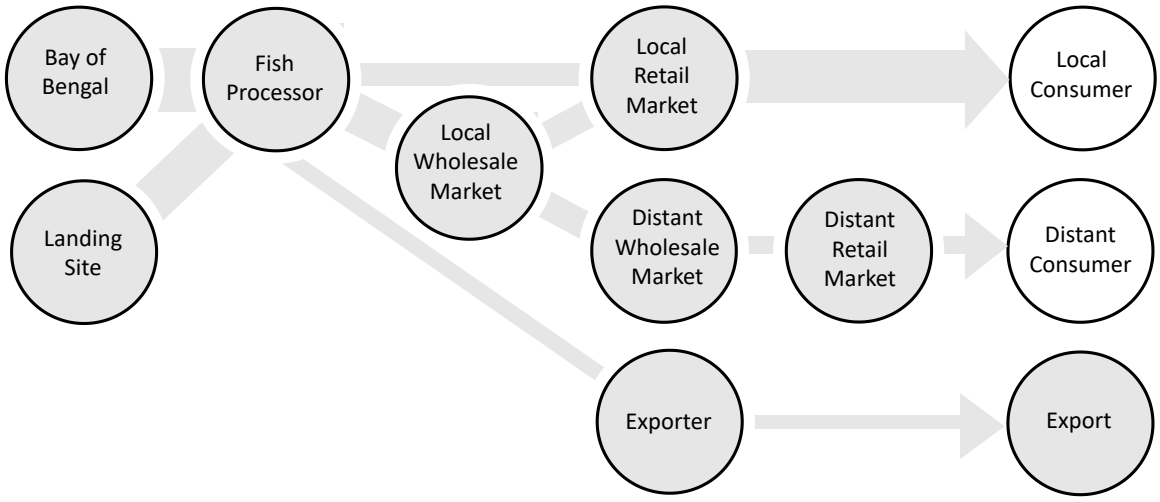


Figure 2-25 Distribution Channels for Processed Marine Products

Source: Survey Result

The post-harvest losses for processed marine products were analyzed using freshness scores at two stages: Pre-process, which covers post-harvest loss until the raw fish is processed, and in process, which covers loss from processing through distribution. The results are shown in Table 2-16. Post-harvest losses occur at each stage of marine product processing, with the loss rates for salted Hilsa standing out above

the rest. The reasons given for this are that the fish used for salted Hilsa is already less fresh when landed and unsuitable for distribution as fresh fish, and that crushed or otherwise compromised Hilsa are used for raw materials.

Table 2-16 Post-harvest Loss Rates in Marine Product Processing (%)

Process Type	Fish	Raw material	Pre process	In Process	Final Products
Sun Drying	Ribbon fish	17.3 ±1.3	18.2 ±0.8	18.8 ±1.5	22.0 ±1.6
	Bombay duck	19.6 ±1.5	22.5 ±1.6	24.5 ±2.2	25.6 ±1.8
	Pomfret	9.4 ±0.6	11.4 ±1.0	12.6 ±0.8	14.7 ±1.0
	Sea Catfish	14.0 ±0.8	16.3 ±1.7	18.2 ±1.3	19.5 ±1.5
	Mackerel	6.3 ±0.4	7.4 ±0.9	8.0 ±0.5	9.6 ±0.4
	Poa	16.8 ±1.0	21.4 ±1.9	22.0 ±0.8	24.3 ±1.2
	Anchovy	7.5 ±0.4	8.2 ±0.5	8.5 ±0.4	9.6 ±0.4
	Clupid fish	5.4 ±0.8	7.3 ±0.4	10.1 ±0.6	10.0 ±0.8
Salted	Hilsa (Dry-salting)	60.3 ±4.5	62.4 ±5.4	62 ±5.4	65.6 ±5.5
	Hilsa (Wet-salting)	60.0 ±5.6	63.0 ±5.8	63.4 ±4.4	67.0 ±5.6
Semi-fermented	Puntius	4.8 ±0.2	5.0 ±0.2	7.2 ±0.6	8.0 ±0.2
Smoked	Shrimp	5.8 ±0.5	9.0 ±0.6	10.2 ±0.6	10.0 ±0.3

Source: Post-harvest Loss Reduction in Fisheries in Bangladesh: A Way Forward to Food Security

Table 2-17 below shows the post-harvest loss rates at each stage of distribution for processed marine products. In distribution, the post-harvest loss rate for processed marine products is highest during the storage stage.

Table 2-17 Post-harvest Loss Rates for Each Stage of Processed Marine Product Distribution

Process Type	Fish	Packaging	Transportation	Storage	Selling
Sun Drying	Ribbon fish	2.4 ±0.2	1.3 ±0.4	20.2 ±1.2	5.4 ±0.5
	Bombay duck	1.6 ±0.3	1.2 ±0.3	14.5 ±1.3	6.6 ±0.6
	Pomfret	1.2 ±0.0	0.7 0.1	10.9 ±1.0	4.3 ±0.3
	Sea Catfish	1.0 ±0.2	1.2 ±0.2	12.4 ±1.0	4.9 ±0.3
	Mackerel	1.3 ±0.2	0.6 ±0.0	10.6 ±0.7	4.5 ±0.5
	Poa	2.4 ±0.0	0.7 ±0.1	15.6 ±0.8	5.6 ±0.4
	Anchovy	2.5 ±0.4	1.0 ±0.1	12.6 ±1.0	4.6 ±0.2
	Clupid fish	2.5 ±0.4	1.0 ±0.1	16.8 ±1.0	3.4 ±0.1
Salted	Hilsa (Dry-salting)	2.2 ±0.2	3.4 ±0.2	12.2 ±0.6	5.4 ±1.2
	Hilsa (Wet-salting)	-	2.5 ±0.3	2.8 ±0.1	2.3 ±0.8
Semi-fermented	Puntius	2.5 ±0.3	1.0 ±0.1	15.2 ±0.7	4.0 ±1.0
Smoked	Shrimp	2.0 ±0.3	2.3 ±0.3	18.7 ±1.4	7.9 ±1.8

Source: Post-harvest Loss Reduction in Fisheries in Bangladesh: A Way Forward to Food

2-8 Fisheries Trading

Fisheries are one of Bangladesh's top industries in terms of export revenue, with fishery exports being the second largest source of foreign currency after textile exports. Seafood exports have the highest contribution among agricultural exports, making it a critical economic sector for the nation.

As shown in the bar graph in Figure 2-26 below, seafood export values steadily climbed from 2001 to 2011 but have since stagnated. Also, since rising to 5.9% of total imports in 2004, the seafood export share has since gradually declined year over year as Bangladesh's total export volume increased, falling to 1.16% in 2019. Still, after textiles, which account for a disproportionate 86.4% of Bangladeshi national exports, seafood is the second most valuable export industry after textiles.

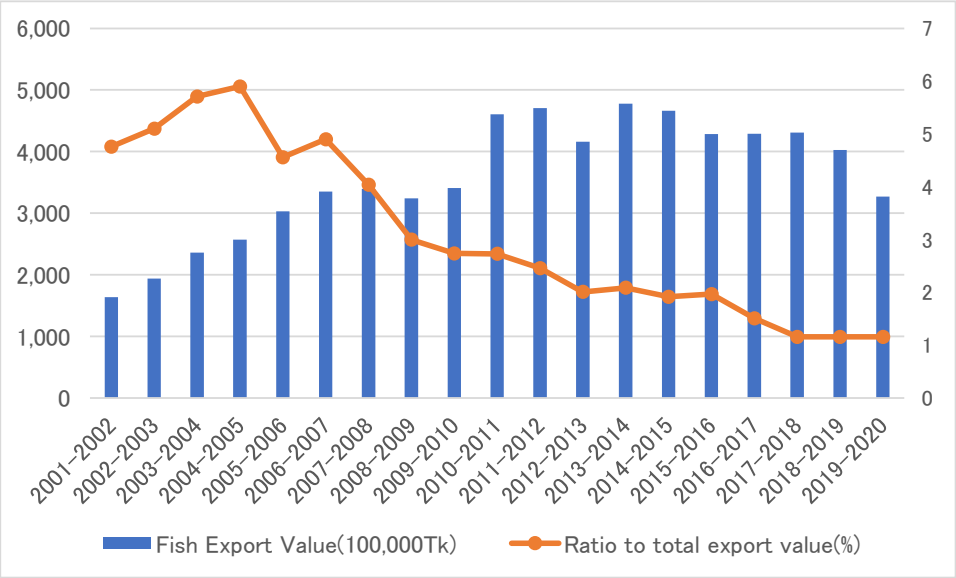


Figure 2-26 Seafood Export Share of Total Exports by Value (2001-2020)

Source: Statistical Yearbook Bangladesh 2020

Looking at the breakdown of seafood exports by value (Table 2-18), crustaceans (shrimp, etc.) were overwhelmingly highest, comprising 85.8% of exports in 2019/20, followed by frozen fish (unprocessed) at 8.8% and processed marine products at 1.6%.

Table 2-18 Export Value of Seafood Products

(Unit: 1,000BDT)

Year / Item	2016/17	2017/18	2018/19	2019/20
Fresh fish	638,287	716,486	1,472,784	957,499
Frozen fish	2,942,482	2,898,584	3,341,506	2,876,819
Fillet (Frozen/Chilled)	24,405	12,515	38,883	8,082
Salt dried/Smoked fish	590,708	706,120	560,879	533,805
Crustacean (Shrimp etc.)	40,778,882	35,093,881	34,243,904	28,050,474
Shellfish	133,582	491,305	599,136	261,733
Total	45,108,346	39,918,891	40,257,092	32,688,412

Source: Statistical Yearbook Bangladesh 2020

Looking at Figure 2-27 below, seafood exports steadily grew by volume up until 2010 but have since been in decline, with 73,171 tons caught in 2018/19. Of this total, live fish, frozen fish, and salt dried fish accounted for 37,202 tons.

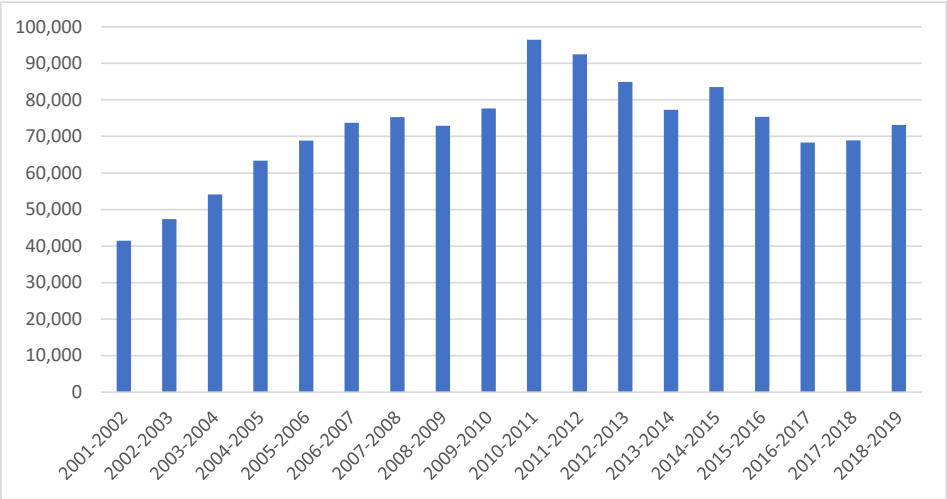


Figure 2-27 Annual Seafood Exports by Volume (MT)
Source: Yearbook of Fisheries Statistics of Bangladesh 2018-19

2-9 Fish Consumption and Nutrition

Although seafood exports do contribute to total exports by value, in proportion to the total fishery production of 4.38 million tons, seafood other than shrimp and shark fin only comprise a small fraction at 0.5% of production in fiscal 2018/19 (22,000 tons). Of the 659,000 tons of marine fisheries produced, 83.8% (553,000 tons) is landed by subsistence-fishing and 16.2% (107,000 tons) by corporate fishing. However, export volumes for seafood other than shrimp and shark fin comprise only 3.3% of total marine fisheries production, or 20.5% of corporate fishing production[35]. The majority of Bangladeshi fisheries production is for domestic consumption. Bangladesh is self-sufficient with its fishery products. Also, Bangladesh ranks as one of the world's biggest fish-eating countries, with seafood accounting for 60% of animal-based protein intake for all Bangladeshis, or 20 to 25 kg per year of seafood intake per person[36].

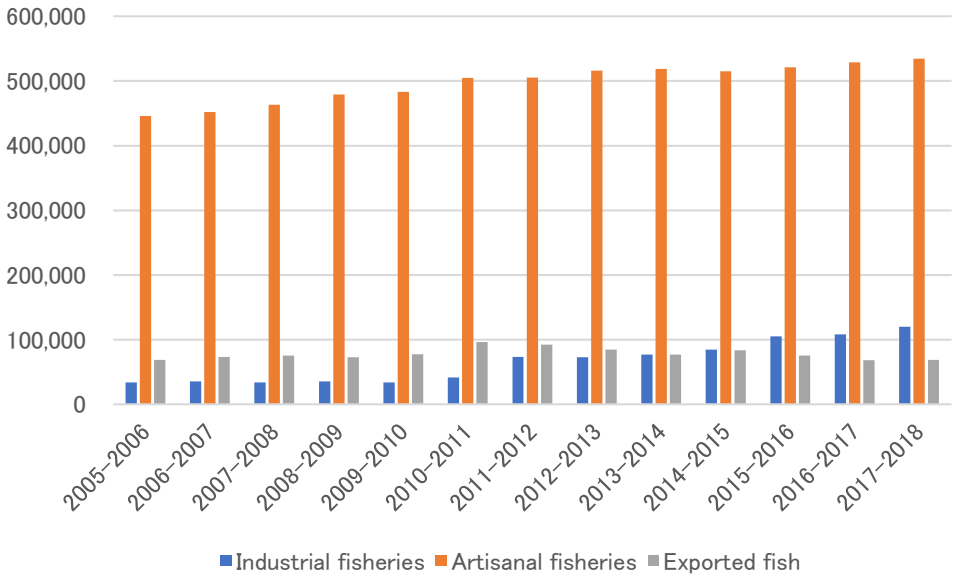


Figure 2-28 Trends of Fish Production by Marine Fisheries and Export Volume (MT)
Source: Statistical Yearbook Bangladesh 2019

[35] Statistical Yearbook Bangladesh 2019, BBS, May 2020, Yearbook of Fisheries Statistics of Bangladesh 2018-19
[36] Nowsad, Post-harvest and Trade; prevailing technology, barriers and domestic marketing scenario in Bangladesh, April 2012

According to the Household Income and Expenditure Survey (HIES) 2016[37], Bangladeshis have a penchant for fish. Bangladeshi seafood consumption is extremely high at 62.58 g/day/person, and seafood is a far more common source of protein than other sources such as chicken or beef (Figure 2-29).

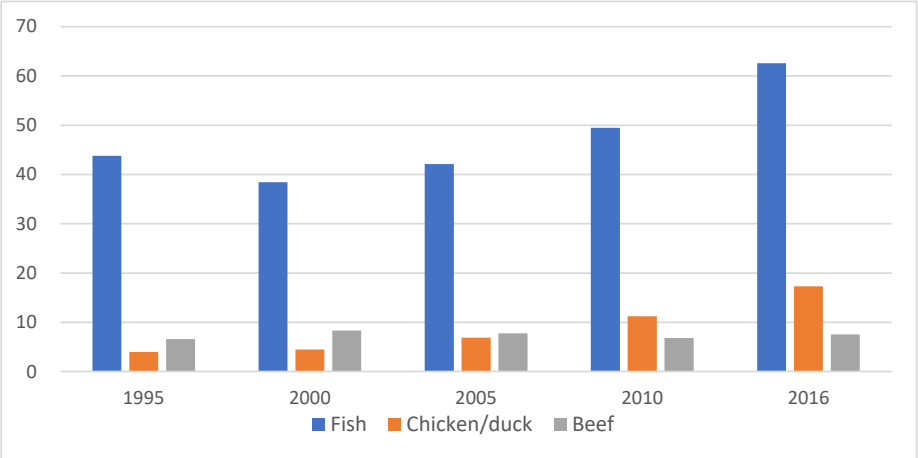


Figure 2-29 Per Capita Daily Consumption of Protein Sources (g/day/cap)

Source: Bogard et al., op. cit.

Fish is the most important food to Bangladeshis not only as an animal protein source, but also for its deep connections to their culture and lifestyles. It is also important for women and other vulnerable groups in rural villages as food high in micronutrients such as iron and vitamin A. According to household surveys conducted in villages nationwide, pregnant women, nursing women, and other related groups get more than 73% of their animal protein intake in meals from seafood products[38].

Table 2-19 Average Animal Protein Intake of Village Women (2011/2012)

	Samples	Fish (g/day/cap)	Dried fish (g/day/cap)	Meat (g/day/cap)	Chicken (g/day/cap)	Eggs (g/day/cap)	% of fish in animal protein sources
Children ages 0-2	726	7	1	1	1	6	47
Pregnant women	262	69	10	10	13	4	73
Nursing women	1,200	73	9	8	12	4	75
Child-bearing age women (ages 15-49, excluding pregnant and nursing women)	5,057	64	9	7	10	5	74

Source: Bogard et al., op. cit.

[37] Final report on Household Income and Expenditure Survey,2016, Bangladesh Bureau of Statistics (BBS)

[38] Non-farmed fish contribute to greater micronutrient intakes than farmed fish: results from an intra-household survey in rural Bangladesh, Bogard et al. 2016

In addition, breaking down the growth rates of household fish consumption from the HIES survey to compare rates for cities vs. villages and poor vs. non-poor, while fish consumption is higher in urban and non-poor areas, the growth rate is higher in villages and among the poor. This illustrates the importance of fish to the nutrition of the rural poor (Figure 2-30 and Figure 2-31).

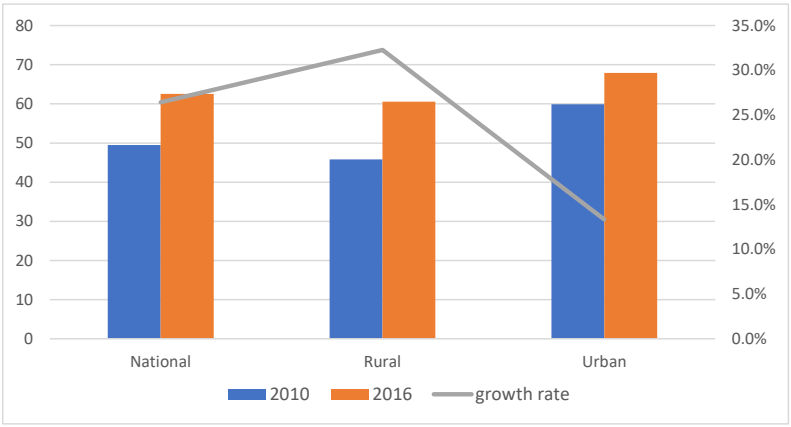


Figure 2-30 Changes in Fish Intake by Region (2010/2016)

Source: Final report on Household Income and Expenditure Survey,2016,BBS

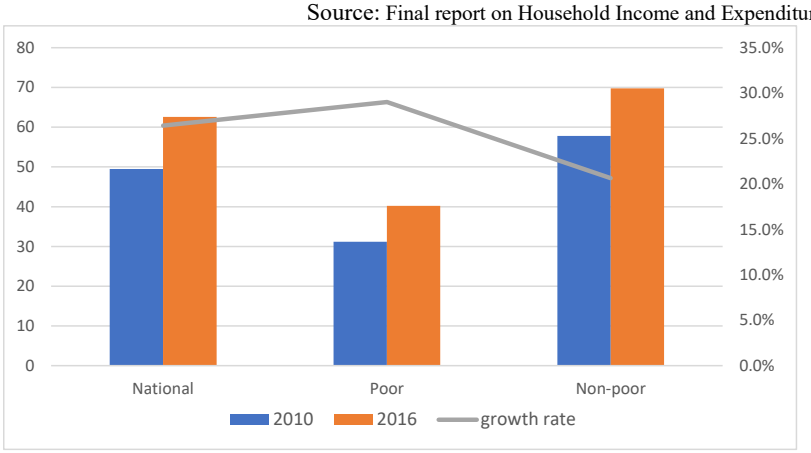


Figure 2-31 Changes in Fish Intake Between Rich and Poor (2010/2016)

Source: Final report on Household Income and Expenditure Survey,2016,BBS

2-10 Fishery Organizations and Groups

There are three fishery organizations in Bangladesh:

Bangladesh Jatio Matshyajibi Samabay Samity (BJMSS)	(Est. 1960)
Bangladesh Jatio Matshyajibi Samity (BJMS)	(Est. 1986)
Bangladesh Jatiotabadi Jele Dal (GJJD)	(Est. 1993)

BJMSS is organized under the Department of Cooperatives, with 88 federations and 4,243 cooperatives under it (as of 1992). The other two organizations were established as affiliates of other ministries and agencies and are not active at the local level. Nationwide fishery cooperative membership numbers 540,000[39]. However, in addition to fishers, the local cooperatives are ridden with fish traders

[39] Karim 2015

and wholesalers, who reportedly hold great influence over both fisheries production and cooperative activity.

The DoF has selected 22 pilot upazilas nationwide, supporting the establishment of Upazila Fisheries Producer Organizations (POs) and organizing 17,400 aquaculture producers nationwide[40].

Bangladesh Shrimp and Fish Foundation (BSFF), a public utility corporation established in 2003, is engaged in projects to improve value chains in the fishery sector, aquaculture, and shrimp industries. The Bangladesh Frozen Foods Exporters Association (BFFEA), established in 1984, serves as an industrial association for fishery processors, cold storage vendors, and exporters. The Bangladesh Marine Fisheries Association (BMFA) consists of fishing companies and exporters of shrimp and fish. At the major landing sites there are associations for fishing boat owners, including the Cox's Bazar Fishing Boat Owners Association and the Fishing Boat Operators Association.

2-11 Artisanal Fishers Socioeconomic Conditions

There are 12 million Bangladesh people is active in the fisheries and related sectors, accounting for 9% of the work force.

Traditionally, women in fishing villages have worked in the production and maintenance of fishing gear and retail sales of fresh and processed fish.

Of fishers, 44.3% do not own fishing boats, and 30% do not even own their own fishing gear. The fishers work on fishing boats owned by moneylenders and engage in fishing[41].

In general, fishers have a high overall illiteracy rate at 37% and average a household size of 6 members, which is higher than the national average of 4.6 members.

Fishing community residents generally live below the poverty level, with the fishers in an especially dire financial situation from December to June, in the lean season[42]. Incomes in fishing communities are unevenly distributed, with a particularly large imbalance between fishers lacking production capital and those who own mechanized boats. With the seasonality of fishing, income is not year-round; rather, incomes vary according to catch volumes between the fishing season (June to November) and lean season (December to June). Unable to ration out their irregular income throughout the year, many are forced to rely on loans[43]. Of fishers, 77.6% borrow money from various parties to subsist during the lean season and closed seasons, and to purchase fishing gear. In addition to the major NGO lenders, fishers borrow from moneylenders, fish traders, boatowners, relatives, neighbors, and other parties[44]. The opportunity cost of capital in Bangladesh is high: loan interest rates are exorbitant at 5 to 15%, accrued monthly[45]. Under heavy pressure with the high interest rates and weekly installment payments, some fishermen are

[40] Department of Fisheries SDG Progress, 2021

[41] Ali, 2014

[42] Karim, Labour in Fishing Sector of Bangladesh, 2015

[43] Aghazadeh, 1994

[44] Ali, 2014

[45] U. Kleih, et al. A Guide to the Analysis of Fish Marketing Systems Using a Combination of Sub-sector Analysis and the Sustainable Livelihoods Approach,2003

reportedly driven to fishing illegally during closed seasons[46]. Over the approximately 6-months of closed seasons for Hilsa (4 months as a period for fry protection, 1.5 months for the 65-day closed season, and a 0.5-month closed period during Hilsa spawning season), the Bangladeshi government provides ID card-holding registered fishers with 40 kg of rice per month per household as food ration support to artisanal fishers.

Artisanal fishers used to be comprised mostly of low caste Hindus, although in more recent years, Muslims with no land that have lost their jobs have also started turning to the fishing profession. Every year many enter the fishing industry, especially after natural disasters such as cyclones and riverbank erosion, starting the living out of necessity from scratch. For the poor, artisanal fisheries is the last lifeline. Fishers on the rivers and coasts have long been poor, are mostly illiterate and, as a result, do not own land due to their history. They often have limited capital and fishing gear, forced to rely on their catches just to survive[47]. The majority of artisanal fishers are socially, economically, and politically disadvantaged[48]. Besides their low income and dearth of assets, the instability and poverty of artisanal fishers also stems from their being politically and geographically alienated by lack of access to land ownership, borrowed gear, healthcare, education, and financial instruments.

Most of boats for artisanal fishers are owned by moneylenders from outside the communities. The fish traders are prominent players in fishing communities, domineering the fishers they provide with fishing boats, fishing gear, food and fuel for fishing, and ice for storage[49].

2-12 Gender

In the artisanal fisheries sector, women are employed in fish processing and distribution. Fish processing is particularly prominent, with 94.6% of women in artisanal fisheries working in this sector (Figure 2-32).

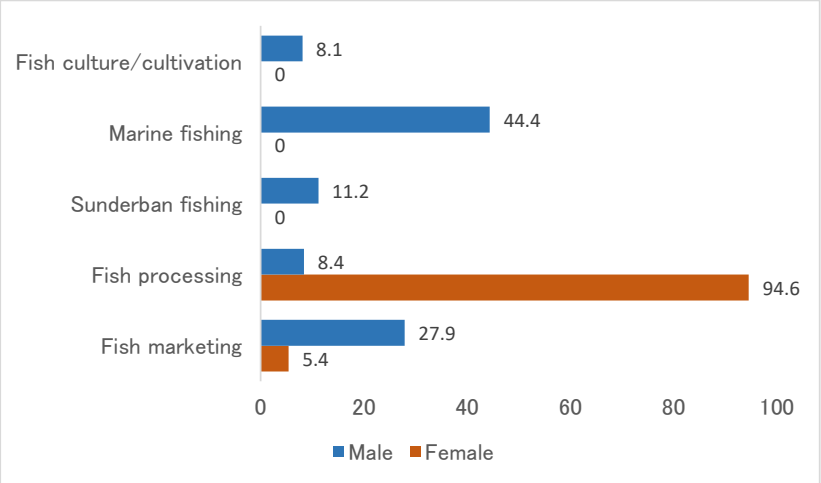


Figure 2-32 Sector of Work of Fishing Labourers (%) by gender
Source: Labour of Fishing Section of Bangladesh, Karim et al. 2015

[46] Islam et al. 2017
[47] Rahman et al. 2002, Jentoft et al. 2010, Islam 2011
[48] Rahman et al. 2002, Islam, 2011
[49] Haroon 2013

However, the women on average earn less than half the monthly income of men.

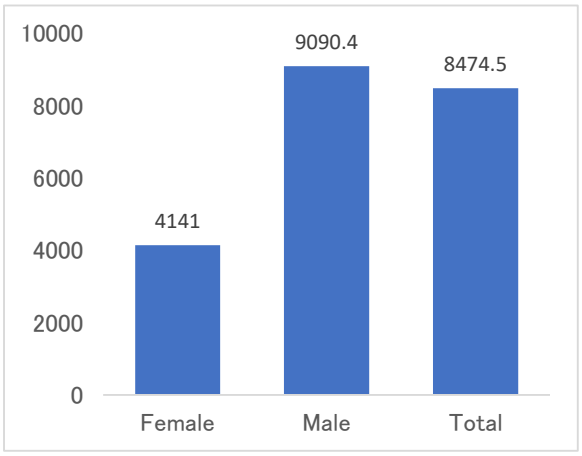


Figure 2-33 Average Monthly Income (BDT) of the Fishing Labourers by Gender (Unit:BDT)
Source: Labour of Fishing Section of Bangladesh, Karim et al. 2015

In fishing households in coastal artisanal fishing communities, the women lead very busy lives and play an important role in the fishing household livelihood. In addition to their duties at home, including meal preparation, cleaning, childcare, eldercare, caring for the sick, securing drinking water, and raising livestock, they also have fishery production duties, such as net repair and cleaning and gear preparations. They may also work for side income, such as post-landing work including fish sorting, rinsing, and processing, or working the general store or day labor, and to reduce food costs, they may also collect crabs, mollusks, seaweed, and more on the beach.

Still, due to their position in fishing communities, these women are restricted by lack of educational opportunities, lack of basic health services, and the security of their village, and they are sometimes exposed to domestic violence from poverty[50].

2-13 Fisheries Human Resource Development

The following universities and research institutes in Bangladesh have departments in the fisheries sector:

Table 2-20 Academic Institutions and their Major Fields of Research

Academic institution name	Major fields of research
Bangladesh Fisheries Research Institute	Hilsa resource management, fish diseases, commodity improvement, sea surface aquaculture, etc.
Bangladesh Oceanography Research Institute	Water quality analysis of dissolved oxygen, nutrient salts, plankton, etc., aquifers in the Teknaf region, marine resource studies, resource management, etc.
University of Dhaka Department of Fisheries	Resource quantitative assessments inside and outside the EEZ, inland water aquatic life conservation, technical improvements in surface fishing and aquaculture, fish diseases, closed season impact assessments, fishermen lifestyle improvement initiatives, etc.
Chittagong University Department of Fisheries	Climate change, fish diseases, Fish stock assessment

[50] Labour of Fishing Section of Bangladesh, Karim et al. 2015

Institute of Marine Science	
Bangladesh Agricultural University, Mymensingh Inland Fisheries Dept / Marine Fisheries Dept / Aquaculture Dept Research Center at Potenga	Water quality control, aquaculture technology, fish diseases, aquaculture business and marketing, fishery product quality control, microbiology, sanitation testing and regulations, etc.
Khulna University Fisheries and Marine Resource Technology (FMRT) Discipline	Aquaculture, marine biology, marine ecology, marine genetics, biotechnology, coastal resource management, post-harvest technology, quality control, etc.
Rajshahi University Department of Zoology, Department of Aquaculture	Aquaculture, climate change, fish disease, etc.

Table 2-21 presents the non-university training institutions for fishing and fishery staff[51].

Table 2-21 Fisheries academies

Name	Location	Training description	Trainees
Marine Fisheries Academy	Chattogram, BFDC	Marine fishery (navigation, engines, electrical, refrigeration machinery, radios, trawl operation, fish processing, seafarer training)	Corporate fishers and merchant boat officer candidates
Fisheries Training Academy	Savar, Dhaka	Administrative work and skills training for DoF personnel	DoF personnel
Fisheries Extension and Training Center	Faridpur	Aquaculture and fishery management	DoF personnel
Fisheries Training Institute	Chandpur	Aquaculture, management, and administrative training for fishery personnel	DoF personnel
Fish Hatchery and Training Center	Raipur	Aquaculture and hatching techniques	DoF personnel

DoF also arranges various types of training for the fishermen as follows.

- Sea safety on the boat or in the sea.
- Code of conduct for responsible fisheries (CCRF)
- Fish protection and Conservation Act.
- Marine fisheries Act-2020.
- Conservation and protection of Marine fisheries and Resources.
- Special Training for boat skipper or boat drivers.
- Training on reduce the post harvest loss.
- Training on dry Fish product maintaining quality of the products.

[51] MoFL 2008

2-14 Japan's Fishery-Related Assistance

(1) Grant aid (fisheries sector)

Table 2-22 Grant aid Project (fisheries sector)

Year	Project name	Grant amount	Implementing Agency	Project description
1978	Provided vessel for fishery survey	500 million yen	DoF	Provided vessel for fishery survey
1979	Coastal Motorization Project	600 million yen	BFDC	Provided 500 fishing boat engines, fishing nets, and net materials Target region: Barishal
1983	Project for Development of Fishing Net Production Equipment	210 million yen	BFDC	Supplied fishing net production equipment and fishing net materials Target region: Chattogram
1988	Project for Development of Fishery Processing and Refrigeration Equipment for the Bangladesh Fisheries Development Corporation	154 million yen	BFDC	Target region: Dhaka
1991	Project for Establishment of Fish Landing, Preservation and Distribution Facilities at Monoharkhali (1/2)	652 million yen	BFDC	Monoharkhali Port, Chattogram (1) Target region: Chattogram
1992	Project for Establishment of Fish Landing, Preservation and Distribution Facilities at Monoharkhali (2/2)	692 million yen	BFDC	Monoharkhali Port, Chattogram (2) Target region: Chattogram
1992	Project for the Establishment of the Permanent Seamen's Training School	643 million yen	Ministry of Shipping	Equipment and facilities for permanent seamen's training school Equipment and facilities for permanent seamen's training school Target region: Chattogram

(2) ODA loan assistance

Table 2-23 ODA loan assistance

Year	Project name	Loan amount	Project description
2007-2016	Small Scale Water Resources Development Project	5.313 billion yen	Capacity building for agricultural and fishery activities with the Water Management Cooperative Associations in Mymensingh, Sylhet, and Faridpur
2017-2024 (Scheduled)	Small Scale Water Resources Development Project (Phase 2)	11.853 billion yen	Capacity building for agricultural and fishery activities with the Water Management Cooperative Associations in Dhaka, Mymensingh, Sylhet, and Rangpur
2017-2023 (Scheduled)	Haor Flood Management and Livelihood Improvement Project	15.27 billion yen	Improvement of agricultural and fishery productivity by restoring and building flood control facilities and rural infrastructure, as well as agricultural and fishery promotion activities, in the Haor area

(3) Specialist dispatch

Five fishery experts in total were dispatched up through 1987[52], but none have since been sent.

(4) Trainees accepted

As for the number of trainees accepted by JICA in the field of fisheries, trainees had been accepted almost every year until FY 2008, but there have been no trainees in fisheries since then[53].

2-15 Other Donors' Fishery-Related Assistance

There has been a lot of support for the fisheries sector in Bangladesh by other donors, and the content of that support has been diverse. The recent projects targeting artisanal coastal fisheries include ECOFISH I and II by USAID/WorldFish and the Sustainable Coastal and Marine Fisheries Project by WorldBank. The following are the contents of support provided by other donors.

Table 2-24 Recent projects targeting artisanal fisheries

Donor	Project	Plan	Outline
USAID/ WorldFish	ECOFISH Ⅰ and Ⅱ	Focusing on improving the management of marine fisheries and aquaculture in coastal areas, and river co-management system for poor fishermen in areas along the Meghna River basin, aiming to further contribute to the economy, poverty reduction and environmental conservation.	ECOFISH I attempted to implement fisheries management on Ribbon fish through a science-based approach to planning and government provision of compensation to fishermen, to achieve sustainable fishing and improve the livelihood of fishermen. This approach is also being utilized in ECOFISH II, a 5-year project for 2021 to 2025, which focuses on the realization of sustainable fisheries and improvement of livelihoods of artisanal fishers not only in the Meghna River basin but also along the Cox's Bazar coast, with a focus on community support and women's empowerment.
World Bank	Sustainable Coastal and Marine Fisheries Project	Focusing on improving the management of marine fisheries and aquaculture in coastal areas, to further contribute to the economy, poverty reduction and environmental conservation.	Four sub-projects with four components, namely Enabling sustainable fisheries sector updated fisheries regulatory regime, improving infrastructure and production practice, Community empowerment and livelihood enhancement and Project management and monitoring, are under implementation or planned for the five-year period from 2018 to 2023.
FAO	Community -based Climate	Enhancing climate change resilience in fisheries and	Transfer and adoption of appropriate site-specific climate resilient fisheries and aquaculture intervention technologies and

[52] "Overseas Cooperation" No.28, June 2003, Overseas Fisheries Cooperation Foundation of Japan

[53] JICA Project Results Technical cooperation (number of participants by field and year)
https://www.jica.go.jp/activities/achievement/index.html

Donor	Project	Plan	Outline
	Resilient Fisheries and Aquaculture Development in Bangladesh 2016-2020	aquaculture	approaches are implemented to strengthen the awareness and knowledge of local communities, and enhance local adaptive capacity in the southwestern coastal areas affected by sea level rise, saltwater intrusion and storm surges, and in the northeastern Haor wetlands severely affected by floods, heavy rains and droughts.

Chapter 3 Natural Conditions and Natural Disasters IN THE SURVEY AREA

3-1 Climate of the Survey Area

3-1-1 Climate of Bangladesh

Bangladesh has a tropical monsoon climate, with three distinct seasons throughout the year. March to May is the hot, summer season, also known as the "pre-monsoon season." June to October is the hot and humid monsoon season, which has the highest amount of rainfall in the year. November to February is the milder winter season, which is cool and dry. The meteorological characteristics of Bangladesh are largely due to its location in a plain surrounded by the Himalaya mountains to the north, the Bay of Bengal and Indian Ocean to the south, and hilly areas to the east and west. Westerly winds meander due to the topography of the Tibetan plateau and the Himalayas, which affects the movement of the monsoon convergence zone and the cyclones that strike before and after monsoon season (Figure 3-1).

Figure 3-1 Bangladesh Terrain and Paths of Monsoons/Cyclones

The average annual temperature is about 25°C, with the highest temperatures of the year being recorded in the May pre-monsoon season. The distribution of annual precipitation (average) in the country is such that it decreases going from the northeast to the west. The target survey area is located in the southeastern part of the country and has the highest annual rainfall amount in the country, at 3,000-4,000 mm per year. The prevailing winds in Bangladesh are southwest-south during the monsoon season, and northeast-northwest in the winter. (Figure 3-2)[54].

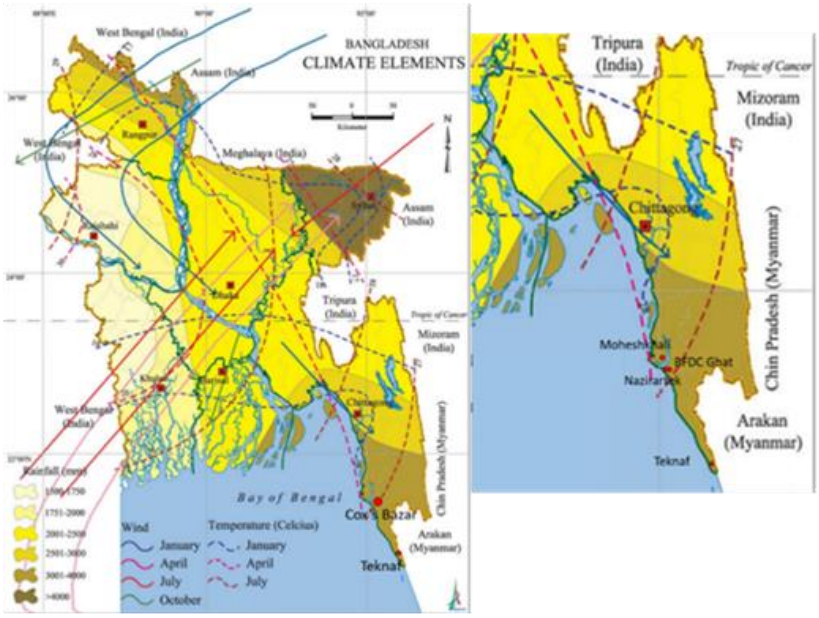


Figure 3-2 Distribution Map of Precipitation, Temperatures, and Wind Systems

[54] Banglapedia, Asiatic Society of Bangladesh

3-1-2 Survey Sites and Meteorological Reference Points

Five sites were selected for the survey in the Cox's Bazar district: the BFDC Ghat, Nazirtek fish landing area, and three sites along the estuary in Moheshkhali (Sonadia, Gotibanga, and Gorokghata). In the Teknaf district, a total of 12 site were selected: 12 sites along the Bay of Bengal coastline and one site at an urban fish landing area.

Figure 3-3 Survey Sites in the Cox's Bazar District

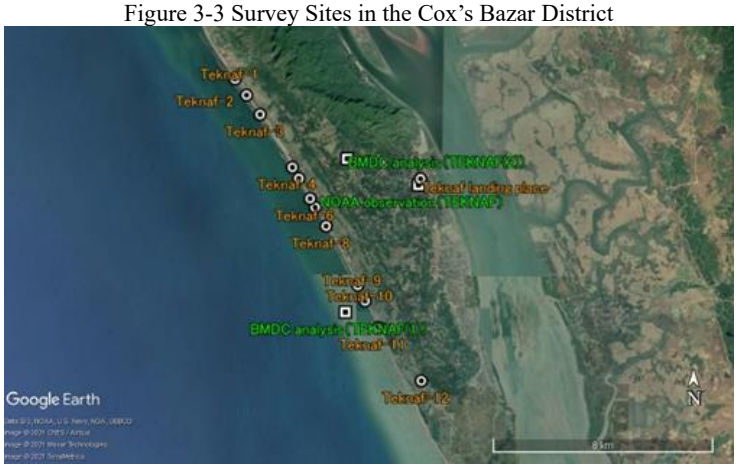


Figure 3-4 Survey Sites in the Teknaf District

(1) Rainfall in Cox's Bazar

The rainy season from June to August accounts for more than half of the annual precipitation. The annual precipitation amount is approximately 4,000 mm.

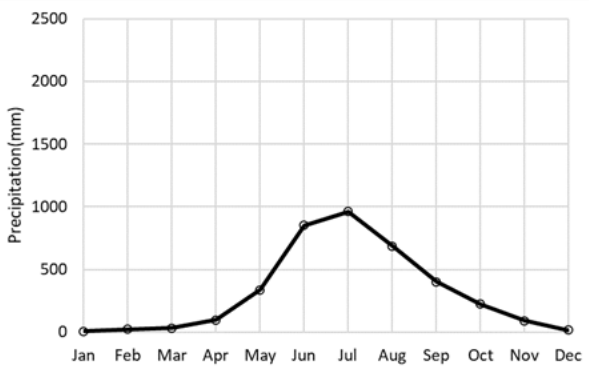


Figure 3-5 Monthly Rainfall in Cox's Bazar (1980-2010)[55]

[55] http://www.bbs.gov.bd/site/page/29855dc1-f2b4-4dc0-9073-f692361112da/Statistical-Yearbook

3-1-3 Temperature in Cox's Bazar

The average temperature in Cox's Bazar tends to range between 20°C and 30°C. The average annual temperature is around 25.5°C.

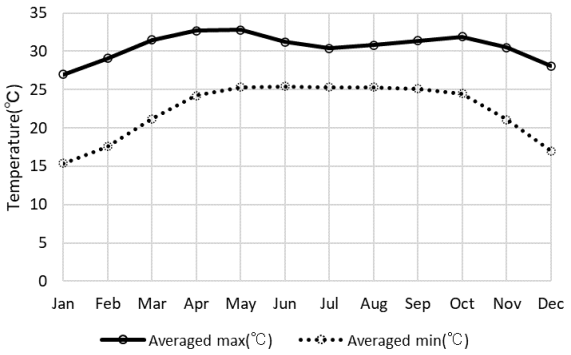


Figure 3-6 Average Monthly Temperature in Cox's Bazar (1981-2010)[56]

3-1-4 Humidity in Cox's Bazar

Monthly relative humidity tends to stay above 60% throughout the year, with levels going above 80% during the rainy season.

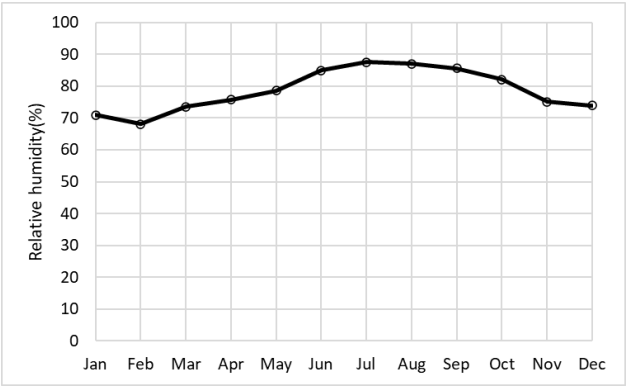


Figure 3-7 Average Monthly Humidity in Cox's Bazar (2004-2013)[57]

3-1-5 Rainfall in Teknaf

The rainy season from June to August accounts for more than half of the annual precipitation. The annual precipitation amount is approximately 4,000 mm.

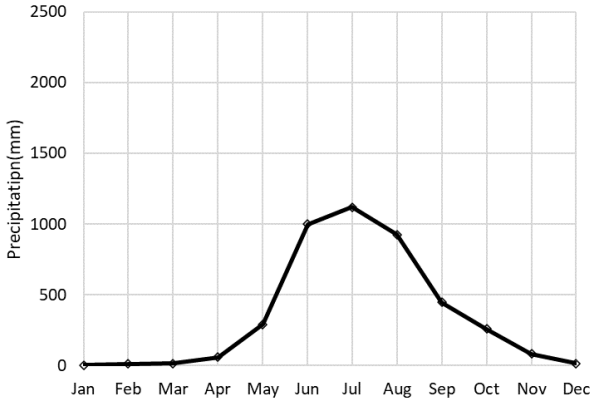


Figure 3-8 Monthly Rainfall in Teknaf (1981-2010)[58]

[56] http://www.bbs.gov.bd/site/page/29855dc1-f2b4-4dc0-9073-f692361112da/Statistical-Yearbook
[57] Same as above
[58] Same as above

3-1-6 Temperature in Teknaf

The average temperature tends to range between 20℃ and 30℃.

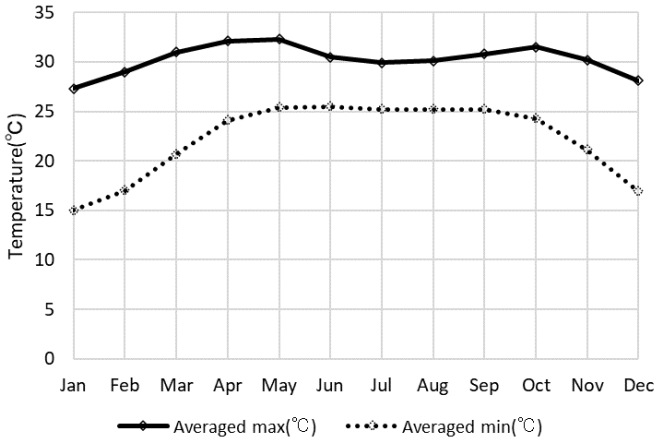


Figure 3-9 Average Monthly Temperature in Teknaf (1981-2010)[59]

3-1-7 Prevailing Wind Direction and Average Wind Speed in Cox's Bazar

According to the Bangladesh Meteorological Department's observation data on prevailing wind speed and direction, southerly winds prevail from June to July and northerly winds prevail from December of January. This trend is consistent with the general meteorological characteristics of Bangladesh.

Looking at the monthly average wind speed throughout the year, it has been shown that wind speeds tend to be weak from November to January, and strong from March to August. In particular, it was confirmed that in some years, the average wind speed exceeded 3 m/s (Table 3-1).

Table 3-1 Prevailing Wind Direction and Average Wind Speed in Cox's Bazar

Cox's Bazar	Jan		Feb		Mar		Apr		May		Jun	
	Monthly prevailing		Monthly prevailing		Monthly prevailing		Monthly prevailing		Monthly prevailing		Monthly prevailing	
year	wind velocity (m/s)	wind direction (26 dir)	wind velocity (m/s)	wind direction (26 dir)	wind velocity (m/s)	wind direction (26 dir)	wind velocity (m/s)	wind direction (26 dir)	wind velocity (m/s)	wind direction (26 dir)	wind velocity (m/s)	wind direction (26 dir)
2004	2.2	N	2.7	W	3.2	S	3.1	S	2.5	S	2.4	S
2005	2.6	N	2.9	NNW	3.3	S	3.5	W	2.8	S	3.5	S
2006	2.2	N	2.2	W	2.6	N	3.2	SSW	2.9	S	3.2	S
2007	1.9	N	2.2	NNW	2.4	N	2.2	SSW	2.4	S	2.5	S
2008	2.0	NNE	2.6	NNW	1.7	WSW	2.5	SSW	2.2	SSW	2.7	S
2009	1.5	NNE	2.4	NNW	2.0	WNW	3.1	S	2.5	SSW	2.6	S
2010	2.1	NNW	2.1	N	2.3	S	2.8	S	2.1	SSW	2.4	S
2011	1.9	NNW	1.9	NNW	2.2	NNW	1.7	W	2.2	S	1.9	S
2012	1.4	N	1.5	NNW	1.5	SSW	2.1	SSW	2.0	S	2.5	S
2013	2.4	NNE	2.3	NNE	1.8	NNW	1.7	SSW	2.2	S	1.5	S

[59] Same as above

Cox's Bazar	Jul		Aug		Sep		Oct		Nov		Dec	
	Monthly prevailing		Monthly prevailing		Monthly prevailing		Monthly prevailing		Monthly prevailing		Monthly prevailing	
year	wind velocity (m/s)	wind direction (26 dir)	wind velocity (m/s)	wind direction (26 dir)	wind velocity (m/s)	wind direction (26 dir)	wind velocity (m/s)	wind direction (26 dir)	wind velocity (m/s)	wind direction (26 dir)	wind velocity (m/s)	wind direction (26 dir)
2004	2.8	S	3.2	S	2.4	S	2.3	S	1.5	CLM	0.7	CLM
2005	3.1	S	3.5	S	2.8	S	2.3	SSW	2.0	NNW	1.9	NNE
2006	3.0	S	2.7	S	2.5	S	1.8	W	1.9	N	2.0	N
2007	2.6	S	2.9	S	2.6	S	2.3	NNW	2.1	NNE	1.8	NNE
2008	2.1	S	2.3	S	1.9	SSE	2.2	NNW	1.5	NNW	1.1	CLM
2009	2.5	SSE	2.0	S	1.9	S	1.6	NNW	1.1	N	1.4	CLM
2010	2.1	S	1.7	S	1.6	S	1.3	S	1.3	NNE	1.5	NNE
2011	2.0	S	1.9	S	1.5	S	1.1	CLM	1.0	CLM	0.8	CLM
2012	2.3	S	2.1	S	1.9	S	2.0	S	1.9	NNE	2.0	NNE
2013	1.5	S	1.5	S	1.3	S	0.9	CLM	0.6	CLM	0.7	CLM

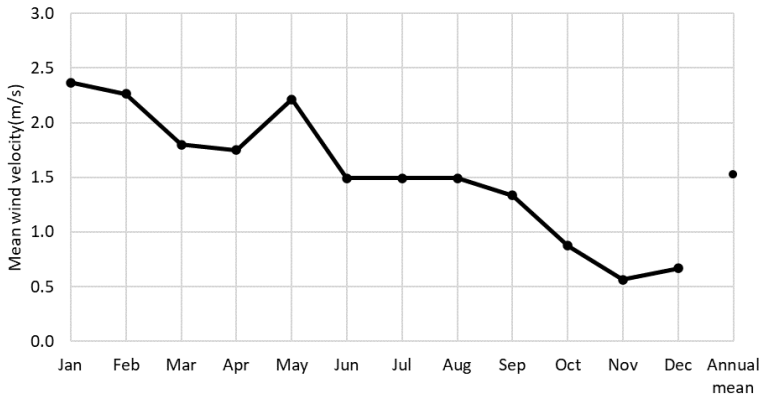


Figure 3-10 Monthly Average Wind Speed in Cox's Bazar[60]

Source : Bangladesh Meteorological Department

3-1-8 Prevailing Wind Direction and Average Wind Speed in Teknaf

Observation data from the Bangladesh Meteorological Department was not available for Teknaf. According to wind rose charts from NOAA's GPV data, southerly winds prevail from June to July and northwesterly winds prevail from December to January. This trend is consistent with the general meteorological characteristics of Bangladesh (Figure 3-11). According to NOAA's GPV data, the average monthly wind speed is generally slow, at around 1 m/s throughout the year, but it is slightly stronger in July.

[60] http://www.bbs.gov.bd/site/page/29855dc1-f2b4-4dc0-9073-f692361112da/Statistical-Yearbook

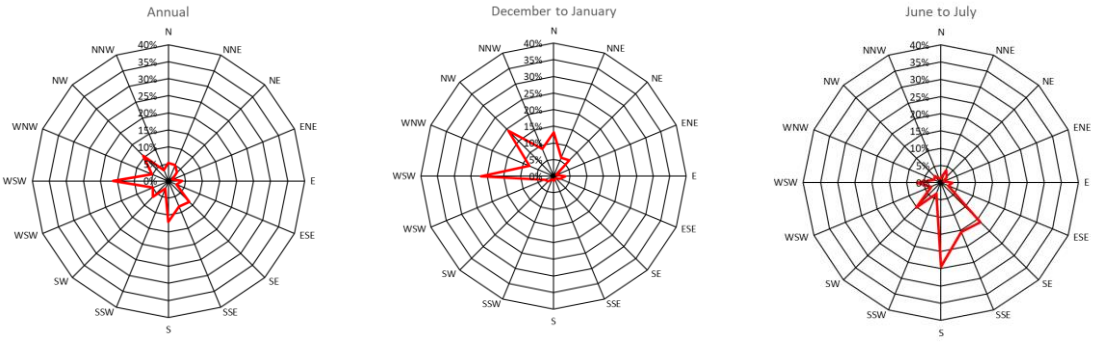


Figure 3-11 Wind Rose Charts for Teknaf61

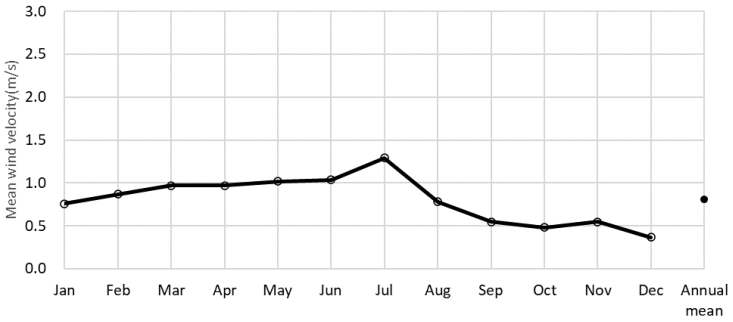


Figure 3-12 Average Monthly Wind Speed in Teknaf (NOAA)62

3-1-9 Water Level Observation Data for the Bakkhali River

The monthly water level data for the Bakkhali River as observed by the BWDB (Bangladesh Water Development Board) for 1995-2020 is shown in Figure 3-14 and Figure 3-15. The observed values represent the height of the water from the Bangladesh Public Works Department (PWD) datum reference level. This horizonal datum is nominally 0.46 m (=1.5 ft) below the Mean Sea Level (MSL) established in India under British Rule and brought to Bangladesh during the Great Trigonometric Survey.[63] Figure 3-13 shows the location of the observation points.

The monthly average water level values tend to be 2.5-4 m throughout the year, with the highest levels from June to October, mainly in July. The highest monthly value reaches about 6.5 m in July, and was approximately 7.6 m in the year with the highest level. The lowest value is about 0.5 m, showing that the difference in water levels can go as high as 7 m. Since seasonal variations in water levels are consistent with the rainfall patterns shown in Figure 3-5, the rise in river water levels can be attributed to seasonal precipitation.

[61] https://www7.ncdc.noaa.gov/CDO/cdo
[62] Same as above
[63] http://www.ffwc.gov.bd/index.php/definitions

Figure 3-13 Water Level Observations Points for the Bakkhali River

(Station ID: SW 40, Station Name: Ramu, N 21.4258°, E 92.1141°)

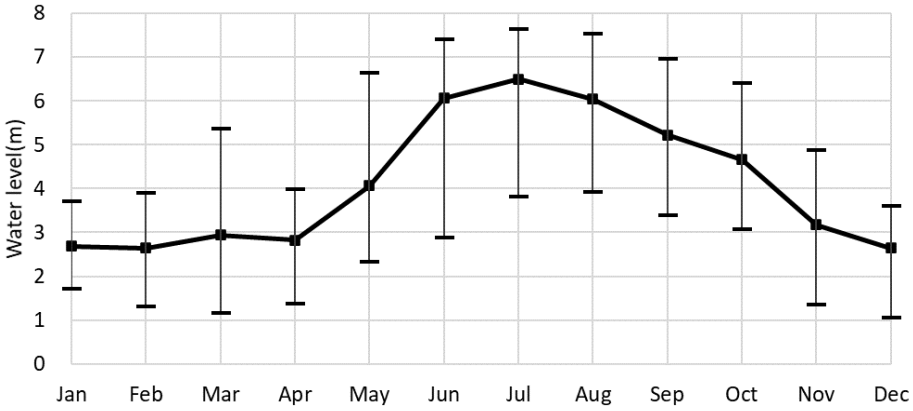


Figure 3-14 Highest Monthly Water Levels in the Bakkhali River (1995-2020 average)[64]

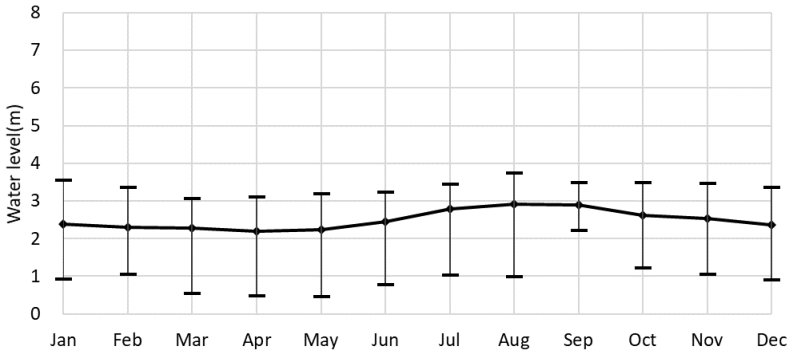


Figure 3-15 Lowest Monthly Water Levels in the Bakkhali River (1995-2020 average)[65]

[64] Observation data by BWDB (The upper and lower limits are the highest and lowest values)

[65] Same as above

3-2 Characteristics of the Bay of Bengal and Currents in the Bay

The currents in the Indian Ocean, located to the south of Bangladesh, have more seasonal variations compared to the ocean currents in other parts of the world, which show consistent patterns, regardless of the season. Due to the monsoon, the wind system over the Indian Ocean is predominantly southwesterly seasonal winds in summer and northeasterly seasonal winds in winter. Therefore, the surface currents of the Indian Ocean also show significant seasonal fluctuations, and the tidal currents in the Bay of Bengal correspond to these seasonal fluctuations, with clockwise circulation in summer and counterclockwise circulation in winter.

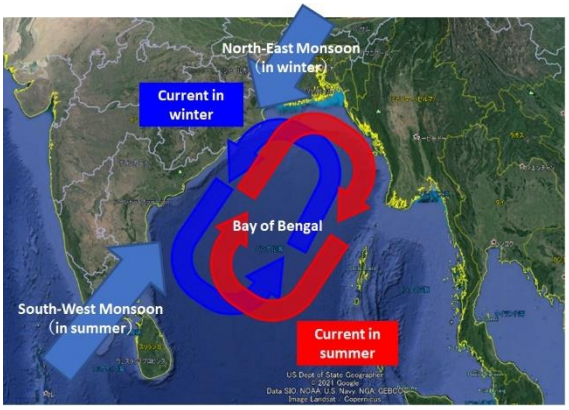


Figure 3-16 Seasonal Fluctuations of Tidal Currents in the Bay of Bengal[66]

3-2-1 Tide Level Observation Data

According to tide level observation data, the differences between mean high and low water springs are estimated to be 3.7 m along the Chattogram coast and 3.0 m along the Cox's Bazar coast (Table 3-2). The southeastern coastal region of the Bay of Bengal has a relatively large difference in tide levels, suggesting that the trend is stronger toward the north. This is attributed to the fact that the Bay of Bengal has a very shallow coastline, due to the large amount of sediment inflow from the Ganges, Brahmaputra, and Meghna Rivers.

Table 3-2 Tidal Surface Levels at Chattogram and Cox's Bazar Coasts[67]

Tidal Levels		Chattogram	Cox's Bazar
HAT	Highest Astronomical Tide	5.3m	4.3m
MHWS	Mean High Water Springs	4.4m	3.5m
MHWN	Mean High Water Neaps	3.2m	2.6m
MSL (Z_0)	Mean Sea Level	2.5m	2.0m
MLWN	Mean Low Water Neaps	1.5m	1.4m
MLWS	Mean Low Water Springs	0.7m	0.5m
LAT	Lowest Astronomical Tide	0.2m	0.0m
	Difference between Mean High and Low Water Springs	3.7m	3.0m
	Difference between Highest and Lowest Water	5.1m	4.3m

Horizontal Datum: The standard sea level according to the UKHO (similar to LAT)

[66] Indian Ocean Currents：Marine Information Research Center, http://www.mirc.jha.or.jp/

[67] United Kingdom Hydrographic Office （UKHO）, ADMIRALTY Tide Tables, Volume 5 （2016）

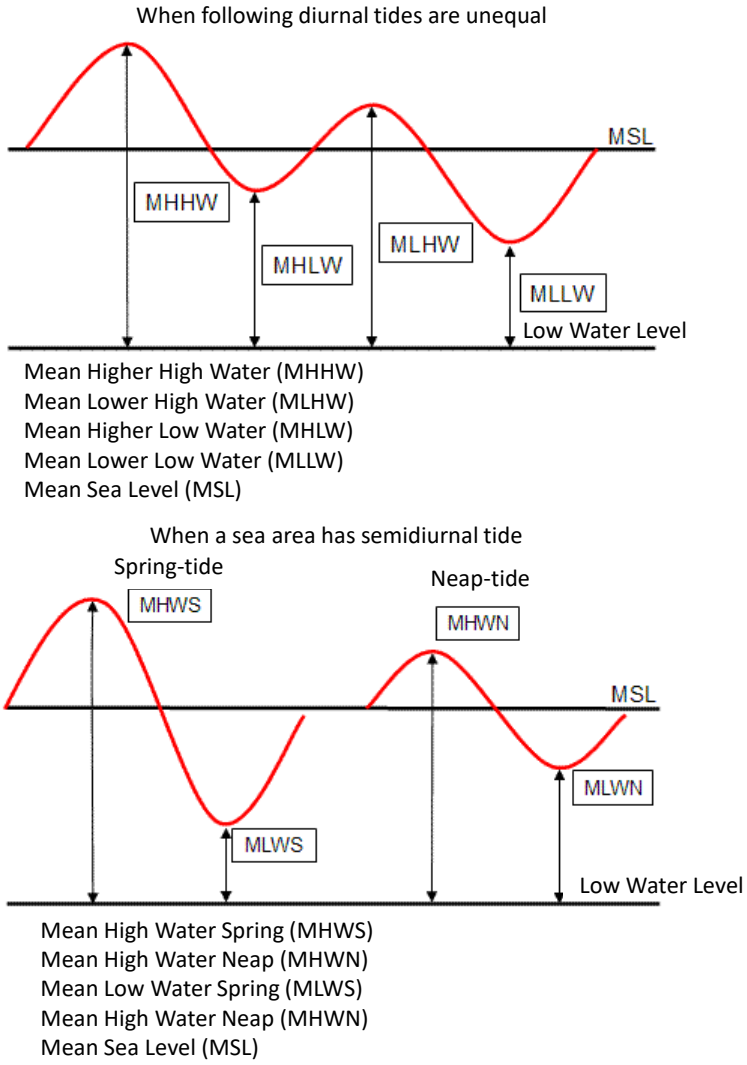


Figure 3-17 Explanation of Terms Appearing in Table 3-2[68]

3-2-2 Wave Data from the Coastal Areas of Cox's Bazar and Teknaf

Since wave observation data was not available for the sites targeted for the survey, information was compiled from reanalyzed ERA5 data. ERA5 is GPV (grid point value) data produced by the ECMWF (European Centre for Medium-term Forecasting) as part of its reanalysis project, for the purpose of understanding and monitoring climate change. It is a set of analytical values simulated by a numerical forecast model that assimilates various observation data.

According to the ERA5 grid point values from the coast of the target area, the monthly average significant wave height is about 1-2 m, with the highest value exceeding 2 m in June-August. Throughout the year, the significant period is about 8 seconds, and the predominant wave direction is south-southwest to southwest. This is thought to be due to the long blowing distance against the southwest monsoon and the development of wind waves in the Bay of Bengal.

Regarding wave height, the ERA5 grid point values correspond to offshore waves, which may be

[68] Japan Coast Guard data

calculated higher than the actual coastal observation values. For verification, it is necessary to obtain local observation data.

May and June, when the wave heights rise, is the period when fishing is prohibited in the area (May-June is also the pre-monsoon period). It can thus be inferred that one of the reasons for this prohibition is that waves tend to be higher.

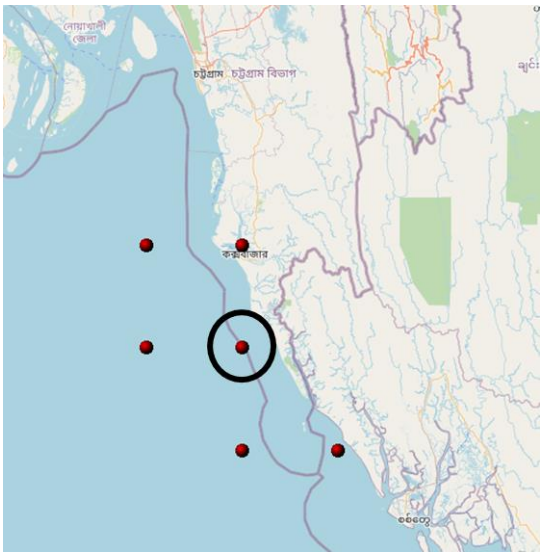


Figure 3-18 ERA5 Data Mesh Center Point (0.5° × 0.5°)

Data mesh center position: Uses the values N21.0°, E92.0°

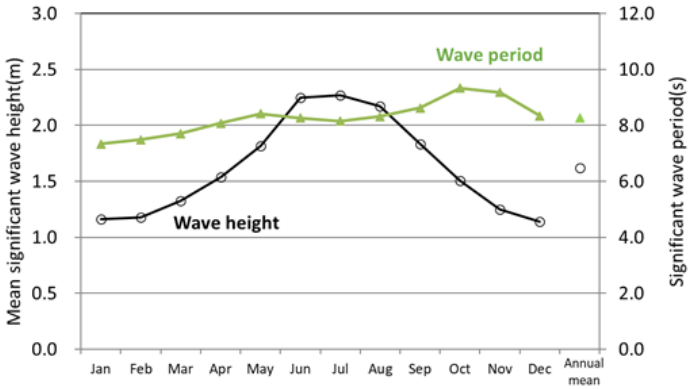


Figure 3-19 Monthly/Yearly Average Significant Wave Height and Period[69]

Data mesh center position: N21.0°, E92.0°　Period: 1979-2020

[69] ECMWF (European Centre for Medium-term Forecasting)（ERA5）

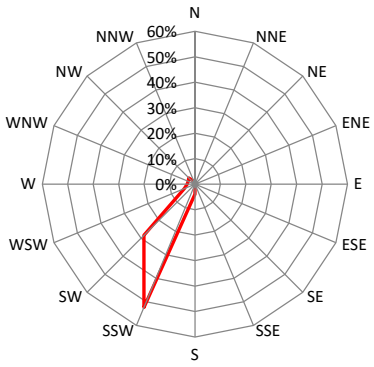


Figure 3-20 Yearly Frequency Distribution of Wave Direction
Data mesh center position: N21.0°, E92.0° Period: 1979-2020

3-3 Geographical and Geological Features of Survey Area

3-3-1 Geographical Features of Bangladesh and Survey Areas

The geography of Bangladesh can be divided into three main zones (flood plain, terrace land, and hills) and 24 landforms. The main center of the country is called the Delta, which is a flood plain formed by the Ganges (Podda) River flowing from the west, the Brahmaputra (Jomna) River from the north, and the Megna River from the northeast (Figure 3-21). The survey area is located in the southeastern part of the country and is part of the coastal and littoral areas of the Bay of Bengal called the Chattogram Coastal Plain. The eastern side of Teknaf is a hilly area with stable ground, while the survey area and its surroundings are all located in sea and river coastal areas, where the ground is weak due to sedimentary soil.

Figure 3-21 Topographic Map of Bangladesh[70]

[70] Land and Soil Resources Database, (Map) Google Earth, Banglapedia https://en.banglapedia.org/index.php/Physiography

3-3-2 Elevation and Geographical Features of Moheshkhali and Cox's Bazar

The survey sites are located in the coastal areas where the Bay of Bengal enters the terrain. The elevation of the survey sites in Moheshkhali (Sonadia, Gotibanga, and Gorokghata) ranges from 0-6 m above sea level. The elevation is 3 m above sea level at the Nazirtek fish landing area, and 6 m above sea level at the Cox's Bazar BFCD Fisheries Center (as shown on Google Earth). More than 80% of the coastal areas in the district are less than 5 m above sea level. The sea between Moheshkhali and Cox's Bazar is subject to high waves that run up the rivers during high tide (a phenomenon called "tidal bore"); therefore, these sites are thought to have a high risk of flooding on a regular basis due to tidal effects.

Figure 3-22 Elevation of Survey Sites (Cox's Bazar, Moheshkhali)[71]

3-3-3 Elevation and Geographical Features of Teknaf

Teknaf is located in the southernmost part of the country, bordering Myanmar. The elevation of the survey sites Teknaf 1-12 in the coastal area of the Bay of Bengal ranges from 0 to 5 m above sea level and the elevation of the Teknaf fish landing area is 5 m above sea level (as shown on Google Earth). The survey sites Teknaf 1-12 are located on terrain that is directly affected by waves and storm surges in the bay.

[71] GoogleEarth（Elevation）、Banglapedia, Asiatic Society of Bangladesh（Map）
https://en..org/index.php/Cox%E2%80%99s_Bazar_Sadar_Upazila

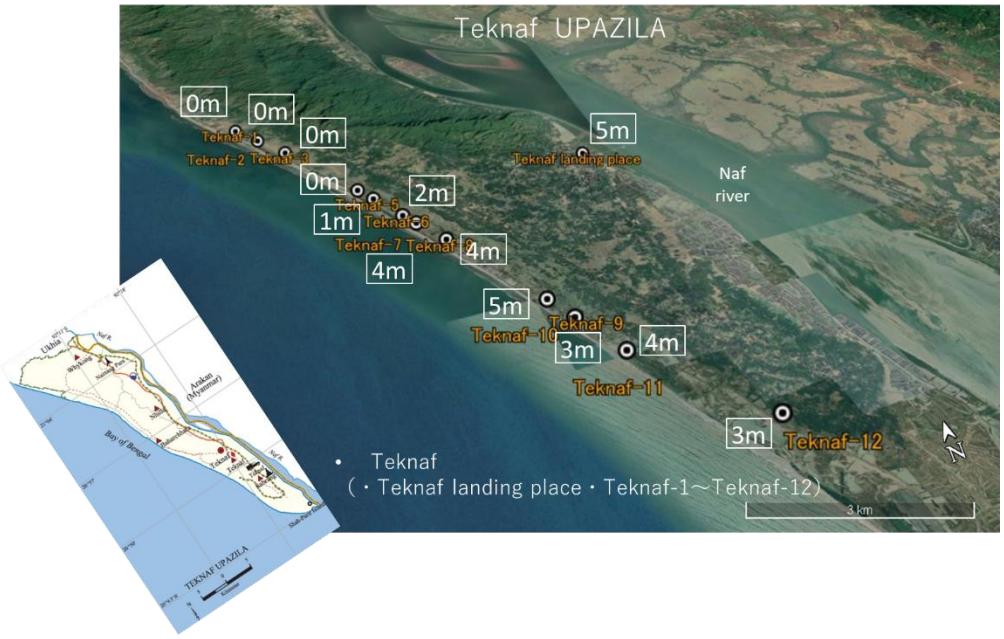


Figure 3-23 Elevation of Survey Sites (Teknaf)[72]

3-4 Soil in the Survey Area

Figure 3-24 shows soil-type distribution in Bangladesh. The main center of the country is the Ganges Delta, which is formed by soil deposited by the Ganges, Brahmaputra, and Meghna rivers. The survey area is a coastal littoral with sandy soil.

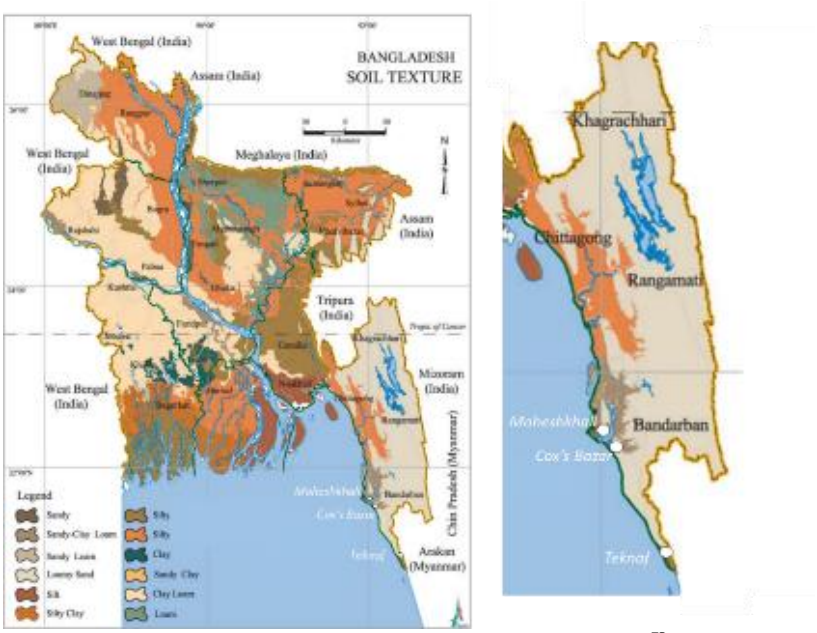


Figure 3-24 Soil Distribution Map of Bangladesh[73]

Figure 3-25 shows that the soil in the survey area, which includes three sites in Moheshkhali (Sonadia, Gotibanga and Gorokghata), two sites in Cox's Bazar (BFDC Ghat and Nazirtek fish landing and drying

[72] GoogleEarth（Elevation）、Banglapedia, Asiatic Society of Bangladesh（Map）
https://en.banglapedia.org/index.php/Teknaf_Upazila

[73] Land and Soil Resources Database ：Banglapedia, Asiatic Society of Bangladesh
https://en.banglapedia.org/index.php/Bangladesh_Soil

area) and 12 sites in Teknaf (Teknaf-1 to Tekna-12), is all classified as sandy loam. The fish landing site in the city area of Teknaf is further subclassified as loamy sand.

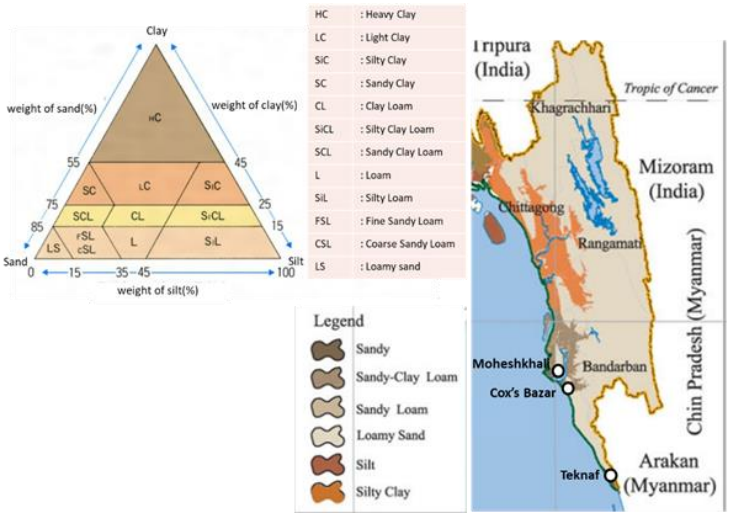


Figure 3-25 Soil Properties Chart and Soil Distribution Map[74]

In terms of geological formation, the survey area is classified as a beach ridge. A beach ridge is a low peak that is formed almost parallel to the shore, mainly by land being washed away by waves or the accumulation of material moved by waves, and it is classified as a less stable soil that is easily eroded (Figure 3-26).

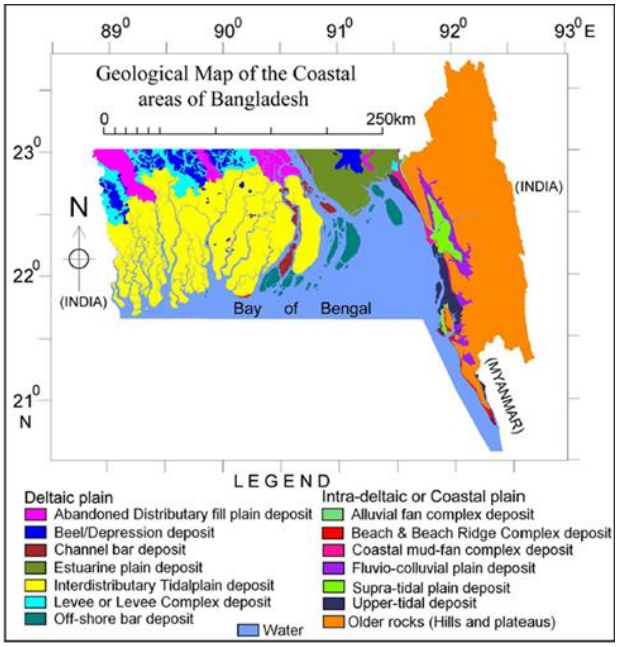


Figure 3-26 Classifications of Geological Formations (Bangladesh Coastal Area)[75]

[74] https://kotobank.jp/word/%E5%9C%9F%E6%80%A7-105232

[75] Division of Statistics, Government of Bangladesh
http://www.gsb.gov.bd/sites/default/files/files/gsb.portal.gov.bd/common_document/ba202943_de86_4780_b768_3eb8b32ff8d0/GSB_BD_Coast_Geologicalmap.pdf

3-5 Shoreline Changes on the Coasts of the Survey Area

Figure 3-27 to Figure 3-32 shows shoreline comparisons in the vicinity of the survey sites in Cox's Bazar, Moheshkhali, and Teknaf. For each district, the red line shows the shoreline of 2006 as a reference, and compares the changes over the 15 years up to 2021.

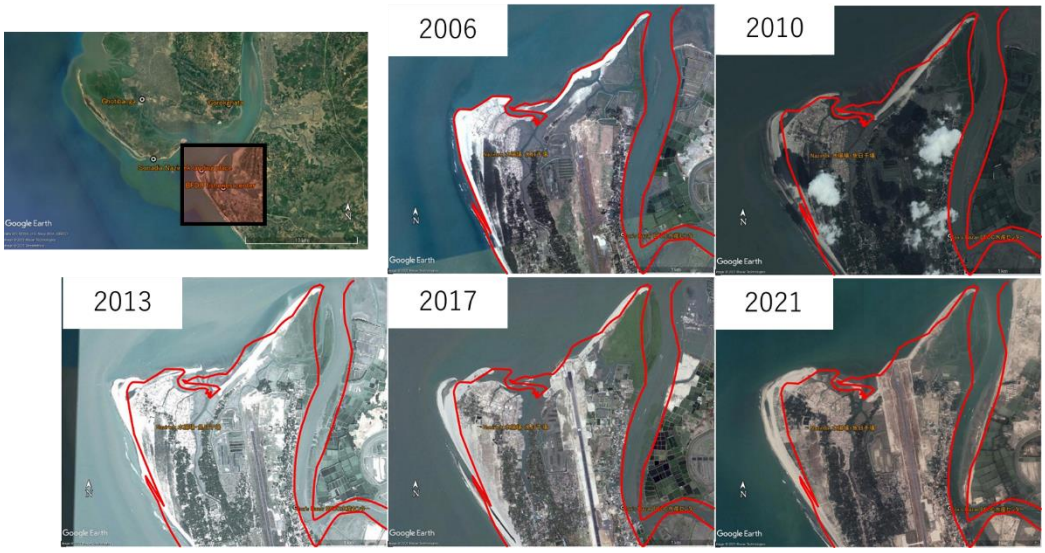


Figure 3-27 Shoreline Changes (Cox's Bazar)[76]

Shoreline changes in the coastal areas around the BFDC Ghat/Nazirtek fish landing area, confirmed through satellite images taken over the past 15 years, show that the shoreline has advanced approximately 300 m, and shape of the Bakkhali River has changed.

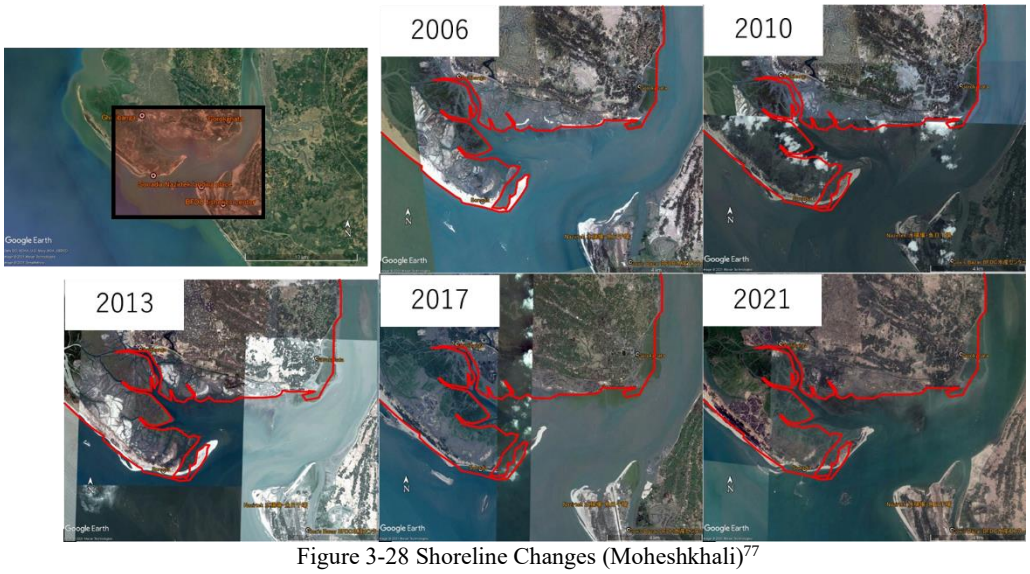


Figure 3-28 Shoreline Changes (Moheshkhali)[77]

Shoreline changes around the Moheshkhali fish landing area, confirmed through satellite images taken over the past 15 years, show that the shoreline has retreated around Sonadia by approximately 300 m and that vegetation has advanced around Gorokghata.

[76] Created from old aerial images of Google Earth
[77] Same as above

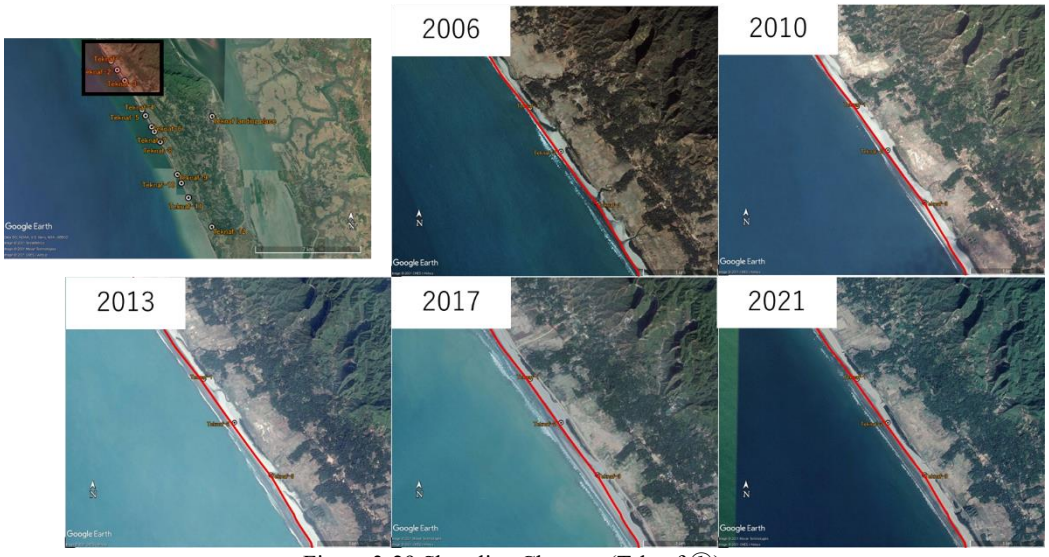


Figure 3-29 Shoreline Changes (Teknaf ①)

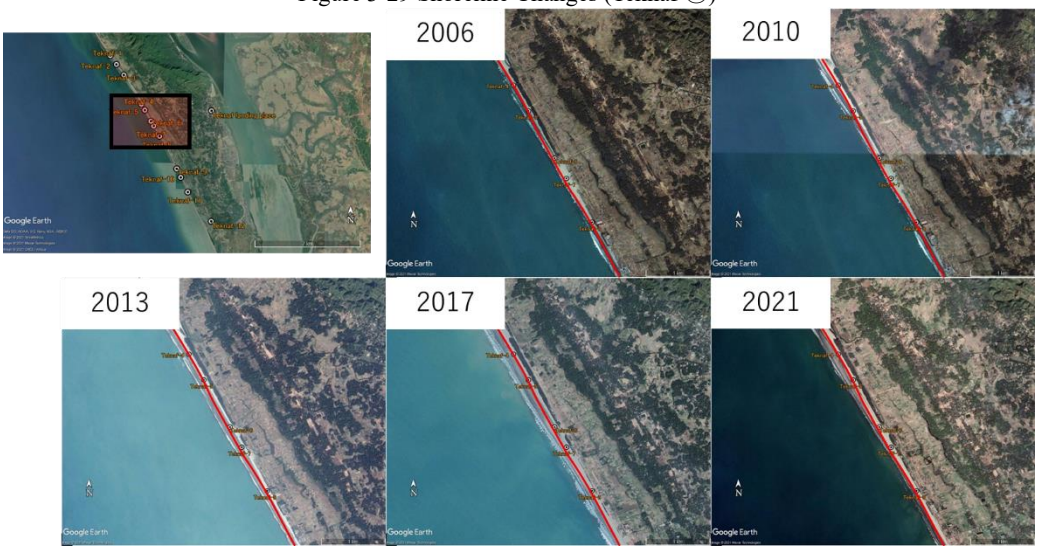


Figure 3-30 Shoreline Changes (Teknaf ②)

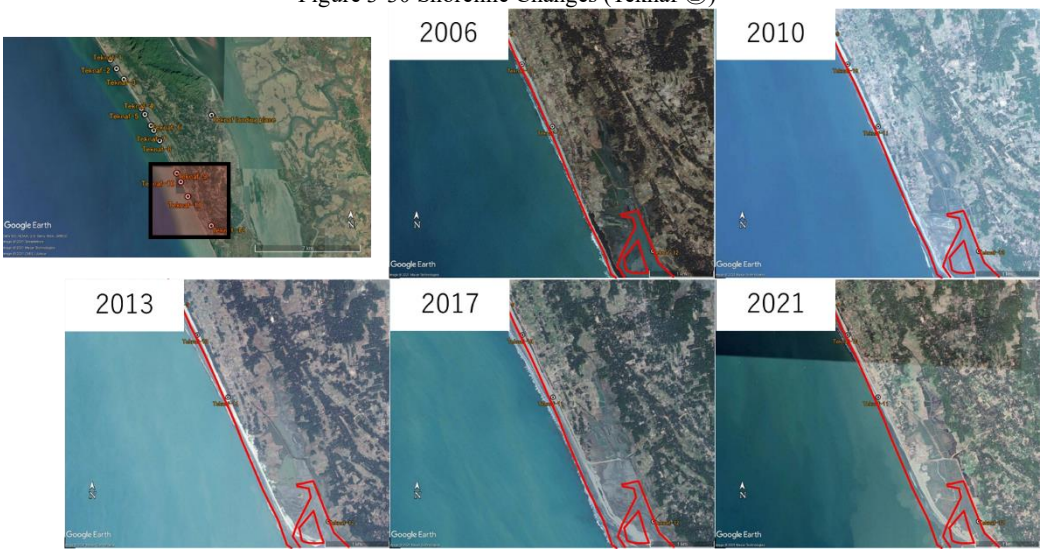


Figure 3-31 Shoreline Changes (Teknaf③)[78]

[78] Created from old aerial images of Google Earth

Shoreline changes in the coastal areas of the survey sites on the Bay of Bengal coast in Teknaf, confirmed through satellite images taken over the last 15 years, show that the shoreline has advanced an average of about 100 m.

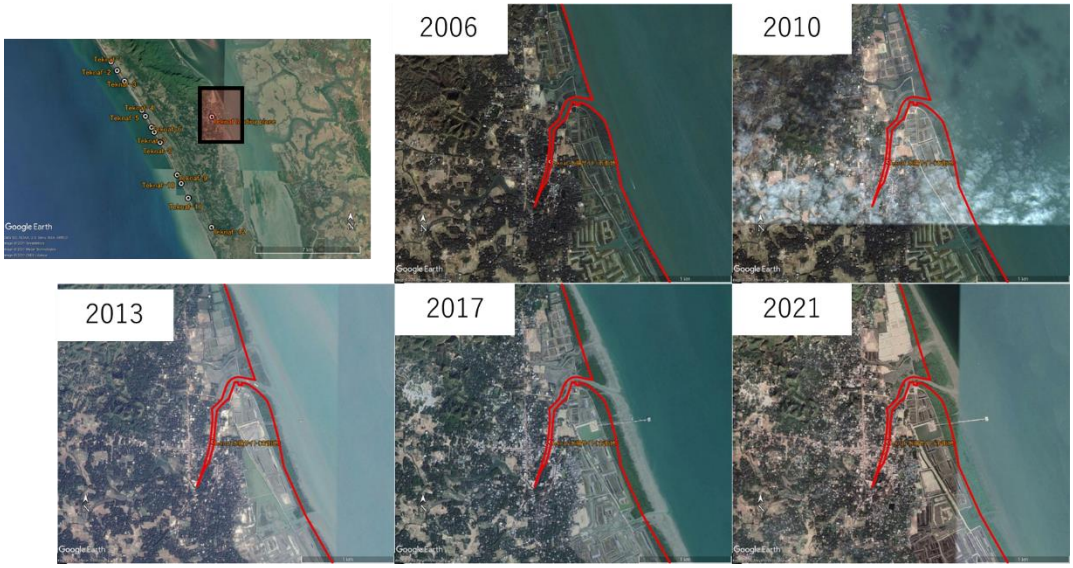


Figure 3-32 Shoreline Changes (Teknaf ④)[79]

Shoreline changes in at the Teknaf fish landing area, confirmed through satellite images taken over the last 15 years, show that the shoreline has advanced approximately 250 m around the confluence point with the river.

3-6 Results of Geological Survey in Cox's Bazar

A geological survey[80] conducted in the Cox's Bazar area shows brown, medium- to fine-grained, dense, sandy silt to a depth of 5.2 m (=17 ft) and dark gray, hard, clayish silt at further depths.

3-7 Disaster Risk in the Survey Area

(1) Natural Disasters of Concern for the Government of Bangladesh

Bangladesh, a country prone to natural disasters, has been working towards the creation of a comprehensive risk reduction framework since the establishment of the Disaster Management Bureau in 1993. In its National Plan for Disaster Management (2021-2025), the Government of Bangladesh has identified the following eight major types of disasters:

1) Earthquakes
2) Tornadoes/Nor'westers
3) Floods
4) Cyclones
5) Riverbank/shoreline erosion
6) Salt damage (groundwater)
7) Drought
8) Arsenic contamination

(2) Earthquakes

Bangladesh is a seismically active region due to its location on the southern side of the Himalayas, which were created from the collision of the Indo-Australian and Eurasian plates. In the survey area, a

[79] Created from old aerial images of Google Earth
[80] Report on sub-soil investigation for the residential building

magnitude 5.1 earthquake was confirmed to have occurred in Moheshkhali in 1999, but no record of past earthquake damage in the survey area could be found. During the 2004 Sumatra earthquake, there was no record of an observed tsunami in the coastal areas of Cox's Bazar, and only a rise in tide level of several tens of centimeters was observed.

Bangladesh is divided into three zones (High, Middle, and Low) for seismic risk, and the survey areas in Cox's Bazar, Moheshkhali, and Teknaf belong to the Middle Risk Zone, with a seismic gravity acceleration of 0.10-0.47 G.

In addition, major active faults in the country have been identified within a 100 km area of Cox's Bazaar to the north, and it is assumed that there is a possibility of an earthquake occurring, with this fault as its epicenter (Figure 3-33).

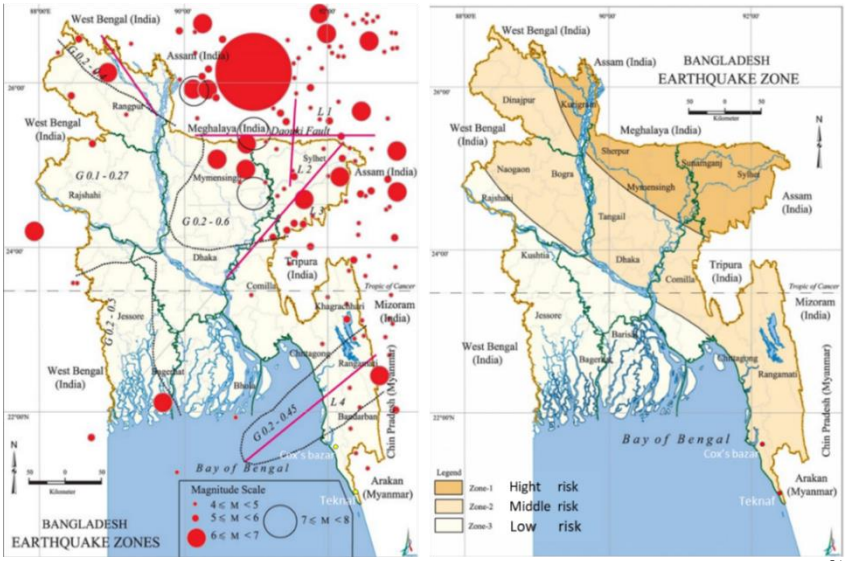


Figure 3-33 Distribution of Earthquakes and Earthquake Risk Zones in Bangladesh[81]

（3）Tornadoes/Nor'westers

In Bangladesh, storms called "Nor'westers" can cause serious damage in April and May, which is the period before the rainy season called the pre-monsoon. During this period, warm, moist air from the Bay of Bengal and hot, dry air from northeastern India converge to form a "dry line," which is the source of cumulonimbus clouds. The dry line moves from northwest Bangladesh along the center of the country, bringing severe weather events with gusty winds, lightning, hailstorms, and tornadoes[82].

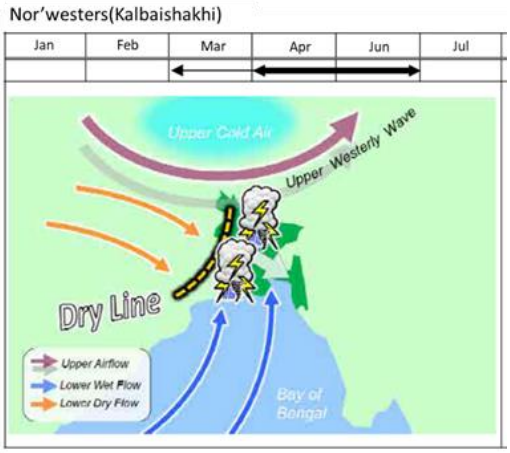


Figure 3-34 Mechanism for Dry Line Occurrence

[81] http://www.gsb.gov.bd/ , http://live4.bmd.gov.bd/bn/p/Zoning-Map/
(Map)：https://en.banglapedia.org/index.php/Earthquake（left)、https://en.banglapedia.org/index.php/Natural_Hazard（right）

[82] PREPARATORY SURVEY REPORT ON THE PROJECT FOR ESTABLISHMENT OF METEOROLOGICAL RADAR SYSTEM IN DHAKA AND RANGPUR IN THE PEOPLE'S REPUBLIC OF BANGLADESH
Table 6: Calendar of Typical Precipitation Events in Bangladesh
https://libopac.jica.go.jp/images/report/P1000018854.html

Tornadoes have occurred in Bangladesh and have caused extensive damage in densely populated areas, mainly in Dhaka, but no past tornado damage in the survey area was found. The frequency of tornadoes in the survey area is 1.11 tornadoes per 10,000 square miles over a 30-year period, which is about one-third the risk of to the central region, where the frequency is 3.19 tornadoes per 10,000 square miles.[83]

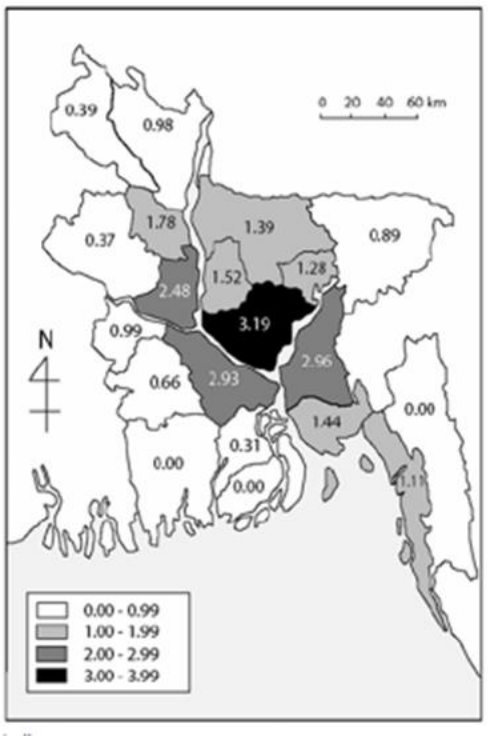


Figure 3-35 Tornado Occurrence Area (1967-1996)

(per 10,000 square miles)

（4）Floods

Floods in Bangladesh are classified into three categories, based on their causes.

① River/Monsoon Floods

River water levels gradually rise, causing flooding over a large area and extensive damage.

② Flash Floods

Caused by short periods of heavy rainfall in upstream areas and breaches in natural or constructed dams.

③ Coastal Tidal Surges

These surges are usually 3-6 meters high and cut off drainage systems on land. Coastal tidal surges are classified separately from storm (tidal) surges and cyclone surges (Figure 3-36).

Since rivers in Bangladesh receive runoff from a catchment area of about 1.72 million km^2, which is about 12 times the land area of the Brahmaputra Basin (552,000 km^2), Ganges Basin (1,087,000 km^2) and Meghna Basin (82,000 km^2), monsoon floods occur annually, extensively, and for long periods of time. The disaster risk for this is projected to be very high in Bangladesh.

[83] Design Adoption of Household Tornado Shelters to Mitigate the Tornado by Y.Ono-2001
https://www.researchgate.net/publication/227112604_Design_and_adoption_of_household_tornado_shelters_for_Bangladesh

The survey area is not located in any of the major river basins in Bangladesh; therefore, the risk of monsoon flooding is considered to be low. Based on tide level observation data along the coast of Chattogram and Cox's Bazar, and the fact that the phenomenon of tides rising past the mouth of the river (tidal bore) has been observed in the bay between Moheshkhali and Cox's Bazar during high tide, it is assumed that ordinarily, the Moheshkhali and Cox's Bazar districts are at a higher risk of coastal tide surges than monsoon flooding. Additionally, although the survey sites in the Bay of Bengal coastal area of the Teknaf district (Teknaf-1~12) are coastal sites, the survey sites in the Teknaf district fish landing area are near the mouth of the Naf River, and may thus be impacted by both river flooding and coastal tidal surges due to its geographical location.[84]

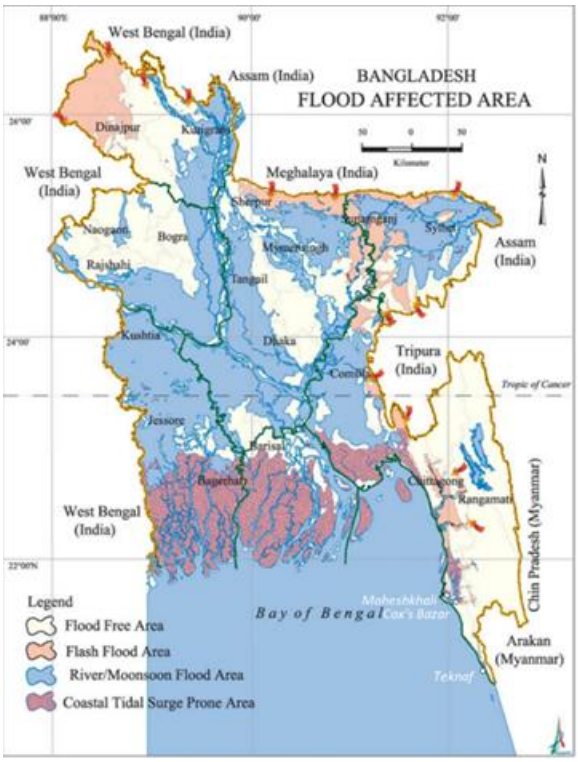


Figure 3-36 Distribution Map of Flood Impacts in Bangladesh

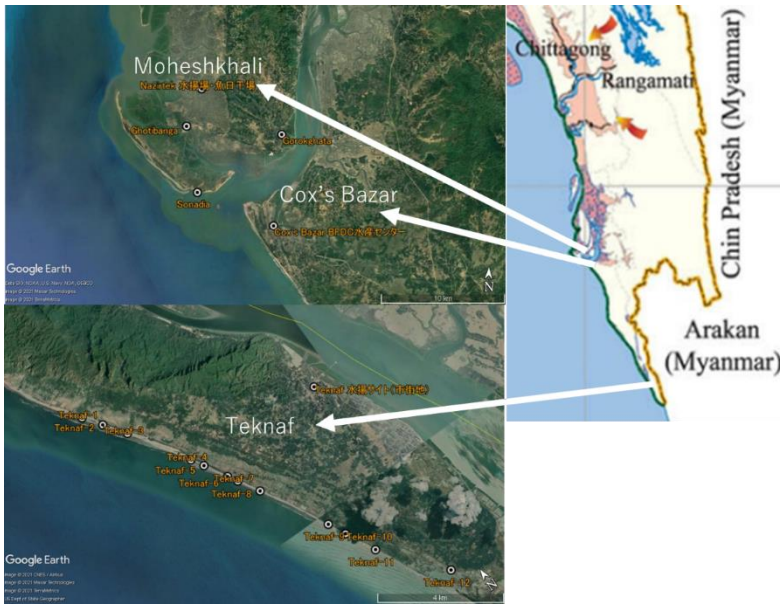


Figure 3-37 Map of Survey Sites and Flood Impact Distribution

Figure 3-38 shows the inundation status in 1955, 1974, 1988 and 1998, after the most severe flood events in Bangladesh. Inundation due to monsoon floods is shown across wide areas in 1974, which included Moheshkhali and Cox's Bazar, and in 1998, which included Moheshkhali, Cox's Bazar and

[84] Banglapedia, Asiatic Society of Bangladesh https://en.banglapedia.org/index.php/Natural_Hazard

Teknaf.[85] This suggests that if there is heavy, continued rainfall in the eastern hilly areas, monsoon flood damage may be incurred.

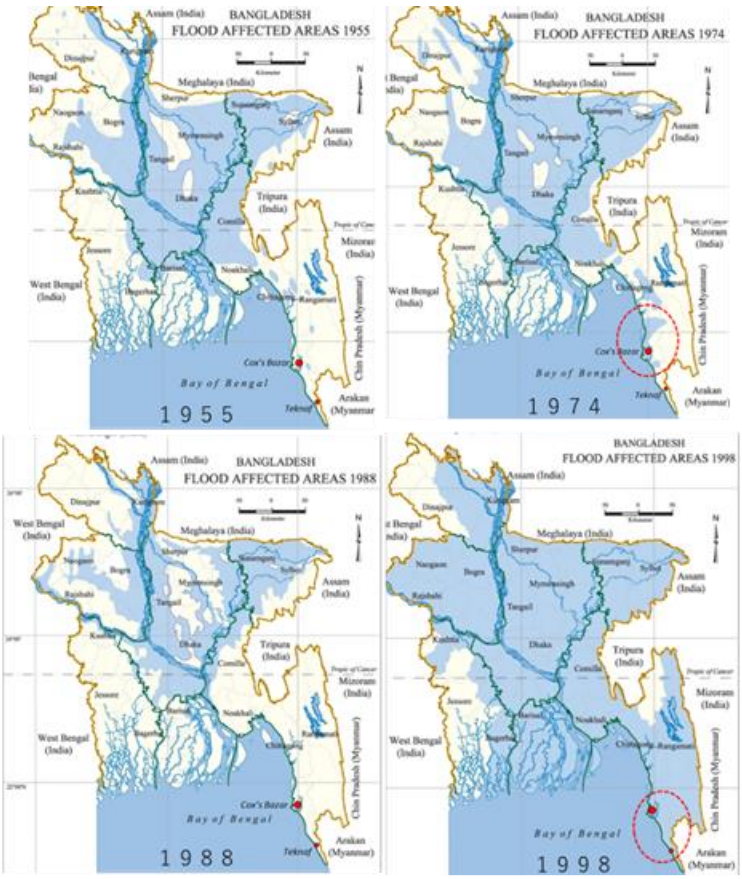


Figure 3-38 Major Flood Damage Years and Inundation Status

（5）Cyclones

The average annual number of cyclones in the Indian Ocean during 1979-2001 was 4.7, of which 3.1 were in the Bay of Bengal and 1.6 were in the Arabian Sea.[86]

Cyclone season in Bangladesh is biannual, with cyclones tending to move northward from the Indian Ocean to the Bay of Bengal and hitting Bangladesh during the pre-monsoon season (April-May) and the post-monsoon season (October-November). Before the rainy season, the major pathway of cyclones is through the southeastern coastal areas of Bangladesh. After the rainy season, cyclones frequently pass over the Indian side of the western part of Bay of Bengal (Figure 3-39). In addition, more than half of past cyclones have passed near the survey area (including over Chattogram and Myanmar), and many cyclones with maximum wind speeds of 30 m/s or more have occurred.

Most of the cyclone damage in the Bay of Bengal is caused by storm surges. The triangular topography of the Bay of Bengal causes large storm surges, due to the concentration of external forces for cyclones

85 Banglapedia, Asiatic Society of Bangladesh https://en.banglapedia.org/index.php/Flood

86 Cyclones around the Bay of Bengal, Annual report 1992 of the Disaster Prevention Research Institute, Kyoto University HAYASHI Taiichi et al. (https://www.engineering-eye.com/rpt/r052_jpgu_200807/pdf/200807c.pdf)

(sea level rise due to pressure drop, wind convergence, and wave synthesis); this causes catastrophic damage mainly in the coastal areas and results in the loss of lives. In particular, when a cyclone strike coincides with high tide, storm surges of 5 to 9 meters hit the coast, causing seawater to flow as far as 5 to 8 km inland.

According to the Oceanography Division of the Bangladesh Space Research and Remote Sensing Organization (SPARRSO), all of the survey sites are designated as high risk areas, with elevations of 0-6 m above sea level and storm surges of 1 m or more, making them extremely vulnerable to cyclone hazards.[87]

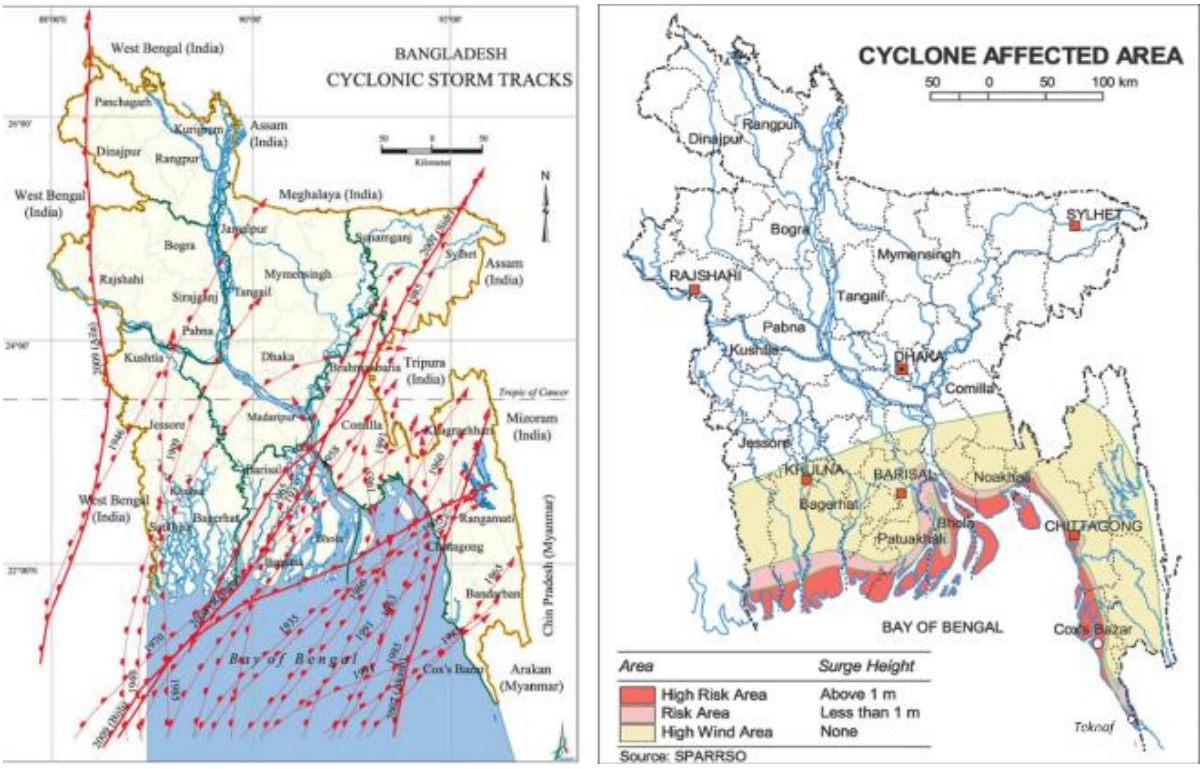


Figure 3-39 Distribution Maps of Major Cyclone Paths and Cyclone Risks

Figure 3-40 shows the impact of cyclone storm surge damage. The survey area is designated as having "extremely high susceptibility" to damage, due to Bangladesh's high population density.

[87] SPARRSO,Banglapedia, Asiatic Society of Bangladesh https://en.banglapedia.org/index.php/Cyclone https://en.banglapedia.org/index.php/Natural_Hazard

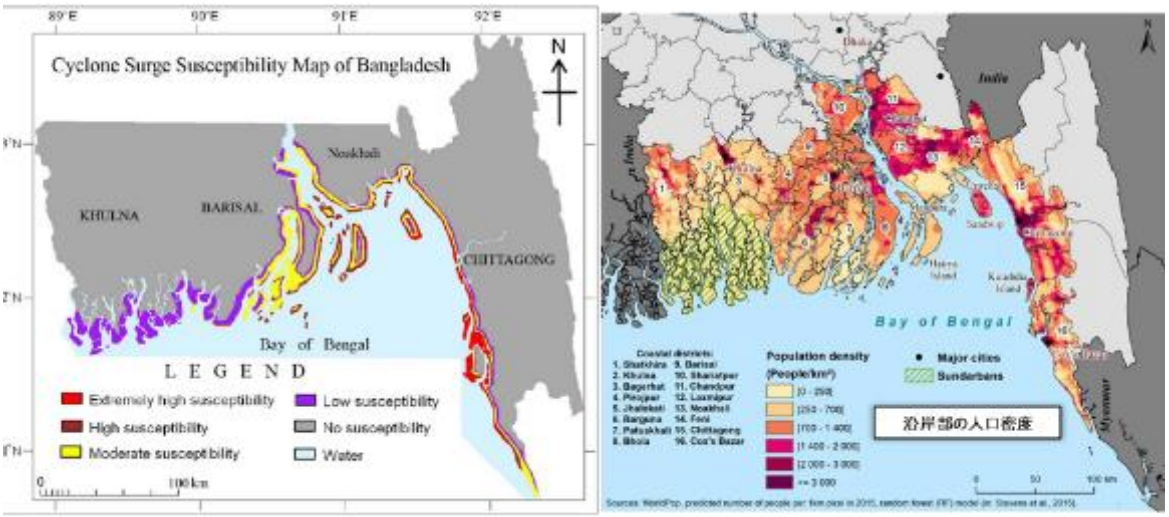


Figure 3-40 Impact of Cyclone Storm Surges (left) and Population Density (right)[88]

（6）Riverbank/Shoreline Erosion

In Bangladesh, the rivers that are most affected by riverbank erosion are the Ganges and Brahmaputra River basins. The average annual erosion rate in the Ganges river basin is 56 m on the right bank and 20 m on the left bank. The river width expansion rate of the Brahmaputra River from 1973 to 2000 is 128 m/year. Over the course of about 30 years, the average width of the Brahmaputra River increased from 9.7 km to 11.2 km (Figure 3-41).

The Moheshkhali/Cox's Bazar districts are also designated areas prone to riverbank erosion. Shoreline analysis using satellite images in Figure 3-27 and Figure 3-28 show that over a period of 15 years, the shoreline around the BFDC Ghat and Nazirtek fish landing area has advanced about 300 m, the Bakkhali River has changed shape, the shoreline near Sonadia has receded about 300 m, and vegetation (mangroves) around Gorokghata has advanced.

[88] (Left)：Cyclone surge susceptibility Map（Division of Statistics）
http://www.gsb.gov.bd/sites/default/files/files/gsb.portal.gov.bd/common_document/66fc50dd_1250_46b2_ab67_7bf957a2e8ba/gsb_BD_Cyclone_surge_susceptibility.pdf
(right)：Bangladesh's vulnerability to cyclonic coastal flooding by Aurélia Bernard, Nathalie Long, Mélanie Becker, Jamal Khan, and Sylvie Ranchette.February 2021
https://nhess.copernicus.org/preprints/nhess-2021-8/nhess-2021-8.pdf

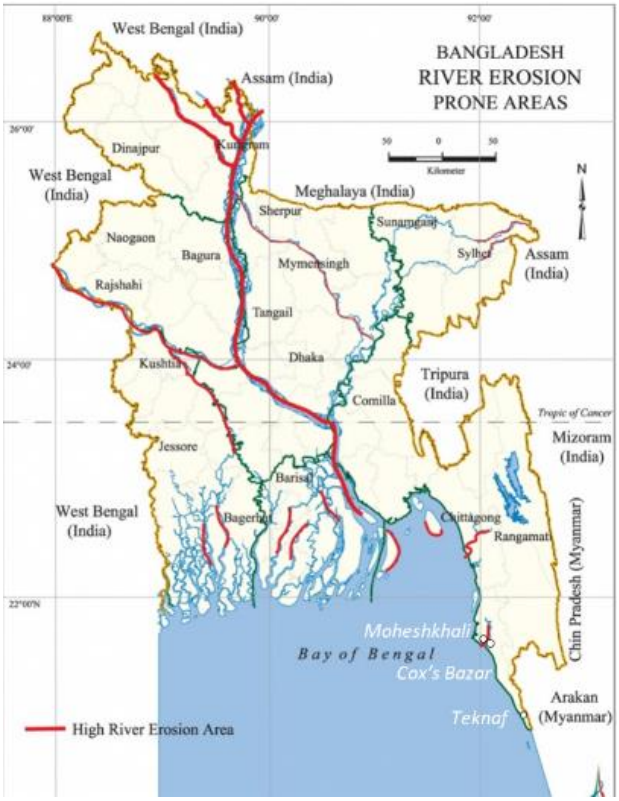


Figure 3-41 Riverbank Erosion Hazard Map[89]

According to the results of calculations from a projected 50-year model for inundation caused by sea level rise due to global warming, the projected values are 1.5 to 3 m in Moheshkhali and Cox's Bazar, and 0 to 1.5 m in Teknaf. All of the survey areas are estimated to be at high risk of shoreline erosion.

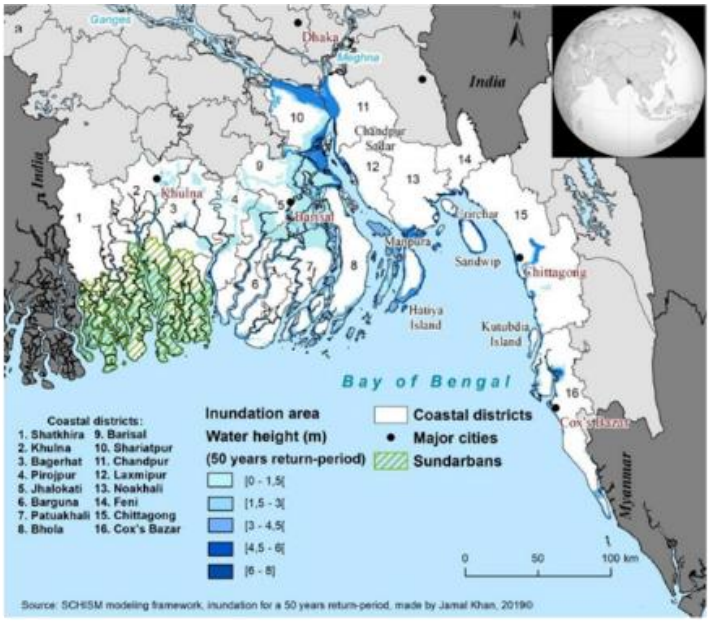


Figure 3-42 Projected 50-Year Inundation Due to Sea Level Rise from Global Warming[90]

[89] Banglapedia, Asiatic Society of Bangladesh https://en.banglapedia.org/index.php/Natural_Hazard

[90] Bangladesh's vulnerability to cyclonic coastal flooding by Aurélia Bernard, Nathalie Long, Mélanie Becker, Jamal Khan, and Sylvie

（7）Salt Damage (Groundwater)

Salinity in Bangladesh soil is greatly influenced by (1) soil properties, (2) sedimentation, (3) tidal action, (4) river sediments, (5) groundwater depth, and (6) proximity to slopes and drainage channels. The silty estuarine floodplain has high salinity values in both the topsoil and the substratum. The distribution of soil salinity is lowest in the northeast and increases gradually towards the west. Seasonal changes in groundwater salinity show an upward trend in February, reaching maximum levels in April and May, with a sharp decline after June. [91]

Groundwater salinity is correlated with the timing and distribution of precipitation. Land undulation, storm surges, seawater inflow, and flooding have a significant influence on the formation of coastal saline soil.

Groundwater salinity in the survey area is at a low level, but increases to a medium level in the dry season due to seawater inflow caused by tides.

Figure 3-43 Distribution Map of Saline Soil[92]

Ranchette.February 2021 https://nhess.copernicus.org/preprints/nhess-2021-8/nhess-2021-8.pdf

91 Banglapedia, Asiatic Society of Bangladesh

92 Banglapedia, Asiatic Society of Bangladesh https://en.banglapedia.org/index.php/Saline_Soil

3-8 Environment in Cox's Bazar

3-8-1 Natural Environment in Cox's Bazar District

(1) National parks in Cox's Bazar District

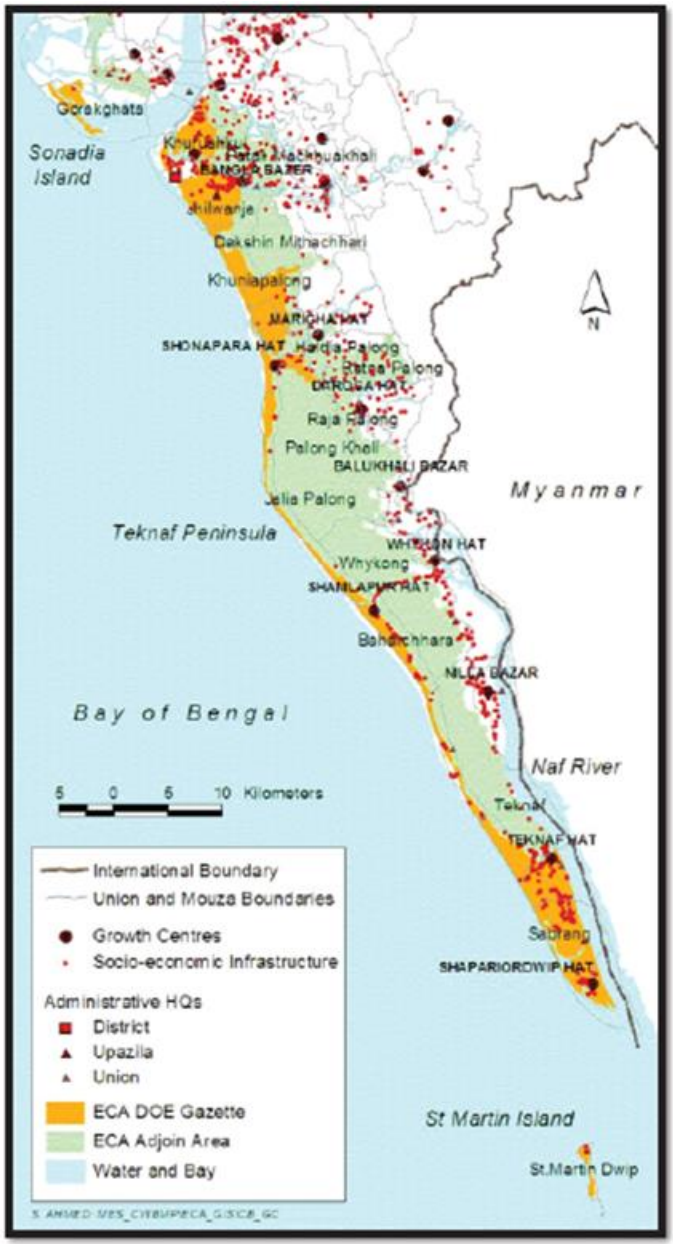
Cox's Bazar District in the Chattogram Region, is long stretched from north to south and has many forest areas in Bangladesh and national parks and wildlife sanctuaries are widely designated. Himchari National Park, Sheikh Jamal Inani National Park and Teknaf Wildlife Sanctuary stretch along the Bay of Bengal. Teknaf Wildlife Sanctuary spands five Unions, Baharchara, Hnila, Subran, Teknaf and Whykheong.

(2) Ecologically Critical Area (ECA)

Cox's Bazar District is known as having the world's longest natural sandy beach of about 120 km, and there is a sandy beach along the national highway (Marine Drive) from Cox's Bazar Sadar to Technaf Upazila at the southern end of Bangladesh.

This sandy beach is called Cox's Bazar - Teknaf Sea Beach and was declared by the Bangladesh government as one of the Ecologically Critical Area in 1999.

Thirteen areas in Bangladesh have been declared as ECA[93], and in addition to the Sea beach mentioned above, ECA in Cox's Bazar District includes Sonadia Island in Moheshkhali Upazila and St Martin's in Teknaf Upazila in the southernmost part of the country. The specified range of ECA (orange color) is as shown in the figure on the right[94].

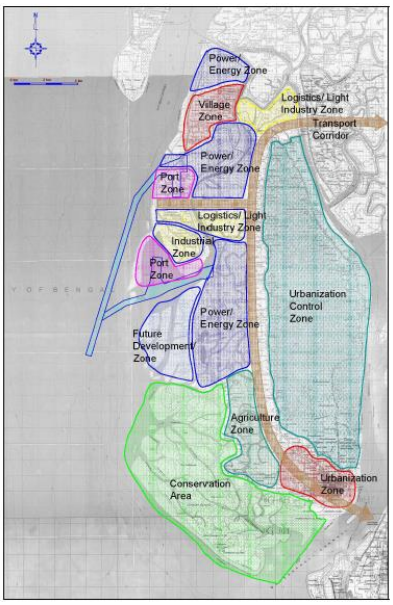


[93] http://www.doe.gov.bd/site/page/9481fd1b-7ca6-4087-890a-886cd226df0e/-

[94] Ecological Assessment of Some Selected Sites in Ukhiya and Teknaf, Cox's Bazar, Bangladesh, 2019, https://www.adb.org/sites/default/files/project-documents/52174/52174-001-emr-

3-8-2 Zoning plan of major development plan in the coastal area in Cox's Bazar District

Currently, in the land use zoning plan of the "Matarbali Port Development Project" being financed by JICA, Sonadia Island is planned as a "Conservation Area" (green color in the figure on the right). （Source：Preparatory survey report for Matarbari Port Development Project in Matarbari area in the People's Republic of Bangladesh, "Land use plan survey in the Moheshkari-Matarbari area）



The Bangladesh Economic Zones Authority (BEZA), which is operated by the Prime Minister's Office, is planning to establish three eco-tourisms parks in Cox's Bazar District. The three parks are: Sonadia Eco-Tourism Park (Moheshkhali Upazila, 9,467 acres)[95], Sabrang Tourism Park (Teknaf Upazila, Sabrang Union, 1,047 acres)[96], and Naf Tourism Park (Teknaf Upazila, Teknaf Sadar Union, 271 acres)[97].

The Sonadia Eco-Tourism Park Master Plan (November 2020) is available on the BEZA website, and shows the following map for the planned development.

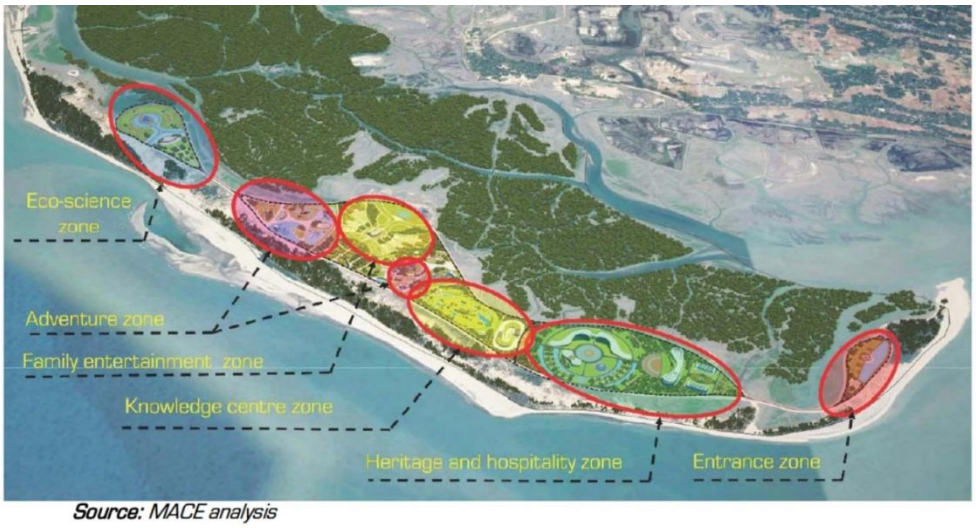


Figure 3-44 Planning Area for Sonadia Island Eco-Tourism Park

[95] https://www.beza.gov.bd/wp-content/uploads/2021/04/Final-Report_Sonadia-Eco-Tourism-Park.pdf
[96] https://www.beza.gov.bd/economic-zones-site/government-owned-sites/sabrang-tourism-sez/
[97] https://www.beza.gov.bd/economic-zones-site/government-owned-sites/naf-tourism-park-jaliardwip/

3-8-3 Environmental Laws of Bangladesh

（1）Bangladesh Environment Conservation Act (BECA)[98] and Environment Conservation Rules, 1997 (BECR)[99]

The Bangladesh Environment Conservation Act, 1995 (BECA), amended in 2000, 2002, and 2010 is an environmental law enacted by the Department of Environment under the Ministry of Environment and Forests. As per Section 12 of the Act, all industrial units or projects must obtain an Environmental Clearance Certificate (ECC) from the Director General, Department of Environment in the manner prescribed by the Bangladesh Environmental Conservation Rules of 1997.

Under the Bangladesh Environmental Conservation Rules (BECR), amended in 2002, 2003, 2005, 2010, and 2017, businesses/projects are categorized according to their size and nature of operation into four categories: Green, Orange-A, Orange-B, and Red, which are ordered from lowest environmental impact. They are then subject to screening and procedures assigned to their respective category. The classifications are shown in Schedule-1 of the BECR. For the Green Category, procedures are simple and times frames are short, but an Initial Environmental Examination (IEE) is required for both the Orange-B and Red Categories. For the Red Category, an Environmental Impact Assessment (EIA) is also required, and an ECC must be obtained before construction begins.

The main duties of the Department of Environment for these procedures[100] include formulating EIA procedures, reviewing and approving EIA reports conducted by project operators (governments, NGOs, individuals), providing advice on completion of EIAs, and issuing ECCs.

（2）Ecologically Critical Area (ECA) Management Rules (2016)[101]

In accordance with the 1995 environmental conservation law, the Government of Bangladesh has currently declared 13 Ecologically Critical Areas (ECA). The Ecologically Critical Area Management Rules (2016) provide mechanisms and restrictions for conservation and development in ECAs. ECAs are managed by the Department of Environment and managing organizations at various administrative levels, and the following point should be taken into consideration in regard to prohibited activities and work in ECAs.

Reference	Rule details
Gazette notifications （1999)[102]	The Gazette of the Government notify following activities and/or processes to be prohibited; （1） felling or collecting trees （2） hunting, catching or killing wild animal

98 https://bangladeshbiosafety.org/bangladesh-doc/bangladesh-environment-conservation-act-1995/

99 https://www.elaw.org/system/files/Bangladesh+--+Environmental+Conservation+Rules,+1997.pdf

100 http://www.doe.gov.bd/site/page/bd7461fd-c27f-4f9d-bc6f-74c518783dbf/-

101 https://moef.gov.bd/site/page/1c05e31e-1bb0-46ce-95a3-6ee3c82b439f/Environment-Laws-&-Acts

102 https://doe.portal.gov.bd/sites/default/files/files/doe.portal.gov.bd/page/1667a013_5bfc_4d1b_9e65_317da15b55ea/%E0%A6%AA%E0%A7%8D%E0%A6%B0%E0%A6%A4%E0%A6%BF%E0%A6%AC%E0%A7%87%E0%A6%B6%E0%A6%97%E0%A6%A4%20%E0%A6%B8%E0%A6%82%E0%A6%95%E0%A6%9F%E0%A6%BE%E0%A6%AA%E0%A6%A8%E0%A7%8D%E0%A6%A8%20%E0%A6%8F%E0%A6%B2%E0%A6%BE%E0%A6%95%E0%A6%BE.pdf

Reference	Rule details
	（3） Capturing and collecting oysters, corals, sea turtles and other wildlife （4） any kinds of activities that could destroy animal and plant habitats （5） any kinds of activities that could change the natural characteristics of soil and water. （6） industrial establishment; polluting water by disposing waste （7） fishing and other activities those are harmful for aquatic life The Environment Bureau DG has the right to change the scope and restrictions of this area for better environmental management.
Ecologically Critical Area Management Rules (2016)	18. Prohibited operations in ECAs (1) In order to meet the objectives of subsection (4) of Section 5 of the Bangladesh Environment Conservation Act, the following points shall be taken into account when deciding to initiate or continue activities in ecologically critical areas: (a) Degradation of protected forests and areas, including existing natural conditions, biodiversity, and wildlife habitats; aquatic reserves including rivers, canals, flood plains, haors, lakes, wetlands, bird habitats, fish reserves, and other flora and fauna; and wetland forests, mangroves, and coastal areas; (b) Pollution and destruction of environments and ecosystems; (c) Dependence on natural resources; (d) Causes of environmental risks and potential threats; (e) Damage caused to local migratory birds and prevention methods; (f) Livelihoods and religious/social culture of residents; (g) Archaeological monuments and archaeological artifacts/sites of artistic and historical importance; (h) Others related to the above. (2) The initiation and continuation of activities to be implemented in ecologically critical areas shall be designated by the Government in accordance with the criteria stated in Sections 12 and 13 of the 1997 Environment Conservation Act.

Chapter 4 Overview of Fisheries Value Chain in South Chattogram Region

4-1 Overview of South Chattogram Region

4-1-1 Major Cities in South Chattogram Region

The Chattogram Division, located in the southeastern part of Bangladesh, consists of 11 districts, including Chattogram, Cox's Bazar, and Comilla. The study area covers Chattogram and Cox's Bazar districts, which are located on the Bay of Bengal in Chattogram (Table 4-1 (1) and (3)).

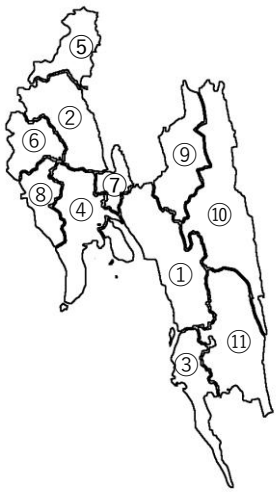
The study target area overlooks the Bay of Bengal to the west, where shipping and marine fisheries have developed. Chittagong Port is the largest commercial port in the country, handling more than 90% of the country's exports and imports, equivalent to about 30% of the country's GDP, and Chattogram District is the second largest city in the country after the capital, Dhaka. Meanwhile, Cox's Bazar is one of the smallest districts in Bangladesh, with an area of only 1.7% of the country's total land area. However, it is one of the most important districts in Bangladesh, as it is home to the city of Cox's Bazar, one of Bangladesh's leading resort areas that attracts many tourists from within the country and overseas every year, and it is also an important area as a major landing, processing and distribution base for artisanal fisheries.

4-1-2 Population of South Chattogram Region

According to the latest statistics (2011), the population of Chattogram Division is about 28.4 million (Table 4-1), which is about 20% of the total population of the country and the second most populous division after Dhaka Division, which includes the capital, Dhaka, at about 30%. The population by district is about 7.6 million in Chattogram and about 2.3 million in Cox's Bazar, and the population within the study target area accounts for about 35% of the total population of the division[103]. In addition, the population growth rate of Cox's Bazar District is 2.55% per year, which is much higher than the Bangladesh average of 1.47%[104].

[103] Statistical Yearbook of Bangladesh 2020
[104] UNDP 2018

Table 4-1 Population by District in Chattogram Division (2011)



①	Chattogram	7,616,352	26.8%
②	Comilla	5,387,288	19.0%
③	Cox's bazar	2,289,990	8.1%
④	Noakhali	3,108,083	10.9%
⑤	Brahmanbaria	2,840,498	10.0%
⑥	Chandpur	2,416,018	8.5%
⑦	Feni	1,437,371	5.1%
⑧	Lakshmipur	1,729,188	6.1%
⑨	Khagrachhari	613,917	2.2%
⑩	Rangamati	595,979	2.1%
⑪	Bandarban	388,335	1.4%
Total		28,423,019	100%

Source: Statistical yearbook 2019

4-1-3 Marine Artisanal Fisheries in South Chattogram Region

The South Chattogram region is an area where marine artisanal fisheries are flourishing, and where the number of artisanal fishermen and the fishery production capital for the important fishing gears for artisanal fisheries, such as estuarine set bag nets and gill nets, are concentrated. The following table shows the figures for marine artisanal fisheries by district (2001)[105].

Table 4-2 Figures for Marine Artisanal Fisheries by District

Name of District	Number of Artisanal fishermen	Estuarine Set Bag net	Gill net
Chattogram	63,138	20,118	4,779
Cox’s Bazar	356,601	21,372	28,018
Noakhali	72,474	3,093	3,752
Barishal	84,350	7,179	32,166
Jhalokathi	1,570		
Pirojpur	10,662		
Bhola	188,018		
Patuakhali	49,112	2,800	8,289
Borguna	15,284		
Khulna	50,871	4,982	3,228
Bagerhat	5,923		
Satkhira	9,265		
National Total	907,268	53,540	95,571

Source: Completion Report of the Marine Fisheries Strengthening Project, Rashid 2001

In both Chattogram and Cox's Bazar districts, the number of artisanal fishermen is 46.3% of the

[105] Completion Report of the Marine Fisheries Strengthening Project, Rashid 2001

national total, the number of estuarine set bag nets is 77.5%, and the number of gill nets is 34.3% (Table 4-2).

4-2 Development Planning and Positioning of Fisheries Sector in South Chattogram Region

4-2-1 Development Planning and Positioning of Fisheries Sector

Poverty reduction is a top priority of the Government of Bangladesh and has been highlighted in several national development plans, including the Bangladesh Delta Plan 2100, the Eighth Five Year Plan for Bangladesh, and through efforts to achieve Sustainable Development Goal 1 (end poverty in all its forms everywhere). In order for the Government to fulfill its commitment to the international community, it is focusing on coastal artisanal fisheries as a target of its poverty reduction efforts. Poverty reduction efforts by the Government of Bangladesh have had some effect, with the national poverty level decreasing by 31.5% in 2010 and by 24.3% in 2016 [106]. Meanwhile, many of the coastal artisanal fishermen in Bangladesh are still living below the poverty level, having been left behind by economic development and lagging behind other industries in terms of wage growth. Figure 4-1 below shows the wage index of fishery workers in comparison with other industries.

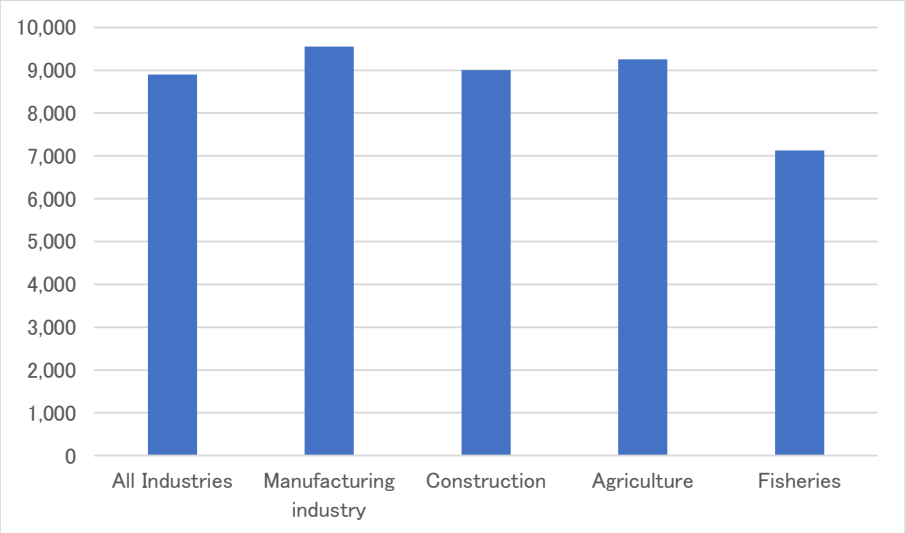


Figure 4-1 Wage Index by Industry (1969/70=100)
Source: Statistical yearbook of Bangladesh 2020

According to a survey in Cox's Bazar, 67% of the fishermen and traders surveyed earn less than 500 Taka per day even during the peak fishing season[107]. Figure 4-2 below shows the ratio of labor wages of fishery workers.

[106] General Economics Division (GED), 2018
[107] Socio-economic condition of fishermen and intermediaries involved in marine fish marketing chain in Cox's Bazar area, Ahsan et al. 2016

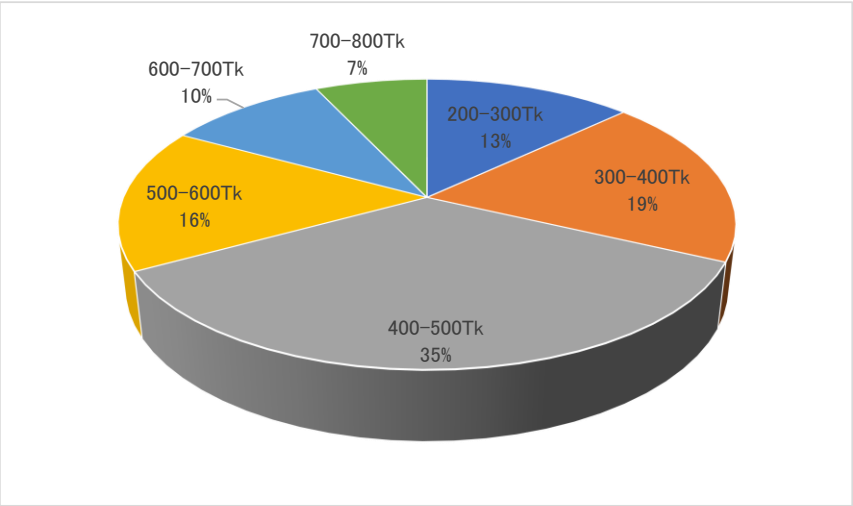


Figure 4-2 Labor Wages of Fishery Workers

Although the main industry in Cox's Bazar is agriculture, fishing is the second most important means of livelihood, with 45,878 registered fishermen. In Teknaf, in particular, only 5.5% of the land is suitable for agriculture, and 13% of the households depend on agriculture as their main source of livelihood, while 57% depend on fishing as their main source of livelihood[108]. Furthermore, if households engaged in fishery-related occupations such as fish sales, fishing net repair, and shipbuilding are included, about two-thirds of all households depend on artisanal fisheries for their livelihood. The following table shows the main occupations of the family heads of the Teknaf coastal region.

Table 4-3 Primary Occupation of Household Heads in Teknaf coastal region

No	Occupations	Number of Household Heads	Percentage
1	Fisher	1902	57%
2	Agriculture	434	13%
3	Wage Labour	367	11%
4	Fish Trader	133	4%
5	Trading	133	4%
6	Net Menders	100	3%
7	Aquaculture	66	2%
8	Boat Makers	51	1.5%
9	Salt Producer	33	1%
10	Fry Collectors	17	0.5%
11	Others	100	3%
Total		3,336	100%

Source: Artisanal Fisheries Status and Sustainable Management Options in Teknaf Coast, Hossain et al.

In the Eighth Five Year Plan for Bangladesh (2020-2025), under SDG 1 (end poverty in all its forms everywhere) and SDG 2 (end hunger, achieve food security and improved nutrition and promote sustainable agriculture), the Government of Bangladesh sees coastal and marine fisheries as a new source

[108] Impacts of the Rohingya Refugee Influx on Host Communities, 2018, UNDP

of growth for the fisheries sector, and has identified the reduction of poverty and promotion of economic development of coastal populations through effective utilization of coastal and marine resources as a component of blue economy development. The Government of Bangladesh also promotes the conservation and management of marine sustainable resources and improved fisheries management of marine fisheries under SDG 14 (conserve and sustainably use the oceans, seas and marine resources for sustainable development)[109].

In the Eighth Five Year Plan (2020-2025), the GoB aligns coastal and marine fisheries as a new source of growth for the fisheries sector, and has identified the reduction of poverty and promotion of economic development of coastal populations through effective utilization of coastal and marine resources as a component of blue economy development. The Government also promotes the conservation and management of marine sustainable resources and improved fisheries management of marine fisheries. These efforts are corresponded among the 17 international goals set as Sustainable Development Goals (SDGs) to achieve a sustainable and better world by 2030, SDG1 (End poverty in every form, everywhere) and SDG2 (End hunger, achieve food security and nutrition improvement, promote sustainable agriculture) and SDG14 (Conserve oceans, seas and marine resources for sustainable development and use it sustainably).

4-2-2 General Situation of Cox's Bazar District

Table 4-4 below shows the area, population, and population density by Upazila for Cox's Bazar District.

Table 4-4 General Information by Upazila , Cox's Bazar

Name of Upazila	Area (q.km)	Municipality	Union	Population	Density (per sq km)
Ukhia	262	-	5	207,379	791
Cox's Bazar Sadar	228	1	10	459,082	2,013
Kutubdia	216	-	6	125,279	579
Chakaria[110]	643	1	18	474,465	737
Teknaf	389	1	6	264,389	679
Pekua	140	-	7	171,538	1,225
Maheshkhali[111]	362	1	9	321,218	887
Ramu	392	-	11	266,640	680
Total of Cox’s Bazar District	2492	4	71	2,289,990	918

Source: Population ＆Housing Census-2011,2001

Chakaria Upazila has the largest population of over 500,000, followed by Cox's Bazar Sadar with about 460,000. Cox's Bazar Sadar has a population density of 2,013 people/km^2, followed by Pekua Upazila with 1,225 people/km^2. The upazilas of Cox's Bazar facing the Bay of Bengal are Ukhia Upazila, Cox's Bazar Sadar, Kutubdia Upazila, Chakaria Upazila, Teknaf Upazila, Moheshkhali Upazila, and

[109] Template for "Developing national SDG Action Plan under 8th Five Year Plan" Draft DoF

[110] Statistical notation is Chokaria

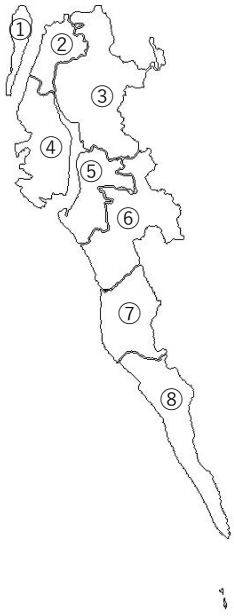
[111] Statistical notation is Maheshkhali

Ramu Upazila.

Statistics on the production of marine fisheries by landing area are not always accurate, and the production of marine fisheries by upazila is not published in the fishery statistics of the Department of Fisheries.

Table 4-5 below shows the production of marine fisheries by upazila in Cox's Bazar according to a survey by the WorldFish Center commissioned by JICA[112].

Table 4-5 Marine Fisheries Production by Upazila in Cox's Bazar (tons)



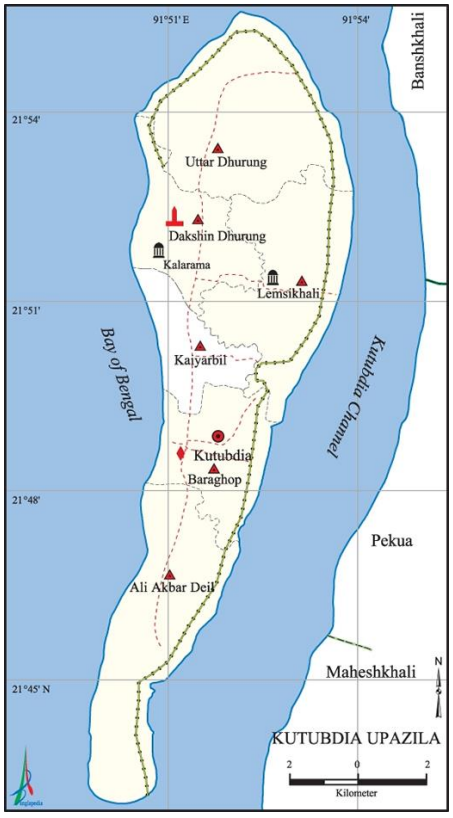
Upazila	landing volume/year (ton)
①Kutubdia	745
②Pekua	159
③Chakaria	85
④Maheshkhali	7,233
⑤Cox's Bazar Sadar	117,758
⑥Ramu	140
⑦Ukhia	1,073
⑧Teknaf	12,807
Total	140,000

Source: Strengthening resilience of coastal fisher communities in Cox's Bazar for improving livelihood ecologically and economically (WorldFish Center)

Cox's Bazar Sadar is the largest producer in the district with 117,000 tons per year, followed by Teknaf with 12,000 tons, Moheshkhali with 7,000 tons, Ukhia with 1,000 tons, and others with less than 1,000 tons per year. A summary of the other upazilas is given below.

[112] Strengthening resilience of coastal fisher communities in Cox's Bazar for improving livelihood ecologically and economically, WorldFish Center, 2018)

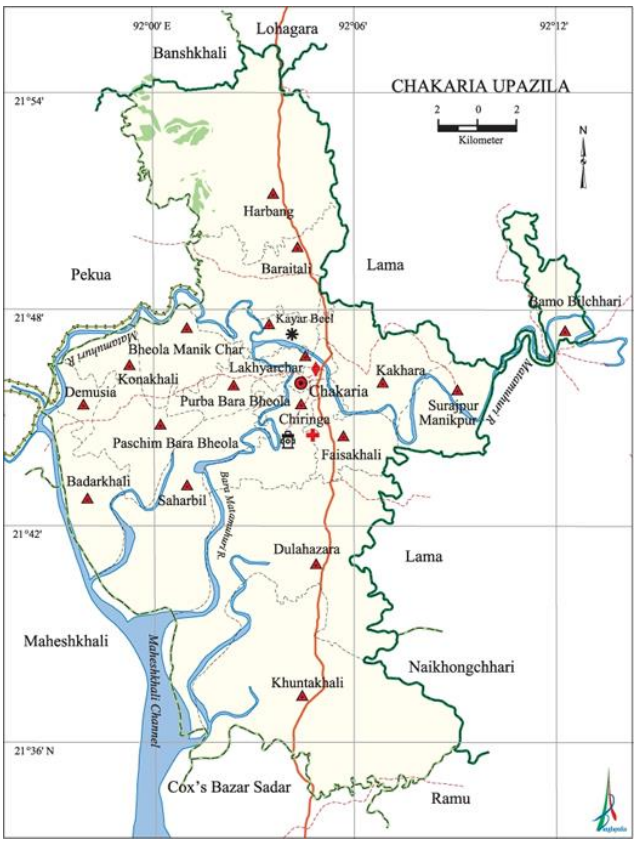
(1) Kutubdia Upazila (shown on the right[113]) is cut off from the mainland by the Kutubdia Aqueduct and has poor access to the mainland. Furthermore, there are frequent cyclones, storm surges, and cyclone-induced rumblings, and the 1991 cyclone was a catastrophe that flooded most of the island and killed 10,000 people.



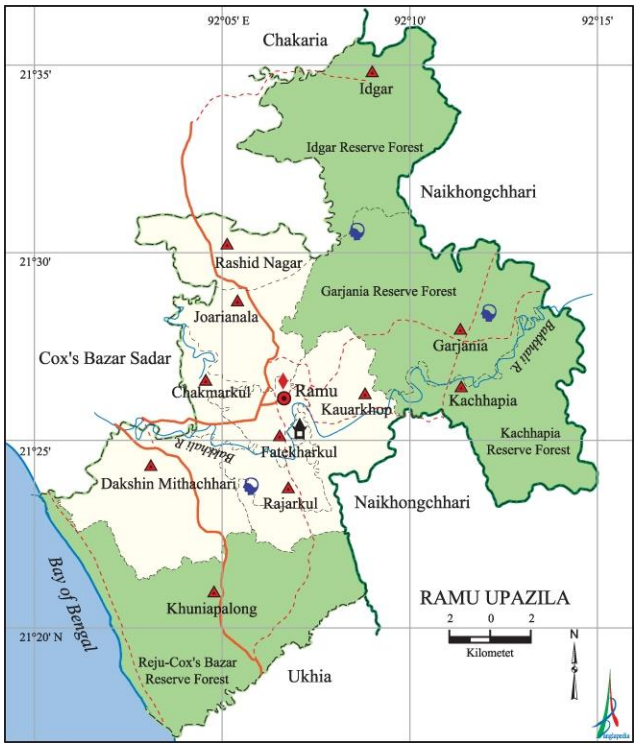
(2) Pekua Upazila (shown on the right[114]), although located along the Bay of Bengal, is at the end of the Kutubdia Channel and is too remote for artisanal fishermen to engage in marine fishing in the Bay of Bengal.

[113] https://en.banglapedia.org/images/7/7a/KutubdiaUpazila.jpg, Asiatic Society of Bangladesh
[114] https://en.banglapedia.org/images/2/24/PekuaUpazila.jpg, Asiatic Society of Bangladesh

(3) Chakaria Upazila (shown on the right[115]) is only partly covered by the innermost part of the Moheshkari Channel.



(4) Ramu Upazila (shown on the right[116]) is sandwiched between Cox's Bazar Sadar and Ukhia, with the Reju-Cox's Bazar protected forest zone looming up to the short coastline facing the Bay of Bengal, leaving little room for marine fishing activities.



[115] https://en.banglapedia.org/images/9/94/ChakariaUpazila.jpg
[116] https://en.banglapedia.org/images/3/37/RamuUpazila.jpg

Based on the above, it seems that the scope for development of marine artisanal fisheries in Cox's Bazar at present is limited to Ukhia, Cox's Bazar Sadar, Teknaf and Moheshkhali Upazilas. Therefore, this study will be limited to the above four upazilas. The population and literacy rates for the four upazilas are shown below in Figure 4-3.

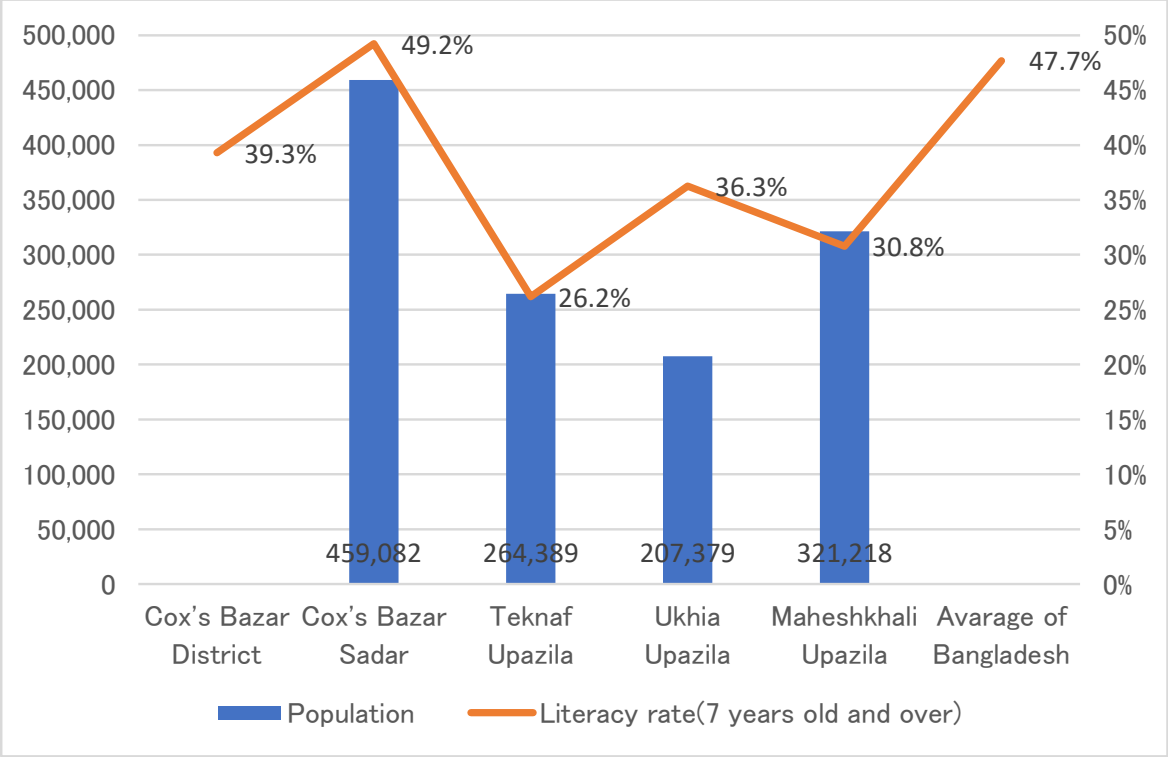


Figure 4-3 Population and Literacy Rate in the Four Upazilas of the Study Area

Source: Bangladesh Housing & Population Census 2011

The literacy rate is considered to be one indicator of poverty. The overall literacy rate in Cox's Bazar is 39.3%, which is below the national average of 47.7%, while the rate in Cox's Bazar Sadar is higher at 49.2%. However, the other three upazilas, Ukhia, Moheshkhali, and Teknaf, are far below the average at 36.3%, 30.8%, and 26.2% respectively[117]. In addition, according to a report[118] analyzing the poverty group levels by each Upazila, Cox's Bazar Sadar is considered as Low level of poverty, while Moheshkhali, Teknaf and Ukhia are considered as Moderate, High and Very High levels of poverty, respectively. Therefore, the poverty level in these areas is high.

4-2-3 Influx of Refugees from Myanmar

In Cox's Bazar District, particularly Teknaf and Ukhia Upazilas, the recent influx of refugees from neighboring Myanmar has put pressure on the livelihood of the local people. Originally, the refugees are Bengali Muslims living in Myanmar's Rakhine State, were not recognized as an ethnic group in Myanmar,

[117] Bangladesh Housing & Population Census 2011

[118] POVERTY MAPSOF BANGLADESHKEY FINDINGS2016（Bangladesh Bureau of Statistics、World Food Programme）2020

and they were treated as illegal Bengali immigrants and persecuted due to the popular sentiment of Muslim exclusion in Myanmar.

The influx of the refugees from neighboring Myanmar into Bangladesh has been observed since 1978, and as of 1991, approximately 270,000 Refugees were housed in refugee camps in Cox's Bazar and Bamboldoon districts. It is believed that a significant number of the refugees at that time remained in Bangladesh. The influx of the refugees into Bangladesh became prominent in the 2010s, with an influx of about 700,000 refugees in six months in 2017, and the number of registered refugees living in refugee camps exceeded one million in January 2018. The Government of Bangladesh does not recognize the refugees coming in from Myanmar as either refugees or its own citizens. However, in response to the rapid growth of the Refugees influx, which has attracted international attention, the Government has gradually expanded support for the refugees by international organizations and NGOs since around September 2017.

The majority of the refugees, currently estimated at 1.4 million, live in camps and communities in Cox's Bazar District, with the majority living in camps and other areas in Ukhia and Teknaf Upazilas. In both of these upazilas, refugee camps are being built, facilities are being constructed, hillsides and forests are being destroyed to secure fuel wood, well drilling is affecting underground aquifers, air pollution is being caused by increased traffic, and plastic bottles and bags are being discarded, and this is also being seen as a massive destruction of the ecosystem that may be irreversible.

The refugees are living not only in the built-up camps but also in neighboring communities, and in those host communities, the rapidly growing number of the refugees is causing negative impacts such as reduced employment opportunities for the residents, lower labor wages, and higher prices of living goods[119].

The number of registered refugees is about 945,000 in Ukhia Upazila and 441,000 in Teknaf Upazila, making a total of about 1,357,000 refugees living in the two upazilas. In contrast, according to 2011 statistics, the population of Ukiah Upazila is 207,379 and Teknaf Upazila is only 264,389, meaning that the ratio of refugees to residents is 455% in Ukiah Upazila and 155% in Teknaf Upazila.

Table 4-6 below shows the number of registered refugees in Ukiah and Teknaf Upazilas as of January 2021, by camp and by community.

[119] What is the Rohingya Issue? (Akashi Shoten,2019)

Table 4-6 Breakdown of the Number of Refugees in Ukhia and Teknaf Upazila

Upazila	Union	Location	Population		
Ukhia	①Haldia Palong	Communities	50,968	945,348	1,357,110
	②Ranta Palong	Communities	28,410		
	③Raja Palong	Kutupalong RC	17,024		
		Communities	59,695		
	④Palong Khali	Camp 14 / Hakimpara	32,848		
		Camp 15 / Jamtoli	51,327		
		Camp 16 / Bagghona Potibonia	21,403		
		Kutupalong Expansion Site	603,315		
		Communities	31,880		
	⑤Jalia Palong	Communities	48,478		
Teknaf	⑥Whykong	Camp 21 / Chakmarkul	16,995	411,762	
		Camp 22 / Unchiprang	21,329		
		Communities	60,014		
	⑦Bahachhara	Camp 23 / Shaplapur	6,559		
		Communities	28,098		
	⑧Nhilla	Camp 24 / Leda	26,717		
		Camp 25 / Alkhali	7,778		
		Camp 26 / Nayapara	40,661		
		Camp 27 / Jadimura	15,507		
		Nayapara RC	22,578		
		Communities	49,927		
	⑨Teknaf	Communities	41,977		
	⑩Teknaf Paurasahva	Communities	29,069		
	⑪Sabrang	Communities	44,553		

Source: Bangladesh: cox's Bazar refugee response(4W)- June 2021 ISCG

Furthermore, refugees from neighboring Myanmar live not only in camps but also in villages and communities in both upazilas. 165,526 people, more than half of the total number of refugees in Teknaf Upazila, live in communities, which is equivalent to about 80% of the resident population.

Figure 4-4 below shows the location of refugee camps and communities in Teknaf Upazila, along with the number of refugees.

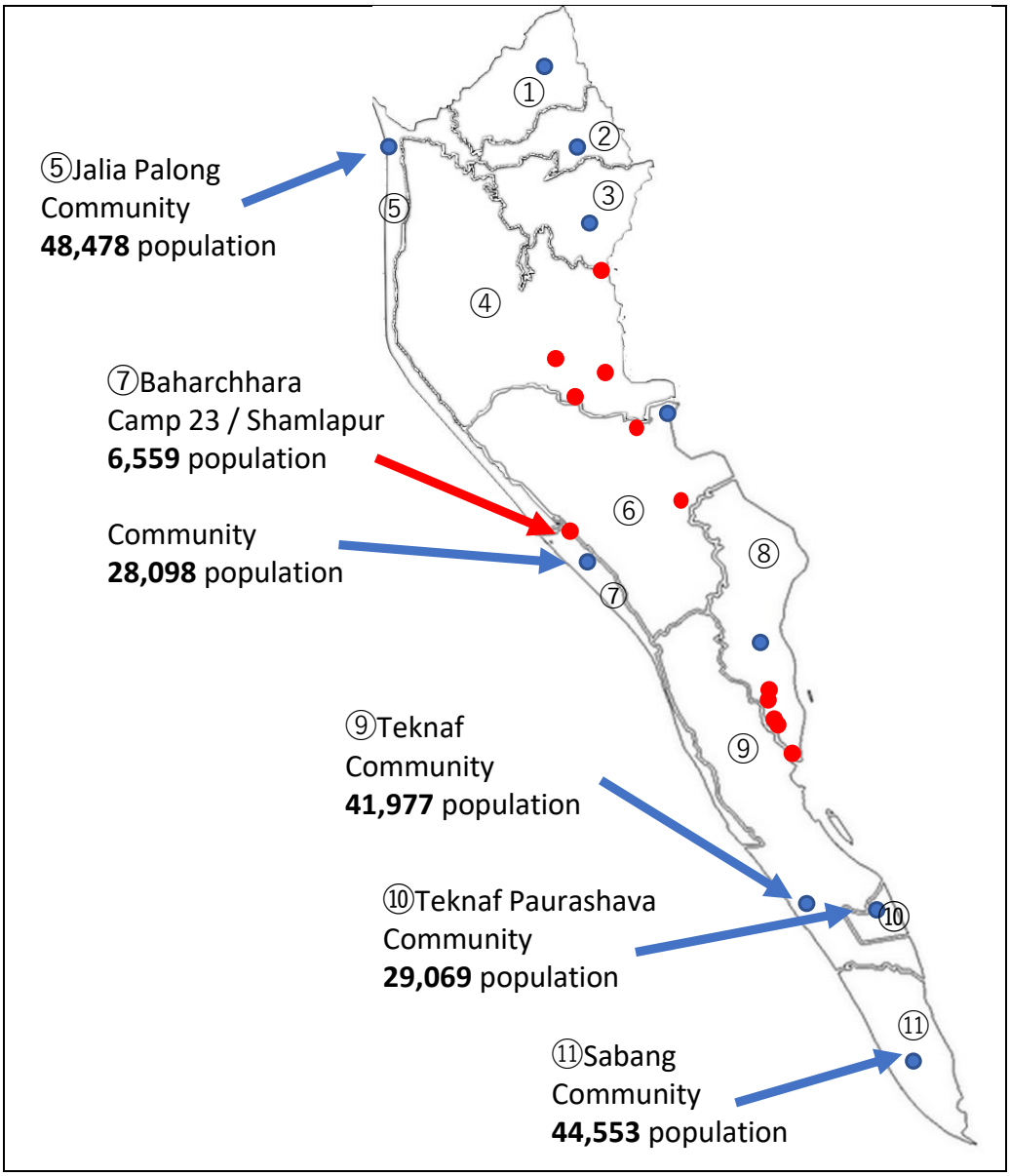


Figure 4-4 Location of Refugee Camp Communities and Number of Refugees on the Bengal Coast
Source: Bangladesh:cox's Bazar refugee response(4W)- June 2021 ISCG

As shown above in Figure 4-4 there are several refugee camps and communities in the hills as well as on the coast of the Bay of Bengal, where a significant number of the refugees live, and there are concerns about the impact on local means of livelihood such as artisanal fishing.

The large number of the refugees from neighboring Myanmar living inside and outside the community has had a significant impact on the livelihood of the residents, especially the rising prices of commodities as well as the increasing competition for scarce employment opportunities. According to a report comparing the socioeconomic status of 35 villages in 2015 and 2020, before and after the influx of refugees, the average annual income of the residents decreased from 187,000 taka to 147,000 taka. The most affected occupations were fishing and day labor, with fishermen's annual income decreasing from 129,000 to 99,000 taka and day laborers from 104,000 to 65,000 taka, a decrease of 23% and 37%

respectively[120]. These lower incomes have greatly reduced the quality of life for fishermen and day laborers. Figure 4-5 below shows changes in the households of fishermen and day laborers based on a survey of the distribution of households by occupation.

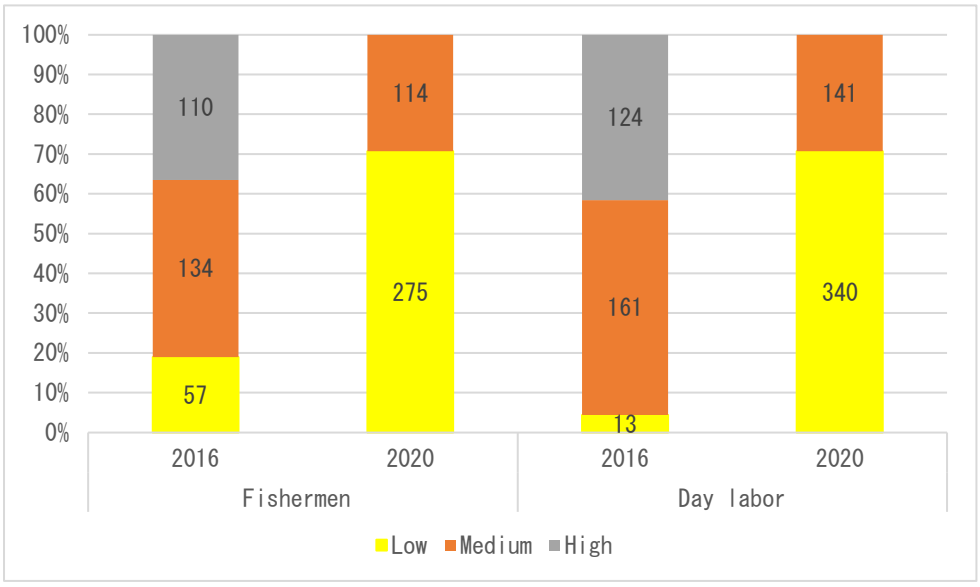


Figure 4-5 Household Distribution Survey by Occupation
Source: Socioeconomic Status Changes of the Host Communities, Ultah et al. 2021

The negative impact on the socioeconomic conditions of the residents has also had a significant impact on sentiment toward the refugees from neighboring Myanmar, and sentiment toward the refugees, which was relatively positive before the mass influx, has declined significantly and become negative after the mass influx (Figure 4-6).

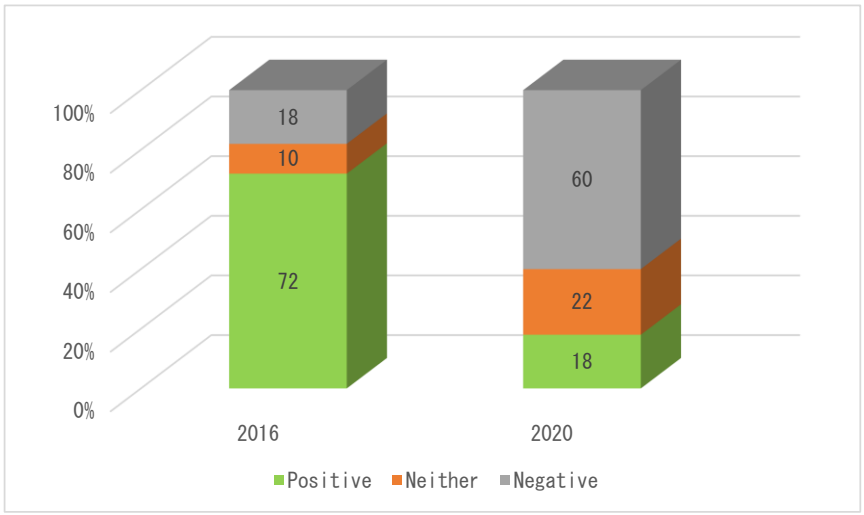


Figure 4-6 Sentiment of Residents Toward Refugees from neighboring Myanmar
Source: Socioeconomic Status Changes of the Host Communities, Ultah et al. 2021

[120] Socioeconomic Status Changes of the Host Communities, Ultah et al. 2021

4-3 Overview of Fisheries Value Chain in South Chattogram Region

4-3-1 Overview of Marine Fisheries in the Target Area

The western part of the South Chattogram region is blessed with a long coastline of about 250 km overlooking the Bay of Bengal, and with shallow waters with a gentle slope, fishery resources are diverse and abundant, and the region boasts one of the highest landings and production volumes of sea fisheries in the country.

The quantity of fish landed in these waters fluctuates greatly depending on the season. It is believed that the large amount of river water that flows into the Bay of Bengal during the rainy season lowers the salinity of the bay, causing fish to migrate to deeper waters. Every summer, monsoon rainwater flows into the Bay of Bengal from the Indian subcontinent, creating a layer of low-salinity seawater on the surface of the Bay of Bengal. While the salinity of the surface layer of the Bay of Bengal during the dry season is 30 ppt, it drops to nearly 20 ppt during the rainy season.

The closed season for fishery is also a factor in the annual fluctuation of landings. There is a 65-day ban on marine fishing from May 20 to July 23, and an October 3-25 ban on Hilsa. Accordingly, the quantity of fish landed in the six-month period up to July is affected by both the barrier fishing season and the closed season, and is significantly lower than the six-month period from August to January.

Figure 4-7 below shows the monthly landings of the BFDC Ghat in Cox's Bazar.

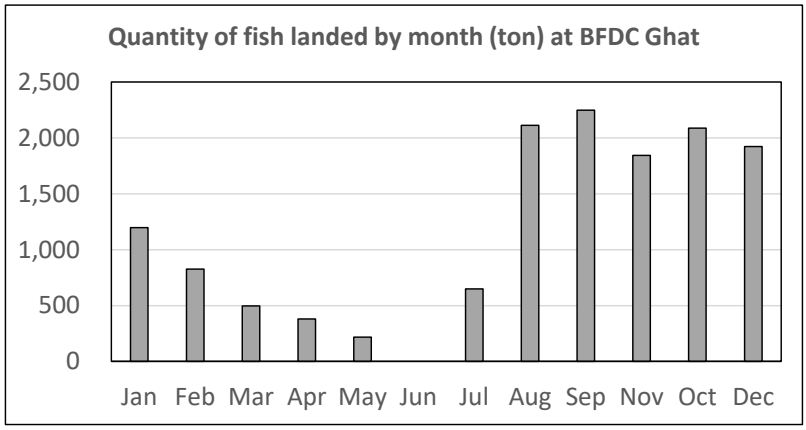


Figure 4-7 Monthly Landings at BFDC Ghat in Cox's Bazar

Source: Survey Result

The annual landing volume at BFDC Ghat is about 14,000 tons, accounting for about 12% of the total landing volume of Cox's Bazar Sadar, which is the main landing site in the county along with Nazirtek, Chofoldondi and Islampu. Fishing boats using BFDC Ghat include boats that are also landing at the landing sites along the Bay of Bengal in Teknaf.

Table 4-7 Marine Fisheries Production by Upazila in Cox's Bazar District (tons)

Upazila	Fish production by Marine fisheries(ton)
①Cox's Bazar Sadar	117,758
②Teknaf	12,807
③Ukhiya	1,073
④Maheshkhali	7,233
⑤Kutubdia	745
⑥Pekua	159
⑦Chakaria	85
⑧Ramu	140
Total	140,000

Source: Strengthening resilience of coastal fisher communities in Cox's Bazar for improving livelihood ecologically and economically (WorldFish)

The catch landed in Cox's Bazar is not only widely distributed in Chattogram, the capital Dhaka, and inland areas of Bangladesh, but is also exported. Cox's Bazar is also Bangladesh's largest dried fish processing center, producing 25,000 tons per year, with much of the raw fish sourced from Chattogram as well as from the Cox's Bazar region.

4-3-2 Outline of Landing Sites

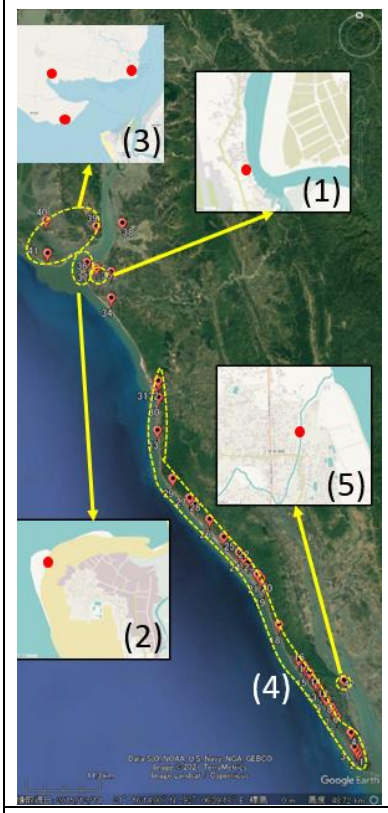
There are numerous landing sites in the target area, including naturally occurring ones, and regional differences are recognized in their characteristics. In this study, the characteristics of these landing sites and the results of the fishery activity survey were analyzed, as well as the results of the survey conducted by the WorldFish Center on suitable landing infrastructure development sites.

The landing sites and photographs of Cox's Bazar and Teknaf that were covered in this study are shown in Figure 4-8.

(1) Cox's Bazar BFDC Ghat

(2) Nazirtek Landing site

(3) Moheshkhali Landing site (Gorokghata)



Location of landing sites

(4) Landing site along Bay of Bengal

(5) Teknaf city Ghat

Figure 4-8 Main Fish Landing Sites in Cox's Bazar District

Source: Survey Result ((4) BORI)

The largest landing site in the Cox's Bazar area is the Cox's Bazar BFDC Ghat managed by BFDC, but more than 30 smaller landing sites have been identified in other areas in Nazirtek, southern Moheshkhali Island, Teknaf city, and along the coast of the Bay of Bengal.

・Cox's Bazar BFDC Ghat

The Cox's Bazar sadar has the largest volume of landings in the target area, and the Cox's Bazar BFDC Ghat ((1) in the previous Figure 4-8) and Nazirtek ((2) in the previous Figure 4-8) are the main landing sites in this area.

Cox's Bazar BFDC Ghat is a landing site on the Bakkali River, which flows into the Moheshkhali Channel connecting to the Bay of Bengal. The landing facilities include a wharf, jetty, covered cargo handling area and ice factory, which are operated by the BFDC. The facility also functions as a wholesale market, and the landings traded at the facility are shipped long distances by truck to mass consumption areas such as Chattogram and Dhaka.

・Nazirtek

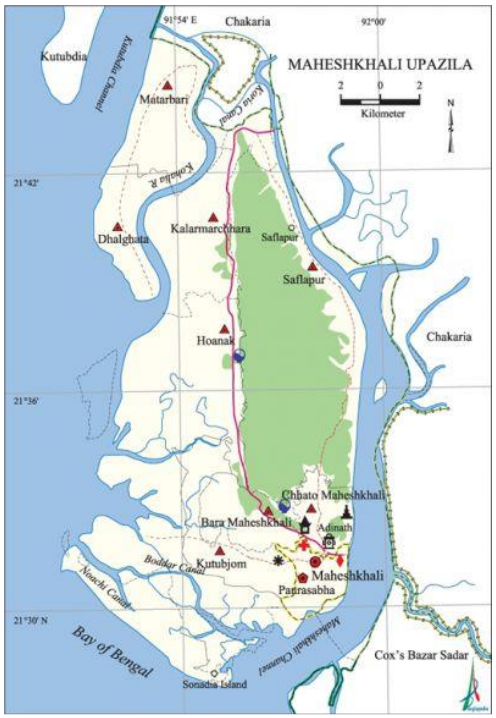
Nazirtek is a shallow sandy beach area between the Moheshkhali Canal and the Bay of Bengal, located on the west side of the airport from the BFDC Ghat. There are no facilities for landing, no mooring facilities, no cargo handling areas, and all landing activities and preparations for fishing are performed

on the beach.

This area has the country's largest dried fish processing area in the adjacent area, so the catch is mainly landed for dried fish processing.

However, there are plans to relocate the dried fish processing area to a site on the other side of the BFDC Ghat, as the adjacent area of the dried fish processing area is being used for airport expansion, and Nazirtek will not continue to be used as a landing site.

・Moheshkhali



The Moheshkhali landing sites Gorokghata, Gotibanga, and Sonadia Island are located in the southern part of Moheshkhali Upazila, across the Moheshkhali Canal from Nazirtek. This area is the second most productive dried fish processing area after Nazirtek, and the landings in the study target area are mainly of raw fish for dried fish processing in the vicinity.

Not only is the island separated from the mainland by the Moheshkhali Channel, but the southern part of Moheshkhali Upazila is also divided by the Noachi Canal and the Boddar Channel, making intra-island transportation a challenge. At the southern end, separated from the mainland by the channel, is Sonadia Island, where a deep-water port was planned until the Matarbari Port Project was realized. The 1991 cyclone devastated the fishing villages and dried fish processing areas in the coastal zone, forcing the relocation of the main dried fish processer from Moheshkhali to Nazirtek, and slowing down the dried fish processing activities in the area.

・Teknaf city Ghat

The Teknaf city landing site is an urban landing site formed on both sides of a narrow channel located in the area up the Naf River from the Bay of Bengal.

In the past, the catch in the Naf River was landed, but now that the Naf River is completely closed to fishing for security reasons due to the heavy influx of the refugees from neighboring Myanmar, fishing boats only go to the Bay of Bengal. The narrow channel and shallow depth of the water limits the access of fishing boats during low tide, and it also provides a safe refuge for fishing boats during stormy weather. As for landing facilities, simple mooring facilities managed by wholesalers and cargo handling facilities for fish catches line the waterways.

・Sandy beach landing site on the Bay of Bengal coast

More than 30 landing sites of various sizes have been identified along the 30 km coastline of the Bay

of Bengal from Ukhia to Teknaf. The Cox's Bazar National Highway (Marine Drive) stretches along the Teknaf Peninsula, and the sandy beach on the west side of the road is considered to be the landing site for this area. On the shallow sandy beaches overlooking the Bay of Bengal, there are many subsistence artisanal fishermen. Unlike other landing sites, traditional crescent-shaped wooden fishing boats called sampans are used to fish in coastal waters. There are no landing facilities, and landing activities take place on the beach. Some of the catches landed at the landing sites are bought by local middlemen, while others are taken by the fishermen themselves to markets in Teknaf for sale.

Next, the characteristics of the four surveyed landing sites were compared in Table 4-8. Only the BFDC Ghat and Teknaf city Ghat are allowed to have landing facilities such as moorings, but the landing facilities at Teknaf city Ghat are simple and the BFDC Ghat is larger than Teknaf in terms of the scale of landing activities. There are auction sites near all landing sites except for Nazirtek. This is due to the fact that Nazirtek's landings are for raw fish for nearby dried fish processing.

Other landings along the coast of the Bay of Bengal also have no landing facilities.

Table 4-8 Characteristic of Main Fish Landing Sites in Cox's Bazar District

Item	Pier	Mooring facilities	Fishing boats	Fishing gear	Fishermen	Auction hall	Ice plants	Ice supply (pcs BLC ICE)
BFDC Ghat	1	8	1,363	26,300	2,085	20	21	741,400
Nazirtek	0	0	487	9,740	17,510	0	0	0
Teknaf	0	30	145	2,077	778	11	1	30,460
Moheshkhali	0	0	583	6,185	3,836	8	2	110,000

Source: Survey Result

Remark : In the table, Teknaf and Moheshkhali refer to the Teknaf city Ghat and Gorokghata landing site, respectively.

4-3-3 Fish Species Caught

As for the species of fish landed by marine fisheries in the region, Bombay duck is the most common, followed by Jew fish and Pomfret, with these three species accounting for about 40% of the total (Figure 4-9). On the right in Figure 4-9 is a breakdown of fish species caught in the Cox's Bazar area, followed by a breakdown of fish species caught in the study landing sites.

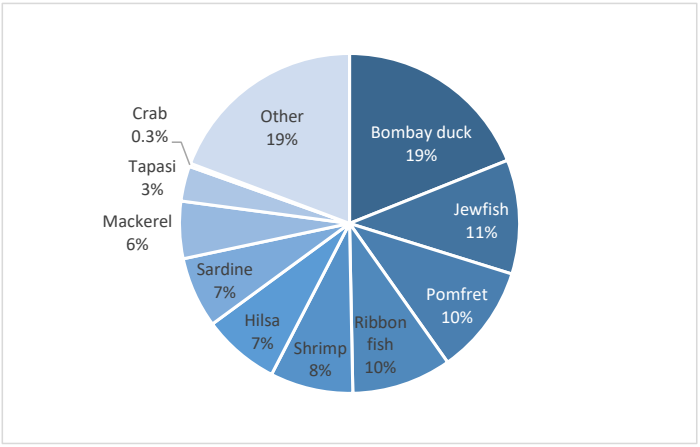


Figure 4-9 Major Fish Species in Marine Fisheries

Source: Survey report on Fish value chain in Cox's Bazar District in Bangladesh（Shushilan）

Table 4-9 Breakdown of Catch by Fish Species by Landing Site

	Cox's Bazar BFDC Ghat		Nazirtek		Teknaf		Moheshkhali	
Hilsa	2,321	17.5%	533	7.0%	236	12.9%	1,913	25.8%
Sea catfish	1,807	11.6%	912	12.0%	199	10.9%	745	10.2%
Tuna	1,284	9.7%	646	8.5%	146	8.0%	565	7.8%
Pomfret	1,066	8.0%	682	9.0%	210	11.6%	520	8.0%
Jewfish	746	5.6%	454	6.0%	178	9.8%	487	6.7%
Bombay duck	887	5.5%	1,140	15.0%	175	9.5%	580	7.8%
Sardine	705	5.3%	343	4.5%	88	4.8%	339	4.2%
Ribbon fish	691	5.2%	1,290	17.0%	182	9.9%	569	7.8%
Mackerel	624	4.7%	492	6.5%	154	8.3%	269	4.5%
Other	3,561	26.8%	1,102	14.5%	259	14.2%	1,122	17.1%
Total	13,691	100%	7,594	100.0%	1,829	100.0%	7,107	100.0%

Source: Survey Result

4-3-4 Fishing Boats and Methods

The number of fishing boats in the Cox's Bazar area is estimated to be about 6,800[121].
In terms of regional breakdown, Teknaf had the largest number of boats at just under 1,800, followed by Cox's Bazar Sadar with 1,400. There are about 1,200 unpowered fishing boats, which account for about 18% of the total number of fishing boats.

Table 4-10 Number of Fishing Boats by Upazila in Cox's Bazar District (tons)

Upazila	Motorized fish boat	Non-motorized fish boat	Total
①Kutubdia	745	120	865
②Pekua	350	90	440
③Chakaria	450	160	610
④Moheshkhali	950	245	1,195
⑤Cox’s Bazar Sadar	1,250	150	1,400
⑥Ramu	100	50	150
⑦Ukhia	250	80	330
⑧Teknaf	1,454	340	1,794
Total	5,549	1,235	6,784

Source: Survey report on Fish value chain in Cox’s Bazar District in Bangladesh (Shushilan)

Figure 4-10 below shows the different types of fishing boats. Most of the fishing boats are wooden, with the larger ones having engines of 75 hp or more, while the smaller ones have engines of 20 hp or less. Traditional fishing boats called sampans are mainly used for fishing along the coast of the Bay of Bengal. Unpowered fishing boats are also used for fishing in shallow waters close to the shore.

[121] Survey report on Fish value chain in Cox’s Bazar District in Bangladesh, Shushilan

(1) Wooden fishing boat (Large)

(2) Wooden fishing boat (Small)

(3) Small wooden fishing boat without motor

Traditional wooden boat with motor

Figure 4-10 Type of fishing boats

Table 4-11 below shows the number of fishing boats and gears used and the amount of landings by survey site. Of the four landing sites, the BFDC Ghat has the largest number of fishing boats and gears, with approximately 1,376 boats and 26,300 small boats respectively, and an annual landing volume of approximately 14,000 tons. While the number of boats using Gorokghata landing site and Nazirtek is about 580 and 490, respectively, but the volume of landings is about the same. Teknaf city Ghat, which has the least number of boats in use, has about 10% of the number of boats in use at the BFDC Ghat.

The total number of fishing boats operating in the Bay of Bengal using the 50 or so identified landing sites in the Cox's Bazar Sadar, Ukhia and Teknaf districts is estimated to be 2,050[122].

Table 4-11 Information on Fishing boats at Major Landing Sites in Cox's Bazar District

	Number of fishing boats	Total HP of engines (HP)	Total of fishing gears	Total landing volume (ton)
BFDC Ghat	1,376	73,111	26,300	13,984
Nazirtek	487	21,576	9,739	7,594
Teknaf	145	4,463	2,077	1,828
Moheshkhali	583	25,271	6,185	7,338

Source: Survey Result

Remark: In the table, Teknaf and Moheshkhali refer to the Teknaf city Ghat and Gorokghata landing site, respectively.

Figure 4-11 to Figure 4-16 below show the engine power of fishing boats in each landing site, the number of crew members by engine power, the annual catch by engine power, the number of boats by fishing method, the number of fishing gears by type, and the number of days per fishing trip by fishing method.

The fishing boats with the highest engine output use the BFDC Ghat the most, with more than 40% of

[122] Survey report on Fish value chain in Cox's Bazar District in Bangladesh, Shushilan

the total number of fishing boats having engine output of 75 hp or more. On the contrary, the lowest engine power of the fishing boats used was Teknaf city Ghat, and all of them had an engine power of 47 hp or less.

As for the number of crew members by engine power, the trends of BFDC Ghat and Nazirtek were similar: fishing boats with 75 horsepower and above had 30 crew members, those with 75 horsepower had 25 crew members, and those with 47 horsepower had 17 crew members, which is relatively high, while boats at Teknaf city Ghat had the lowest number of crew members, around 8 even for boats with 47 horsepower.

From the annual catch by engine power, it is possible to understand the trend of fishing boats contributing to the landings at each landing site, with 75 hp boats landing the most at the BFDC Ghat and Nazirtek, 47 hp boats landing the most at Gorokghata landing site, and 23 hp boats landing the most at Teknaf city Ghat.

In terms of the breakdown of the number of boats by fishing method, MSBN was the most common method at the BFDC Ghat and Nazirtek, while in Gorokghata landing site, drift gillnet for Hilsa and MSBN were the most common methods. On the other hand, in Teknaf city Ghat, it was evident that various fishing methods such as dragnet, drift gillnet, and MSBN were used without any bias.

The breakdown of the number of fishing gears used showed that drift gillnets for Sardine were the most common gears used at the BFDC Ghat, MSNB at Nazirtek, and drift gillnets for Hilsa at Gorokghata landing site and Teknaf city Ghat.

The number of days of operation per fishing trip was about 2 days only at Teknaf city Ghat, while in other landing sites it was longer, ranging from 6 to 10 days.

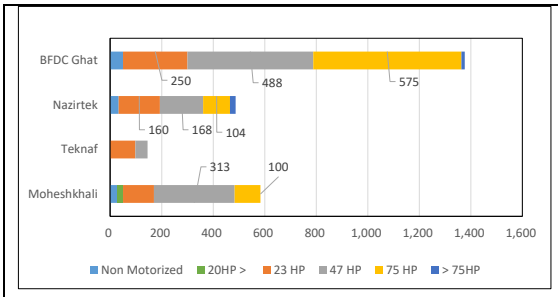


Figure 4-11 Number of Fishing Boats by HP

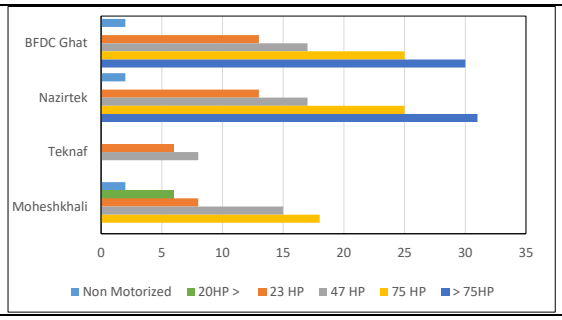


Figure 4-12 Number of Crews by HP

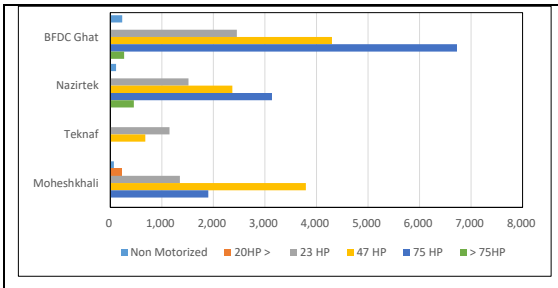


Figure 4-13 Fish Catch Volume by HP (ton／year)

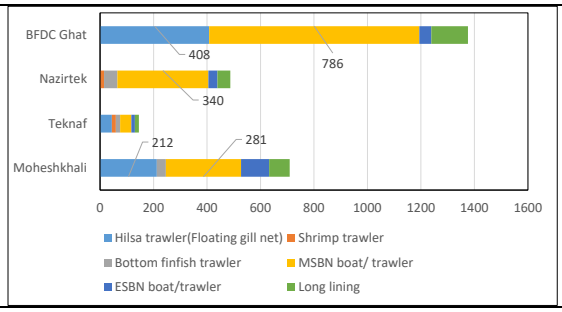


Figure 4-14 Number of Fishing Boats by Fishing Method

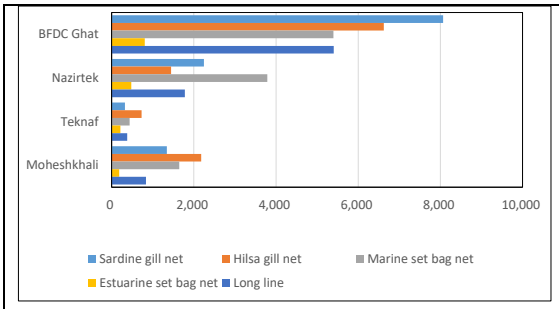


Figure 4-15 Number of Fishing Gears by Landing Sites

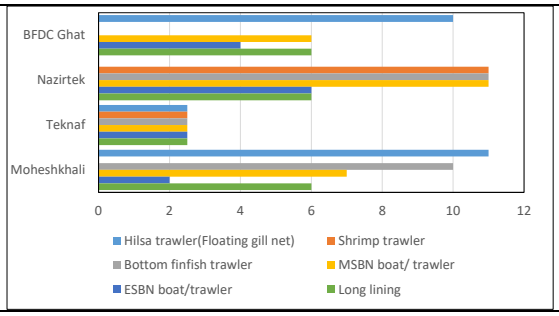


Figure 4-16 Operating Days per One Trip by Fishing Gears

Source: Survey Result

Remark: In the figure, Teknaf and Moheshkhali refer to the Teknaf city Ghat and Gorokghata landing site, respectively.

4-3-5 Ice Production and Distribution

The main form of ice used in the area is block ice, and there are ice factories in various locations. Among the surveyed sites, the BFDC Ghat has a directly operated ice factory on its premises, and several private ice factories were also found in the vicinity. There is no ice factory in Nazirtek, which is located west of the BFDC Ghat across the airport, so ice is transported from the ice factory close to the BFDC Ghat, where it is temporarily stored in a cold storage facility for ice storage. In Moheshkhali and Teknaf city Ghat, there are private ice factories near the landing sites where block ice is produced. A typical block of ice is 2.5 x 1.5 x 1 foot in size and weighs 70-80 kg. The ice has some quality problems due to clay, mud, and metal contamination caused by the water quality and aging of the ice machines. In addition, while the demand for ice during the closed season is limited to some fish farms and processed fish, the demand for ice fluctuates greatly during the peak fishing season, when ice is in short supply and prices can soar, and ice production does not match the demand during the peak season. Ice plants near the small landing sites scattered along the coast of the Bay of Bengal, such as Shaplapur (Teknaf Upazila), have been in limited supply, and ice had to be procured from Cox's Bazar or Teknaf city. However, in response to the strong demand for ice, an ice plant with a daily ice making capacity of 25 tons is being constructed in Shaplapur and surrounding areas, improving access to ice at landing sites along the Bay of Bengal coast. According to the ice factory owners and other stakeholders, the investment cost for the ice factory can be recovered in a short period of time, even considering the fact that ice is hardly sold during off-season and closed season.

The block ice is crushed by ice crushers or manpower and applied to the fresh fish when it is used for fishing or for distribution after landing.

The block ice made at the BFDC Ghat is transported from the jetty to the fishing boats before they leave the fishing grounds and is also crushed and iced on the fresh fish when they are traded or packed for shipment. The amount of ice applied during distribution is relatively high for high-priced species such as Pomfret, Shrimp, and Hilsa, but insufficient for low-cost species such as Bombay duck.

The status of ice production and block ice transportation in the target area is shown below in Figure 4-17.

(1) Ice plant (Cox's Bazar BFDC Ghat)

(2) Ice loading at Cox's Bazar BFDC Ghat

(3) Ice Plant (Moheshkhali)

(4) Ice loading for fishing boat (Moheshkhali)

(5) Ice loading for fishing boat (Cox's Bazar)

(6) Ice stocker (Nazirtek)

Figure 4-17 Ice Making and Block Ice Transportation in the Target Area

Source: Survey Result

4-3-6 Wholesale Market and Retail Market

The wholesale and retail markets in the target area handle marine fish from nearby and distant landing sites and fish from inland aquaculture. Interviews with market participants revealed that the wholesale and retail market in Cox's Bazar handles not only fresh fish from the BFDC Ghat but also fresh fish from Shaplapur and Chattogram, while the wholesale and retail market in downtown Teknaf has recently seen an increase in the distribution of fresh fish from Shaplapur and other sandy beach landing sites along the Bay of Bengal coast. In addition, at the wholesale market near the Shaplapur landing site, fresh fish being iced and packed for direct shipment to Chattogram were observed, in addition to fresh fish for shipment to nearby markets. These photos are shown on Figure 4-18.

It was confirmed that the landings of the target area are widely distributed not only to consumers near the production area but also to distant consumption areas such as Chattogram, and at the same time, the wholesale market functions as a distribution center for fresh fish between distant consumption areas and distant production areas. However, the market facilities are aging, and the poor drainage of the facility floors and sales tables make it difficult to handle fresh fish hygienically.

	
(1) Selling fresh fish in a wholesale and retail market (Cox's Bazar Bahar Chara Bazar Fish Market)	(2) Overview of the dilapidated retail market (Cox's Bazar Kanaier Bazar Retail Fish Market)
	
(3) Selling fresh fish in the wholesale and retail market (Teknaf upper Bazar retail market)	(4) Overview of the wholesale and retail market (Teknaf upper Bazar retail market)
	
(5) Trading of fresh fish landed in the market (Shaplapur Fish market)	(6) Packing of fresh fish for shipment to Chattogram (Shaplapur Fish market)

Figure 4-18 Market Conditions in the Target Area

Source: Survey Team survey results

4-3-7 Fish Processing

The distribution pattern of fish products landed in the target area differs depending on the fish species. Nearly 80% of the landed fish, such as Bombay duck and Ribbon fish, are used as raw fish for dried fish processing, and about 20% of Hilsa, which is of lower quality, is used for salt storage (Table 4-12).

Table 4-12 Distribution Patterns by Fish Species

	Pomflet	Hilsa	Mackerel	Sea catfish	Jewfish
Fresh fish without ice	40 ±15	18 ±5	22 ±11	23 ±6	30 ±12
Fresh fish with ice (partial)	60 ±23	51 ±12	41 ±18	52 ±18	44 ±24
Frozen/thawed-wet fish	8 ±2	11 ±3		16 ±4	9 ±4
Freezinng for export		8 ±2			
Drying	18 ±10		28 ±7	18 ±13	20 ±11
Salting		18 ±8			
Fermentation					
Others		8 ±5	11 ±11	11 ±2	5 ±5
	Sardine	Tuna	Bombay duck	Ribbon fish	Other
Fresh fish without ice	18 ±5	9 ±4		17 ±8	16 ±5
Fresh fish with ice (partial)	47 ±18	68 ±6	18 ±5	18 ±11	52 ±17
Frozen/thawed-wet fish		14 ±4			8 ±2
Freezinng for export		13 ±4			7 ±3
Drying	33 ±18		80 ±8	77 ±11	20 ±9
Salting					
Fermentation					10 ±5
Others	1 ±3	8 ±4	5 ±1	7 ±3	

Source: Survey Result

Nazirtek is the largest fish processing area in Bangladesh. There are two drying methods: laying the fish out on a drying table, and hanging the fish on wooden hangers set up vertically. The former method is used to process dried fish such as Bombay duck, while the latter is used to process dried fish such as Ribbon fish. The current dried fish processing area is government land that is rented out to private processors for dried fish production, and the dried fish processing area is removed every year during the rainy season. In addition to dried fish, salted Hilsa and fermented food (Ngapi) are also produced in this area. The following figure shows the status of fish processing.

(1) Fish processing area（Nazirtek）

(2) Fish processing area（Nazirtek）

(3) Fish processing (dried)

(4) Fish processing (dried)

(5) Fish processing (salted: Hilsa)

(6) Fish processing (Ngapi)

Figure 4-19 Fish Processing Areas

Source: Survey Team survey results ((1) and (2) BORI)

According to the literature surveying the major fish processing areas in Cox's Bazar District, the Cox's Bazar District alone produces about 25,000 tons of dried fish per year and employs about 11,000 workers. The largest producer is Nazirtek with about 9,000 tons per year, followed by Sonadia with 3,000 tons (Table 4-13).

Table 4-13 Dried Fish Processing Production and Number of Processing Workers by Region

Upazila	Location	Production(ton/year)		Number of Labors	
Cox's Bazar Sadar	Nazirtek	9,000	±1000	2,750	±250
	Kutubdiapara	1,350	±150	900	±100
	Nunierchara	1,350	±150	750	±50
	Shaplapur,Khurusul	550	±50	225	±25
	Chowfalldandi	350	±50	190	±10
Moheshkhali	Gothibanga	1,100	±100	450	±50
	Sonadia	3,000	±500	1,350	±150
	Dhalghata-Matarbari	1,350	±150	900	±100
	Goroghata Charpara	900	±100	450	±50
	Goroghata Ghat	450	±50	225	±25
	Sairardel-Matarbari	750	±50	250	±50
	Ahmadiakata	350	±50	250	±50
Kutubdia	Khuiddartek	1,100	±100	550	±50
	Moheshkhalipara	500	±100	250	±50
	Baraghope	600	±100	325	±75
Teknaf	Saint Martine's Island	750	±50	350	±50
	Shaplapur,Baharchora	400	±100	250	±50
	Dorgarchora	450	±50	175	±25
	Shahparir dweep	450	±50	350	±50
	Sabrang	350	±50	225	±25
Total		25,100		11,165	

Source: Strengthening resilience of coastal fisher communities (Host communities) in Cox's Bazar for improving livelihood ecologically and economically

The following table is an overview of the dried fish processing in each survey area of this study.

Nazirtek has the largest number of fish processers, employees, and production volume, with an annual production volume of about 8,600 tons, which is equivalent to about 80% of the entire survey area. Because the weight of processed raw fish is considered to be three to four times the weight of the product, the amount of processed raw fish in Nazirtek is calculated to be 33,275 tons, which is more than the 30,221 tons of raw fish landed in the study area.

Table 4-14 Number of Fish Processers and Processed Production by Region

	Number of dried fish processing plants/areas	Total area of dried fish processing (ha)	Number of Enplyee	Volume of Dried fish production (ton/year)	Raw fis volume for dried fish processing (ton/year)	Landing volume by area (ton/year)
Moheshkhali	340	298.3	3,836	855	3,406	7,107
Teknaf	83	49.3	778	775	2,092	1,829
Cox's bazar	143	97.5	2,085	522	2,056	13,691
Nazirtek	1,331	225.3	17,510	8,606	33,275	7,594
Total	1,897	670.4	24,209	10,758	40,828	30,221

Source: Survey Result

The following table shows the amount of dried fish processed by type of fish in the target area. The main species of dried fish processed are Bombay duck and Ribbon fish, and these two species alone account for about half of the total dried fish production. Nazirtek alone produces about 10,000 tons of Bombay duck and about 5,500 tons of Ribbon fish products.

Table 4-15 Fish Species Breakdown of Processed Dried Fish Volume by Region (Unit: tons)

	Cox's Bazar		Nazirtek		Teknaf		Moheshkhali	
Pomfret	49	2.4%	11	0.0%	35	1.7%	208	6.1%
Jewfish	12	0.6%	2,332	7.0%	138	6.6%	30	0.9%
Mackerel	19	0.9%	60	0.2%	62	3.0%	62	1.8%
Tuna	33	1.6%	68	0.2%	40	1.9%	121	3.6%
Hilsa	-	-	-	-	-	-	-	-
Bombay duck	571	27.8%	10,560	31.7%	494	23.6%	1,155	33.9%
Ribbon fish	555	27.0%	5,542	16.7%	336	16.1%	806	23.7%
Sardine	72	3.5%	505	1.5%	123	5.9%	135	4.0%
Sea catfish	16	0.8%	133	0.4%	151	7.2%	41	1.2%
Other	728	35.4%	14,063	42.3%	714	34.1%	848	24.9%
TTL	2,056	100%	33,275	100%	2,092	100%	3,406	100%

Source: Survey Result

4-3-8 Fresh Fish Distribution Channels

The distribution channels for fresh fish in the Cox's Bazar region include: from each landing site to the local wholesale market for distribution to the local retail market; from the local wholesale market at the site to the mass consumption area for transportation to the local wholesale markets for distribution to the retail markets in the mass consumption area; and for overseas export.

The functions of the landing site, wholesale market, and retail market are not necessarily separate and independent facilities, and there are cases in which there are landing sites with wholesale market functions and wholesale markets with retail market functions. The fresh fish distribution channels are shown below.

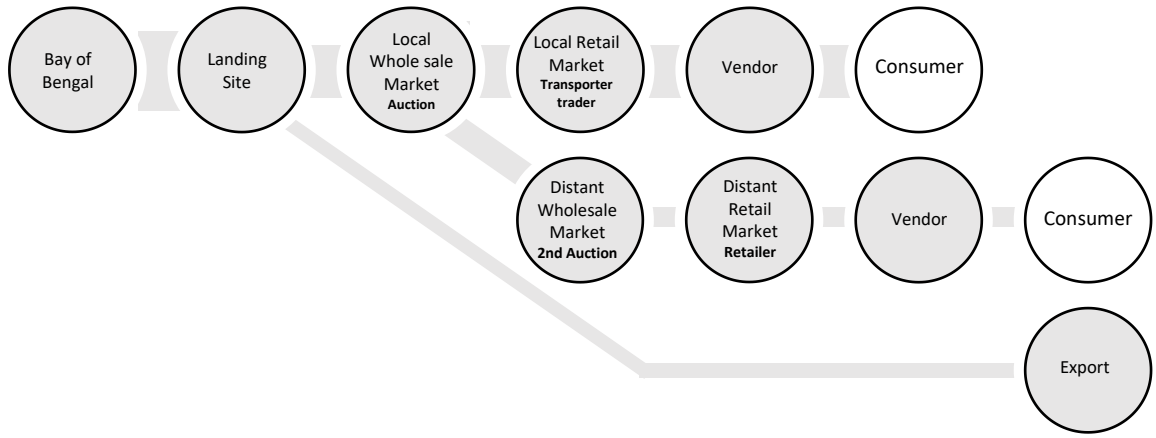


Figure 4-20 Fresh Fish Distribution Channels

Source: Survey Result

The following table shows the results of a survey on the percentage of fresh fish landed in the target area that is distributed to nearby retail markets. Depending on the species, about 40% of the landings are distributed to local retail markets, and the remaining 60% to mass consumption areas, while Tuna and Hilsa are exported as semi-frozen products, Bombay duck and Ribbon fish are processed as dried fish, sardines are processed as dried fish or fermented food, and Jewfish are salted and exported.

In terms of consumption in the region, dried fish tends to be preferred over fresh fish, but this is due to the fact that the residents of the Teknaf coast have low incomes and cannot afford expensive fresh fish, and can only purchase inexpensive small dried fish.

Fresh fish is also distributed within the region, but the regional trends for the consumption of fresh fish lean toward smaller sizes and inexpensive species. Expensive fresh fish is mainly distributed to consumption areas outside the region.

Table 4-16 Annual Volume of Fish Handled by Retail Markets by Species and Percentage of Annual Landings in the Region

	Cox's Bazar City		Teknaf		Moheshkhali	
	(Ton/year)	%	(Ton/year)	%	(Ton/year)	%
Pomfret	482	45.2%	88	41.7%	226	38.5%
Jewfish	337	45.1%	74	41.4%	212	43.5%
Mackerel	275	44.0%	65	43.1%	117	35.2%
Tuna	562	43.8%	62	42.5%	246	43.3%
Hilsa	1,018	43.8%	99	42.3%	832	44.2%
Bombay duck	409	46.1%	73	42.4%	252	44.0%
Ribbon fish	315	45.6%	76	41.9%	247	43.4%
Sardine	319	45.3%	37	42.0%	147	47.5%
Sea catfish	846	46.8%	82	41.5%	325	43.5%
Other	1,538	43.2%	259	42.6%	640	51.1%
Total	6,099	45%	915	42.1%	3,244	44.4%

Source: Survey Result

4-3-9 Fish Price Composition

Various studies have been conducted in the past on changes in fish prices during the distribution stage [123] [124] [125] [126] [127] [128]. In the distribution of fresh fish after landing, the fish price is formed by the

[123] A Background Paper for Bangladesh Fisheries Value Chain Study

[124] A Guide to the Analysis of Fish Marketing Systems Using a Combination of Sub-sector Analysis and the Sustainable Livelihoods Approach

[125] Study on Marketing and Value Chain of Some Commercially Important Coastal and Marine Aquatic Products of Bangladesh

[126] LIVELIHOODS IN COASTAL FISHING COMMUNITIES, AND THE MARINE FISH MARKETING SYSTEM OF BANGLADESH

[127] Power, profits and payments for ecosystem services in Hilsa fisheries in Bangladesh: A value chain analysis

[128] Marketing system of marine fish in Bangladesh an empirical study

accumulation of the costs and profits of the fishermen involved in the process of transporting fresh fish not only to consumers in the production area but also to consumers in distant consumption areas. The fact that the route to the retail market in the consumer's area is considered to be a well-established distribution route means that the problem of unnecessarily high fish prices at the time of delivery to the consumer due to unnecessary distribution centers has not occurred. Accordingly, the fish price composition is judged to be reasonable.

On the other hand, whether the fishermen who work on the fishing boats are adequately compensated based on the fish price at the time of landing needs to be judged from a different perspective. Fishermen on board fishing boats have an employer-worker relationship with the boat owner and others, but many fishermen have debts, called *dadon*, with the boat owner or loan lender in order to maintain their livelihood. Fishermen who have borrowed money form a kind of prepaid employment contract with the shipowner, putting them at an overwhelming disadvantage in terms of wages. Also, in the distribution stage of marine products after landing, it is thought that the controlling party in each distribution stage, who is the employer, tends not to fully distribute profits to employees and trading partners. However, there are examples of shipowners lending livelihood funds without interest during the closed season in order to secure fishery workers, and not all shipowners are unfairly exploiting fishery workers. On the other hand, with inefficient infrastructure at the fishing and distribution stages, as well as unresolved issues such as packaging containers and ice control during transportation, the cycle of seafood distribution and securing profits only for those fishermen with capital is a structure that continues to exploit the workers at the bottom of each distribution stage.

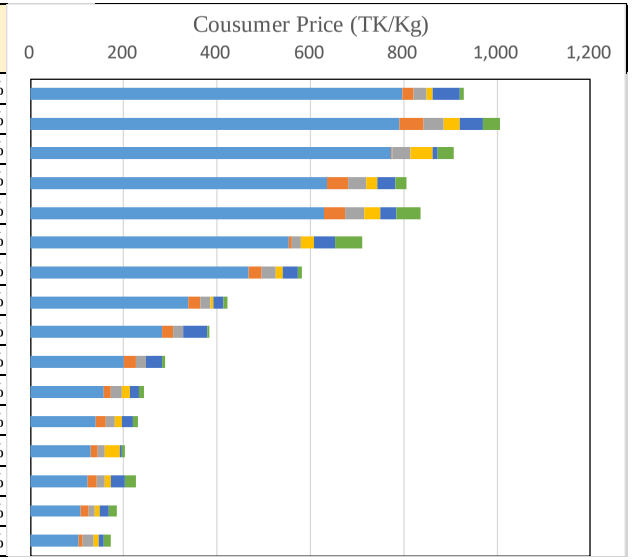
Table 4-17 below shows the ratio (%) of the price increase at each distribution stage to the terminal price of each fish species at the four landing sites where the survey was conducted, and a comparison between the terminal price and the price increase at each distribution stage.

The higher the price, the higher the share of the terminal price accounted for by the price at the landing stage, and the lower the price, the higher the share accounted for by the price increase at the distribution stage after the wholesale market. However, the increase in fish price at each stage is generally greater for high-end fish.

Table 4-17 Price Changes by Distribution Process for Fresh Fish at each Landing Site

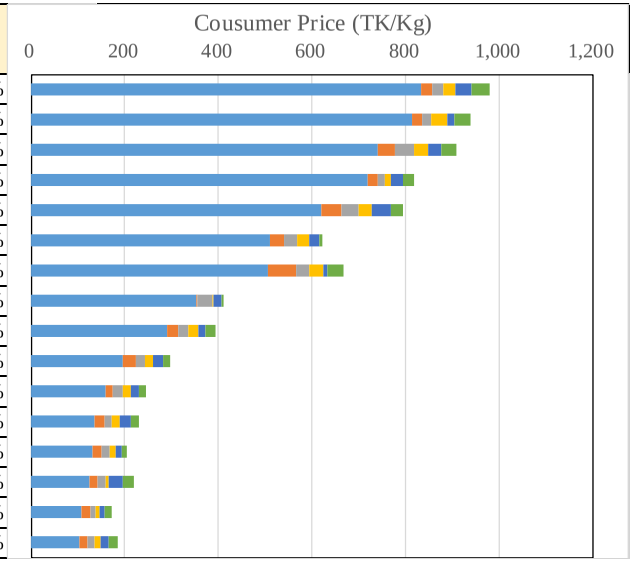
Cox's Bazar BFDC Ghat

Fish	Price at landing (TK/Kg)	Consumer Price (TK/Kg)	Landing center	Primary auction	Transpoter	2nd auction	Retailer	Fish Vendor
Chinese Pomfret	798	928	86.0%	2.4%	3.0%	1.5%	6.3%	0.9%
Hilsa(>1kg)	790	1,006	78.5%	5.3%	4.3%	3.4%	5.0%	3.6%
Brown shrimp	773	906	85.3%	0.2%	4.3%	5.2%	1.3%	3.6%
Indian Salmon	635	805	78.9%	5.6%	4.8%	3.1%	4.8%	2.7%
Hilsa(1kg > >500g)	630	835	75.4%	5.3%	5.0%	4.1%	4.1%	6.1%
Hilsa(500g>)	554	710	78.0%	0.8%	2.8%	3.8%	6.3%	8.2%
Black pomfret	467	581	80.4%	5.0%	5.0%	2.6%	5.7%	1.4%
Mackerel	338	422	80.1%	5.9%	5.5%	1.2%	5.5%	1.9%
Sea catfish	283	369	76.7%	6.0%	6.0%	0.0%	14.1%	1.1%
Others	200	289	69.2%	9.3%	6.9%	0.3%	12.1%	2.1%
Jewfish	158	243	64.9%	5.8%	9.5%	7.0%	8.2%	4.6%
Sardine	140	231	60.6%	9.1%	8.2%	6.9%	10.0%	5.2%
Tuna	128	203	63.1%	8.4%	7.4%	15.3%	2.5%	3.4%
Anchovy	123	227	54.2%	8.4%	7.9%	5.3%	13.7%	10.6%
Bombay duck	107	184	58.2%	9.2%	7.1%	6.0%	10.3%	9.2%
Ribbon fish	103	173	59.5%	5.2%	13.9%	6.4%	6.4%	8.7%



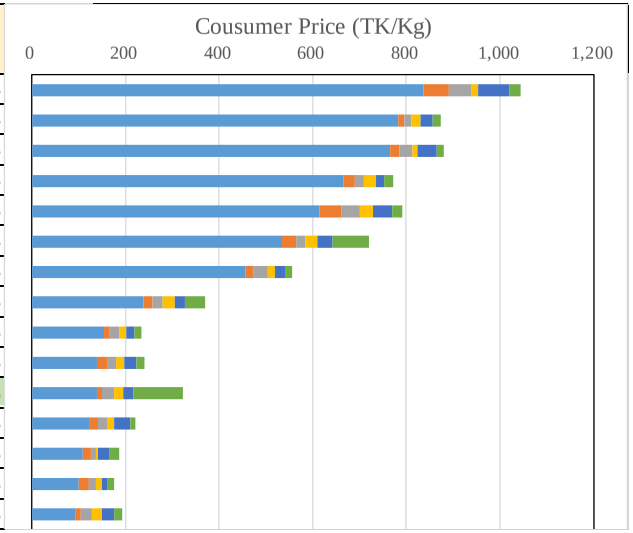
Moheshkhali

Fish	Price at landing (TK/Kg)	Consumer Price (TK/Kg)	Landing center	Primary auction	Transpoter	2nd auction	Retailer	Fish Vendor
Hilsa(>1kg)	833	980	85.0%	2.6%	2.2%	2.7%	3.6%	4.0%
Chinese Pomfret	815	940	86.7%	2.2%	2.1%	3.6%	1.6%	3.7%
Brown shrimp	740	909	81.4%	4.1%	4.6%	3.3%	3.1%	3.5%
Hilsa(1kg > >500g)	720	818	88.0%	2.6%	1.8%	1.7%	3.1%	2.8%
Indian Salmon	620	794	78.1%	5.5%	4.4%	3.5%	5.4%	3.0%
Black pomfret	510	622	82.0%	5.0%	4.3%	4.2%	3.4%	1.1%
Hilsa(500g>)	506	667	75.9%	9.0%	4.3%	4.5%	1.3%	4.9%
Mackerel	354	412	85.9%	0.5%	7.5%	0.7%	4.1%	1.2%
Sea catfish	290	394	73.6%	6.1%	5.3%	5.6%	4.1%	5.3%
Others	195	298	65.4%	9.4%	7.0%	5.4%	7.4%	5.4%
Jewfish	159	245	64.9%	5.8%	9.3%	6.5%	7.8%	5.7%
Anchovy	135	231	58.4%	9.1%	7.4%	7.4%	9.5%	8.2%
Tuna	132	204	64.7%	9.3%	7.8%	6.4%	6.4%	5.4%
Sardine	125	219	57.1%	7.8%	8.2%	2.3%	14.2%	10.5%
Ribbon fish	108	171	63.2%	10.5%	6.4%	5.3%	6.4%	8.2%
Bombay duck	104	186	55.9%	9.1%	7.5%	7.0%	9.1%	11.3%



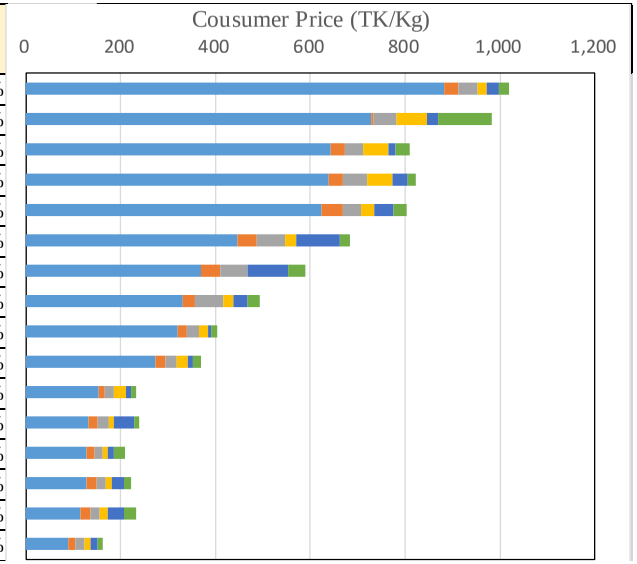
Nazirtek

Fish	Price at landing (TK/Kg)	Consumer Price (TK/Kg)	Landing center	Primary auction	Transpoter	2nd auction	Retailer	Fish Vendor
Brown shrimp	836	1,045	80.0%	5.4%	4.4%	1.5%	6.3%	2.4%
Hilsa(>1kg)	783	873	89.7%	1.5%	1.7%	2.2%	3.0%	1.9%
Chinese Pomfret	766	880	87.0%	2.3%	3.1%	1.1%	4.9%	1.6%
Hilsa(1kg > >500g)	666	773	86.2%	3.1%	2.6%	3.4%	2.2%	2.6%
Indian Salmon	614	791	77.6%	5.9%	5.1%	3.4%	5.3%	2.7%
Hilsa(500g>)	535	720	74.3%	4.2%	2.8%	3.5%	4.4%	10.8%
Black pomfret	456	556	82.0%	3.2%	5.4%	2.9%	4.0%	2.5%
Sea catfish	238	371	64.2%	5.4%	5.9%	7.0%	5.9%	11.6%
Jewfish	155	235	66.0%	4.3%	9.4%	6.0%	8.1%	6.4%
Sardine	140	240	58.3%	8.7%	7.9%	7.5%	10.4%	7.1%
Tuna	139	323	43.0%	3.1%	8.7%	5.6%	6.8%	32.8%
Anchovy	124	221	56.1%	7.7%	9.0%	6.3%	15.8%	5.0%
Bombay duck	110	186	59.1%	8.6%	5.4%	3.2%	12.4%	11.3%
Ribbon fish	100	177	56.5%	11.9%	9.6%	7.3%	5.6%	9.0%
Mackerel	93	194	47.9%	6.2%	11.9%	11.3%	13.9%	8.8%



Teknaf

Fish	Price at landing (TK/Kg)	Consumer Price (TK/Kg)	Landing center	Primary auction	Transpoter	2nd auction	Retailer	Fish Vendor
Hilsa(>1kg)	883	1,020	86.6%	2.9%	3.9%	2.0%	2.4%	2.3%
Chinese Pomfret	729	983	74.2%	0.4%	5.0%	6.4%	2.4%	11.6%
Brown shrimp	644	809	79.6%	3.6%	4.8%	6.6%	1.7%	3.7%
Hilsa(1kg > >500g)	639	822	77.7%	3.6%	6.3%	6.3%	4.0%	1.9%
Indian Salmon	623	803	77.6%	5.7%	4.9%	3.5%	5.0%	3.4%
Hilsa(500g>)	447	684	65.4%	5.8%	8.8%	3.4%	13.6%	3.1%
Black pomfret	370	575	64.3%	7.1%	9.9%	0.0%	14.8%	6.4%
Seabass	332	493	67.3%	4.9%	12.4%	4.1%	6.1%	5.3%
Mackerel	320	403	79.4%	4.7%	6.7%	4.5%	1.5%	3.2%
Sea catfish	273	369	74.0%	6.0%	6.2%	6.2%	3.3%	4.3%
Jewfish	153	233	65.7%	5.6%	8.6%	11.2%	4.7%	4.3%
Tuna	132	240	55.0%	8.3%	10.0%	4.2%	17.5%	5.0%
Ribbon fish	129	209	61.7%	8.1%	8.1%	4.8%	5.7%	11.5%
Sardine	128	223	57.4%	9.4%	9.0%	5.4%	11.7%	7.2%
Anchovy	116	233	49.8%	8.6%	9.0%	6.9%	15.0%	10.7%
Bombay duck	89	163	54.6%	9.8%	11.0%	8.6%	9.2%	6.7%



Source: Survey Result

Note: Teknaf and Moheshkhali in the table refer to Teknaf city Ghat and Gorokghata landing site, respectively.

In the wholesale market, fresh fish sellers are required to pay commission to wholesalers based on their sales when conducting transactions. The commission as a percentage of sales varies by landing site and species, and is higher for fishermen who have taken out loans than for those who have not. The fact that these costs are incurred by fishermen is thought to be one of the reasons why it is difficult to distribute profits to fishermen in the seafood value chain.

Table 4-18 Commission at Wholesale in each Landing Area

	BFDC Ghat	Moheshkhali	Nazirtek	Teknaf
Pomfret	5%	5%	0%	7%
Jewfish	3%	5%	0%	4%
Mackerel	4%	5%	0%	3%
Tuna	8%	5%	0%	3%
Hilsa	10%	5%	0%	10%
Bombay duck	3%	5%	0%	5%
Ribbon fish	3%	5%	0%	5%
Sardine	5%	5%	0%	5%

Source: Survey Result

Remark: In the table, Teknaf and Moheshkhali refer to the Teknaf city Ghat and Gorokghata landing site, respectively.

The fish price at the landing stage was compared by landing site as shown in Figure 4-21. By using the price of fish at the landing stage at the BFDC Ghat as the standard, the differences in the prices of Gorokghata landing site, Nazirtek, and Teknaf city Ghat are shown as a percentage of the total price, in order from the highest to the lowest price.

The overall price of fish in Teknaf city Ghat is low compared to the prices in other landing sites. Although it is difficult to determine the impact of specific factors on the price of fish at the landing stage, as it varies depending on the volume of fresh fish traded, seasonality, freshness, and other factors, it is believed that if the landing site has good access to major consumer markets due to its location and transportation infrastructure, the fish will be purchased at a relatively high price due to the lower cost of the distribution process. The landing price is believed to be greatly influenced by the market price.

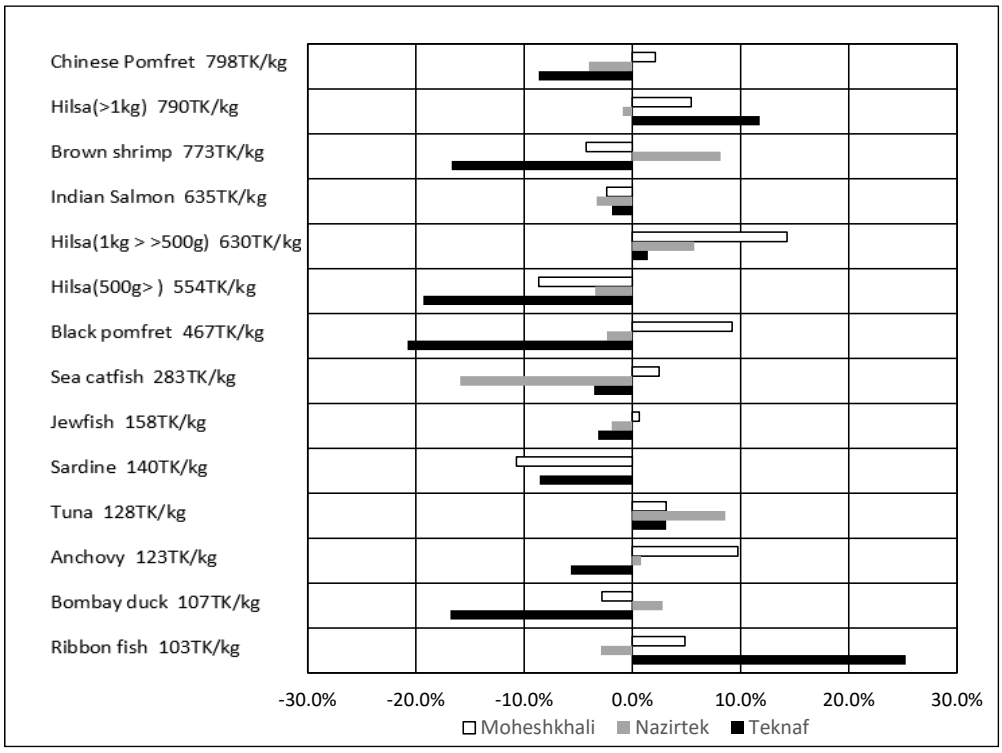


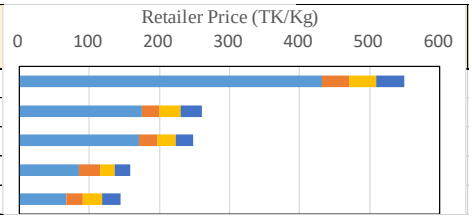
Figure 4-21 Comparison of fish prices between the three landing sites and the BFDC Ghat (TK/kg by type of fish)
Source: Survey Result

As for processed fishery products, they also pass through the wholesale market of the production area and the wholesale market of the consumption area before being distributed from the processers to the retail market of the consumption area.

The next table (Table 4-19) presents the results of past surveys on price increases in the distribution stage of processed fish[129]. The percentage (%) of the terminal price accounted for by price increases at each stage of distribution, and the comparison of the terminal price with price increases at each stage of distribution, are shown by type of fish, from high-end fish to less expensive species. The higher the price of high-end fish, the higher the percentage of the terminal price that is accounted for by the price at the processer stage, and the lower the price of inexpensive fish, the higher the percentage that is accounted for by the price increase at the distribution stage after the wholesale market. However, the increase in fish price at each stage is larger for high-end fish.

Table 4-19 Price Changes by Distribution Process for Processed Fish

Fish	Price at Fish Processor (TK/Kg)	Retailer Price (TK/Kg)	Fish Processor	Primary auction	2nd auction	Retailer
Pomfret	432.5	525.0	82.4%	7.1%	7.6%	7.6%
Tuna	175.0	240.0	72.9%	10.4%	12.5%	12.5%
Shrimp	170.0	235.0	72.3%	11.7%	10.6%	10.6%
Ribbon fish	85.0	142.5	59.6%	21.1%	14.9%	14.9%
Jewfish	67.5	125.0	54.0%	18.0%	22.0%	22.0%



[129] Study on Marketing and Value Chain of Some Commercially Important Coastal and Marine Aquatic Products of Bangladesh

4-3-10 Wages of Fishermen by Occupation and Percentage of Total Fishermen

The following figure shows the relationship between wages and the number of people in each occupation. The occupations with the highest incomes are boatowners, brokers, wholesalers, and processing owners, while those with the lowest incomes are fishermen, processing workers, and laborers who work as manual laborers at the landing sites. In terms of the number of people working, the number of people working in high-income occupations is low, while the number of people working in low-income occupations in the fishing industry is overwhelmingly high.

The low-income, artisanal fishermen are unable to escape from their economically vulnerable status because their work is not regular and their sources of income are unstable, and they are forced to remain unfavorable hierarchical relationships with their employers and loan lenders, as the fisheries value chain is constructed in such a way that profits are concentrated only in a few occupational categories of fishermen. The role of each fishery related party in the table is as described in Table 2-15 in Chapter 2.

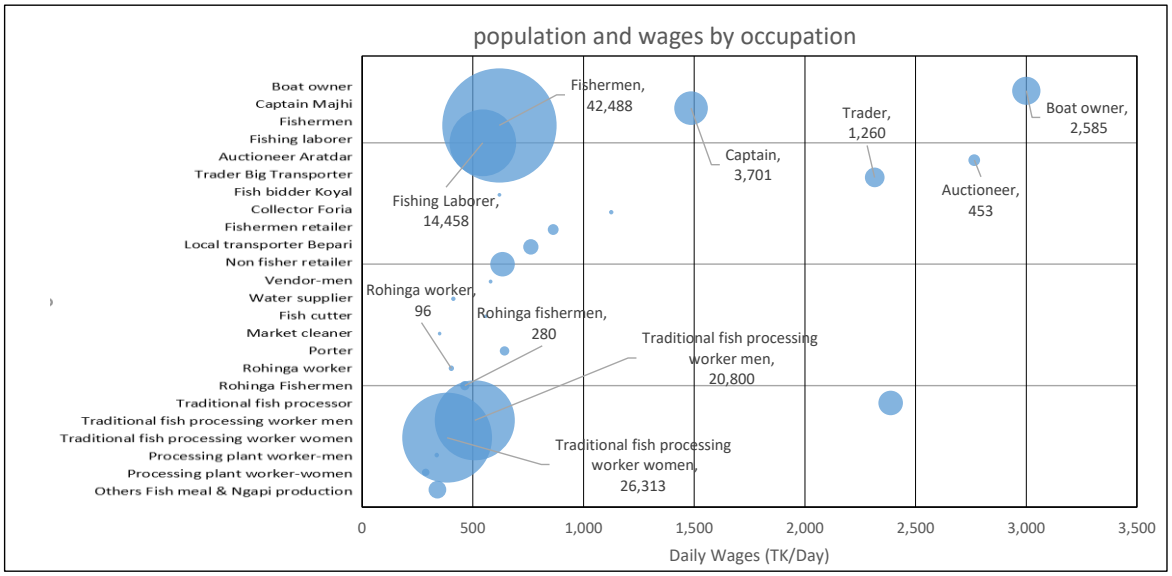


Figure 4-22 Relationship Between Population and Wages by Occupation (major stakeholders)

Source: Survey Result

Most of the fishermen in the target area are economically vulnerable, and many of them do not own fishing gears and boats, and work as manual laborers with unstable employment, and borrow money from boat owners to sustain their lives, as drastic improvement of these people's lives has not been realized. The structure of the artisanal fisheries sector as a whole, in which profits are concentrated only in the hands of a small number of fishery stakeholders such as boat owners and wholesalers, is itself a hindrance to the development of the fisheries value chain in the target area. Coastal fishermen are the most vulnerable socio-economically, due in part to the natural conditions of the region, which has always been prone to natural disasters such as cyclones and earthquakes.

4-4 Current Status and Challenges of Artisanal Fisheries Value Chain Infrastructure in the Target Area

4-4-1 Position and Challenges of the Target Area in the Artisanal Fisheries Sector

The following table shows the current challenges in terms of hard and soft components in the value chain of artisanal fisheries in the target area.

Table 4-20 Challenges of artisanal fisheries value chain

Stages of fishery distribution	**Catch →**	**Landing →**	**Distribution (production area market) →**		**Processing →**	**Distribution (consumer market) →**
Current challenges for Hard components	***Fishing boats*** · Insufficient loading capacity ***Fishing gear*** · Inadequate storage for nets ***Maritime safety*** · Inadequate night beacons · Lack of life-saving equipment · Inadequate rescue boats	***Landing facilities*** · Inadequate or lack of landing facilities · Lack of sanitation facilities · Lack of clean water · Natural disaster risk ***Fresh fish handling*** · Deterioration of freshness due to prolonged landing · Inadequate temporary storage facilities for fresh fish · Inadequate or lack of fish boxes	***Roads/vehicles*** · Undeveloped access roads · Inadequate transport vehicles ***Transportation facilities*** · Inadequate temporary storage facilities · Lack of temperature-controlled transport network ***Refrigeration*** · Insufficient supply/low quality of ice	***Wholesale facilities*** · Aging facilities · Unsanitary fresh fish sales tables · Inadequate fresh fish handling facilities · Inadequate market sanitation facilities · Lack of clean water	***Processing facilities*** · Lack of permanent facilities · Unsanitary drying tables · Inadequate sanitation facilities · Lack of clean water · Open air drying ***Storage*** · Inadequate storage facilities for processed products	***Market facilities*** · Aging facilities · Inadequate sanitation facilities · Lack of clean, fresh water · Lack of hygiene at sales tables
Current challenges for Soft components	***Fishing grounds*** · Decline in catch volume · Seasonal fluctuations in catches · Illegal trawler operations ***Storage of catch*** · Lack of ice ***Resource management*** · Inadequate catch statistics · Fish net mesh regulation violations · Inadequate control of illegal fishing · Inadequate resource surveys ***Fishers*** · Lack of funds to purchase fishing boats and gear · Unregistered fishers · Lack of alternative occupations to control the increase of fishers	***Improved handling of fresh fish landing*** · Insufficient knowledge of fresh fish handling ***Food safety and hygiene management system for landing facilities*** · Insufficient hygiene knowledge of facility users · Absence of official control ***Operation and maintenance of landing site*** BFDC Ghat is the only public control by governmental organizations. Other landing sites are privately managed by fish distributors. ***Fish prices*** · Controlled by distributors ***Labor*** Low wages, child labor	***Improvement of post-harvest loss in fresh fish distribution*** · Insufficient knowledge of fresh fish handling · Lack of hygiene knowledge · Inadequate fresh fish transport containers · Prolonged transport times ***Refrigeration*** · Inadequate cold storage of fresh fish	***Improvement of post-harvest loss in distributed fresh fish*** · Insufficient knowledge of fresh fish handling · Lack of hygiene knowledge ***Fish prices*** · Controlled by distributors ***Whole facilities management*** · Absence of official control · Private control by distributors	***Improvement of raw fish quality*** · Use of low-quality raw fish · Insufficient knowledge of fresh fish handling ***Seasonal fluctuations in processing*** · Response to no-fishing season ***Improvement of processing and preservations techniques*** · Lack of hygiene knowledge · Lack of knowledge of processing preservation techniques · Introduction of new processing technologies · Use of harmful chemicals · Deterioration due to long-term storage ***Female labor*** · Wage inequality ***Lack of capital*** · Inability to obtain bank loans	***Improvement of post-harvest loss in distributed fresh fish*** · Insufficient knowledge of fresh fish handling · Lack of hygiene knowledge ***Stable supply of fresh fish*** · Unstable supply of fresh fish · Insufficient response to fish consumption needs, including demand for premium fish ***Fish prices*** · Large fish price fluctuations · Controlled by distributors ***Product development / branding*** · There are attempts to commercialize it, but high priority is given to responding to

Stages of fishery distribution	Catch →	Landing →	Distribution (production area market) →		Processing →	Distribution (consumer market) →
	Maritime safety · Lack of maritime safety knowledge · Lack of anti-piracy measures				***Decreased exports*** · Decline in exports due to COVID-19	excessive consumption demand. ***Quality control in the sale and export of marine products*** · There are laws and regulations, but monitoring not well functioning
	Human resource development · Insufficient activity bases for fisheries related training, etc. · Insufficient training of field-level leaders					

(1) Current situations and challenges for hard components

Artisanal fisheries in the South Chattogram region are facing difficult conditions due to a lack of basic social infrastructure such as water supply and sanitation, as well as erosion and deteriorating resources. In terms of hard components in the fisheries value chains, at each stage of the process from catching the fish to delivery of fishery products to the consumer, there are infrastructures such as fishing boats and gear at the catch stage, landing facilities, roads and transport vehicles, ice and cold storage facilities, market facilities, and processing facilities. However, facilities are aging or deficient, traditional wooden fishing boats do not have adequate holding capacity, and traditional processing facilities are not hygienic. As there has not been adequate maintenance and development of this infrastructure, it has not been sufficiently modernized. This is believed to be hindering the improvement of the fisheries value chain, and there are many challenges that need to be addressed.

Especially for landing sites, since there are no fishery facilities in most of the landing sites, involuntary inefficient landing operations are obliged, and there are problems in handling catch in terms of freshness and hygiene. The existing few landing facilities do not meet the landing demand due to the aging facilities and/or damaged by natural disasters, which lead to a decline in landing capacity and not able to supply a demand. In addition, there is a difficulty to develop landing infrastructure because the tidal range is large and risks of natural disasters.

Meanwhile, compared to the past, the distribution channel for fisheries products has improved, with the development Marine Drive in the Teknaf area and the trunk road from Chattogram to Cox's Bazar. The city of Cox's Bazar has also grown remarkably as a tourist destination, and domestic tourists have been coming to the area via long-distance buses and air routes in recent years. Despite the increasing need for stable and efficient intra- and extra-regional distribution of high-quality marine fish due to the growing demand for marine fish in out-of-region consumption and the growing interest of tourists in marine fish, development has been hampered by the slow development of infrastructure directly related to artisanal fisheries.

Regarding the ice-making and storages facilities, the construction of new facilities by private sector has been developing in recent years in response to the increase in demand at the landing sites along the

Bay of Bengal in Teknaf.

(2) Current situations and challenges for soft components

As an effort to address issues regarding soft components of the fisheries value chains, in the area of catching fish, laws and regulations are being established and educational activities are being conducted with the aim of conserving fishery resources. In addition to the introduction of a closed season and the strengthening of segregation of fishing areas from industrial fisheries, fisheries resource surveys are also being conducted by government-own research vessel.

In the area of maritime safety, training is being conducted for fishers, with additional help from the Coast Guard. In the post-landing stages, educational activities are being conducted to improve the handling of fresh fish to reduce post-harvest losses. In the processing stage and sales of processed products, food safety is being addressed through regulations on the use of harmful chemicals. However, these efforts related to soft components are not effective because they are implemented without the sufficiently developed facility infrastructure related to hard components. Some stakeholders also say these soft components are not taking root. In terms of coastal fisheries management, the Department of Fisheries has not been able to conduct sufficient monitoring and enforcement due to a lack of human resources, and the community-based coastal fisheries management that the DoF was aiming for has not been achieved at the landing sites in the south Chattogram area, where there has been little improvement made on the landing sites.

Regarding the operation and management of landing facilities, landing sites other than the landing facilities operated by BFDC are used by boatowners and fish traders as bases for handling operations and distribution, and are not managed by public. The facility of BFDC Ghat, which is the only landing site in the target area operated by BFDC, is aging and has been damaged by river erosion. In addition, efforts for hygienic handling of fresh fish in the facility have not been progressed.

Regarding fish-product development and branding, activities such as marketing fresh and dried fish online, and setting up antenna shops in consumption areas in other regions by dried fish processors are being carried out, but they are still emerging stages, therefore, stabilizing the supply of marine fish to meet the demand of domestic consumption is considered to be the key to fish-product development and branding.

(3) Urgency of landing site improvement

Poor fishery infrastructure, lack of or inadequate means of storage on board fishing vessels and on land, poor processing techniques, poor working conditions, and unsanitary fish handling conditions have led to rapid deterioration of the freshness and quality of fish caught due to contamination, resulting in significant post-harvest losses. In addition to the loss of much of the value that fishers in the marine product supply chain should have gained, it has become difficult to provide consumers with marine products retaining quality as safe food. Marine products are an indispensable part of the national diet as a source of high-quality animal protein. In order to ensure that marine products are consumed as food in a streamlined manner without waste, it is necessary to develop infrastructure facilities for artisanal

fisheries, as well as reduce their catch loss, processing loss, and distribution loss. Their distribution volume of artisanal fishery products must also be greatly expanded. The quality of the catch is greatly affected by its freshness, so preventing deterioration of freshness and contamination are the most crucial factors in improving the value chain. The handling of the catch at the landing site, which is the first point where the catch leaves the sea for the land, is the foundation for value formation in the supply chain and is the most important. At the artisanal fisheries of the South Chattogram region, delays in the development of landing sites have led to deterioration in the quality of marine products for distribution; therefore, the development and improvement of landing sites are the most urgent issues, and have the highest level of priority.

Efforts to improve the landing sites in this region will secure and improve its functionality as a supply area, ensure the safety of marine products as food, increase the amount of marine products distributed to consumers, without compromising the original value of the products, and reduce the labor of fishers involved in distribution. In addition, the reduction of post-harvest losses will improve the income of fishers and contribute to poverty reduction, thus contributing to regional economic development. Since the landing sites become a shared production base for the community's fishers, it can also serve as a platform for community-based coastal fisheries management.

Although the basic infrastructure such as roads is developing, the infrastructure directly related to the fishing activities is almost neglected. The measures of fisheries development taken by DoF have been mainly in the fishery management and co-management of resources, but without fisheries infrastructure development.

The target areas have the following challenges due to inadequate landing facilities. They are, 1) inefficient landing and distribution of marine fish, 2) limits on hygienic handling of fresh fish, and 3) lack of a shared and jointly used production platform for artisanal fishers makes it difficult for development of the community-based fishery management.

The development of landing centers in the target areas will provide a shared production base for artisanal fishers and it will be able to expect to lead to the realization of hygienic and efficient fishery distribution and reduction of post-harvest loss, and to implement community-based fishery management pursued by DoF. In this way, the development of landing facilities can further promote the measures of DoF and bring about a great socio-economic impact on the country. Therefore, there is a high need for project implementation.

4-4-2 Issues By Study Area

(1) Cox's Bazar BFDC Ghat

The landing facility operated by the BFDC is deteriorating and the river erosion by the Bakkali River is progressing, and part of the foundation of the facility facing the river has collapsed. Because the collapsed area was originally a fish handling area, half of the fish handling area is now unusable, and because river erosion is expected to continue, there is a very high risk that a larger area will be damaged by the collapse.

Although the current fish handling area is a one-story building with a roof, the two-story reinforced concrete fish handling building, which originally had fishing gear storage and office functions on the second floor, was demolished when the foundation collapsed, and only one half of the building, where the foundation has not collapsed, is being used with a roof over the pillars of the remaining first floor. In the beginning, four stairway jetties were attached to the quay in front of the river. There was also a jetty jutting out into the river to the south of the fish landing shed, so it is thought that the facility's landing function was more extensive than it is today, and that landing operations were carried out more efficiently. The ice machine at the site is declining in capacity due to aging, and there is a shortage of water from the well.

The above-mentioned points were also raised as problems in the user survey. In addition, there are other problems such as congestion at the landing site due to the reduction of the facility area, long waiting time for fishing boats to land, lack of facilities, lack of ice and water for use, and inconvenience in berthing due to the accumulation of sediment in the river front.

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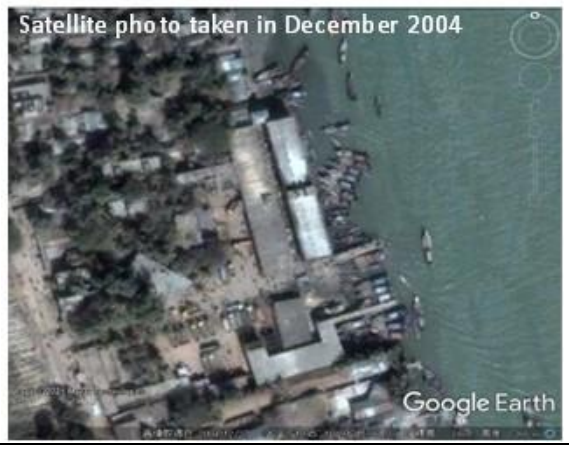
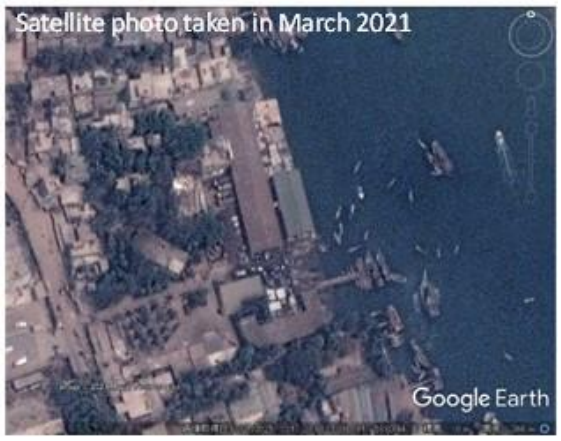
<tr><td> 
</td><td> 
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<tr><td>Satellite photo to taken in December 2004</td><td>Satellite photo to taken in March 2021</td></tr>
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<tr><td>Cox’s Bazar BFDC Ghat before river erosion damage</td><td>Cox’s Bazar BFDC Ghat after river erosion damage</td></tr>
</table>

Figure 4-23 Comparison between initial and current Cox’s Bazar BFDC Ghat

Source: (1) and (2) Google Earth, (3) Flickr.com, (4) Survey Team survey results

（2）Nazirtek

There are no landing sites, no mooring facilities, no cargo handling areas, and all landing activities and preparations for fishing take place on the beach. The shallow sandy beach where the landing site is located is about 600 meters away, and the fishing boats land over a wide area, making it impossible to conduct intensive landing operations. Even if fishing nets are dried or repaired in the sandy areas, there are no warehouses, so the nets have to be piled up on the beach for storage, which lacks the functions necessary for fishing activities. In addition, the ice used for fishing and distribution after landing has to

be procured from sources such as BFDC Ghat, resulting in inefficient operations. The above points were also raised in the user survey, and the need for landing facilities such as jetties and an ice factory was strongly emphasized.

(1) Location of landing site in Nazirtek

(2) Fish landing from each boat

(3) Maintenance of fishing nets

Figure 4-24 Location and situation of Nazirtek landing site

Source: (1) Google Earth, (2) and (3) Survey Team survey results

（3）Teknaf City Ghat

Because the channel connecting the Naf River to the landing site is narrow and shallow, the timing of fishing boats' departure and return is greatly influenced by the ebb and flow. The location of the entrance to the channel and the change in water level at the entrance to the channel with tide are shown below. At low tide, the bottom of the channel is exposed and it is impossible for fishing boats to leave or return to port.

Location of Estuary, Naf River

Channel entrance at high tide (Naf River connection)

Channel entrance at low tide (Naf River connection)

Figure 4-25 Teknaf City Ghat(Tidal change)

Source: (1) Google Earth、(2) and (3) Survey Team survey results

Because the width of the channel where the landing site is located is very narrow, the size of fishing boats that can enter the channel is also limited, so large fishing boats cannot be used. Furthermore, the landing site, located in the center of Teknaf, is far away from Cox's Bazar, which makes it less favorable than other landing sites in terms of distribution and access to mass consumption areas. Shotage of ice, landing and auction space are some of the problems cited by users.

(1) Location of Teknaf City Ghat

(2) Teknaf City Ghat at low tide

(3) Teknaf City Ghat at high tide

Figure 4-26 Teknaf City Ghat (Tidal change)

Source: (1) Google Earth、(2) and (3) Survey Team survey results

（4） Moheshkhali

There are no facilities at any of the major landing site (Gorokhata), landing activities and other fishing activities are conducted under direct sunlight, and the timing of fishing departure and return depends on tides. As for Sonadia and Gotibanga, although they are used as landing sites for raw fish for drying during the season when there is a lot of dried fish processing in the vicinity, the bridges on the road connecting to the jetty of the shipping service to Cox's Bazar are damaged due to storm surge damage, making it difficult for vehicles to pass through and greatly impeding the transportation of processed products. In the interviews with stakeholders, the lack of landing facilities, shortage of ice during the peak fishing season, and lack of storage space for fishing nets were cited as problems.

(1) Location（Moheshkhali Gorokghata）

(2) Mooring the fishing boats

(3) Maintenance of fishing nets

Figure 4-27 Landing Site of Moheshkhali Gorokghata

Source: (1) Google Earth、(2) and (3) Survey Team survey results

(1) Location（Moheshkhali Gotibanga and Sonadia）

(2) Situation of fish landing（Gotibanga）

(3) Broken bridge（Gotibanga - Sonadia）

Figure 4-28 Moheshkhali Gotibanga and Sonadia Missing Bridge Parts that Serve as Landing Sites and Access Roads

Source: (1) Google Earth、(2) and (3) Survey Team survey results

（5） Sandy beach landing sites along the Bay of Bengal

The landing sites scattered along the shallow sandy beaches along the Bay of Bengal from Ukhia Upazila to Teknaf Upazila were naturally created as landing points by fishermen living nearby who were engaged in subsistence fishing activities. Of these, Shaplapur, Teknaf Upazila has been rapidly

developing as a distribution center since about two years ago, attracting many fishing boats, with large landings, and middlemen have set up huts for cleaning, sorting, and shipping fish, which are shipped not only for local consumption but also to Refugees camps, Cox's Bazar, Teknaf, and Chattogram.

There are no landing facilities at landing sites, and no infrastructure such as water and electricity other than Shaplapur. The catch is landed on the beach under the direct sunlight and sold. In addition to consumption in the neighborhood, some of the landings are shipped to retail markets in Teknaf, but these are far away from the distribution centers, and there are problems with distribution access. In addition, the location of the landing site is not fixed due to its susceptibility to flooding during the rainy season, changes in river flow, and changes in the coastline caused by quicksand and high waves.

(1) Artisanal fishing boats in Shaplapur

(2) Condition of River in the rainy season

(3) Condition of River in the dry season

Figure 4-29 Seasonal Flow Changes in Rivers near Shaplapur Landing Site
Source: (1) Survey results, (2) and (3) Google Earth satellite images

The results of hearing from the fishers at each landing site are as follows.

Table 4-21 Results of Interviews on Issues with Existing Facilities

Landing sites	Outline of landing site	Issues related to landing infrastructure
Cox's Bazar BFDC Ghat	Landing wharf, cargo handling station, ice machine, etc.	Shortage of jetties and mooring facilities Erosion and collapse of quay foundations by rivers Siltation of the river Lack of storage facilities for landings Lack of repairing space for fishing nets, and fishing net storage
Landing site in Nazirtek	Shallow natural coastline (fishing boat beach raising)	Lack of jetties and mooring facilities Lack of access roads Lack of transportation vehicles Lack of storage facilities for landings Shortage of ice during peak fishing season Lack of ice factories Lack of repairing space for fishing nets, and fishing net storage
Landing site in Moheshkhali	Shallow natural coastline (fishing boat beach raising)	Lack of jetties and mooring facilities Lack of landing facilities Lack of ice factory Lack of repairing space for fishing nets, and fishing net storage
Landing site in Teknaf City	In a narrow channel that empties into the Naf River	Shortage of landings and auction space Inaccessibility at low tide Lack of drainage system Shortage of ice
Landing site in Shaplapur	Shallow natural coastline (fishing boat beach raising)	Shortage of ice Lack of landing facilities Lack of landings storage facilities Lack of fishing net repairing space and fishing net storage Shortage of tractors for beaching fishing boats
Other landing site along the Bay of Bengal	Shallow natural coastline (fishing boat beaching)	Lack of ice Lack of landing facilities Lack of fishing net repairing space and net storage

Chapter 5 Project Proposals to JICA

5-1 Proposal for Grant Aid Project for the Development of Fisheries Value Chain Infrastructure in South Chattogram

5-1-1 Selection of Target Landing Sites

The lacking and aging landing infrastructure in the target region has caused inefficiencies in landing at each landing site, resulting in longer work hours, increased costs, and workplace risks to fishery workers. Also, the lack of adequate facilities to maintain the freshness and quality of landed fish is likely resulting in post-harvest losses and lower fish prices.

In order for the target region to fully function as a fresh fish supplier, the first priorities should be to make it possible to land catches efficiently and to outfit facilities where fishery workers can handle fish with sufficient freshness and quality. Specific measures will be considered for developing the fisheries infrastructure of highest need to the target area securing and improving its landing functionality.

When selecting suitable landing sites for infrastructure development from among those surveyed, specific measures will be considered for each landing site in the region. To do so, the survey landing sites will be classified into the following three categories, assessing the characteristics of each landing site:

1． Landing sites important to communities livelihood
2． Distribution base for consumer market landing sites
3． Raw fish for drying landing sites

(1) Landing sites important to communities livelihood

Landing sites important to communities livelihood are spotted along the coastal sandy beaches of the Bay of Bengal near communities. At these landing sites, nearby residents fish along the bay in shallow water as subsistence fishing. The main landing sites are as follows in Table 5-1:

Table 5-1 Landing Sites Important to Resident Livelihood

#	Landing site	Number of fishers'HH's nearby	Number of boats gather at the beach	Number of boats operate for daily fishing	Total annual catch landed (MT)	Access to power / electricity	Surrounding land
①	Rejukhal Ghat	57	45	35	346.2	Yes	Yes
②	Madarbunia Ghat	253	33	25	169.8	Yes	Yes
③	Shaplapur Ghat	381	160	120	915.6	Yes	Yes
④	Rajarchora Ghat	22	20	15	62.58	No	Yes
⑤	Moheshkhalipara Ghat	257	42	35	251.9	Yes	No
⑥	Baharchora Ghat	69	68	52	363.8	Yes	Yes
⑦	Poschim Ghat	82	105	80	459.7	No	No

Source: ECOFISH Survey result

Although these sites do not handle large volumes of fresh fish, fishery activity is one of limited options for local community members to make a living as a means of securing food. Also, as the neighboring villages are host communities, landing activity serves as an important local employment opportunity.

In terms of the number of fishing households, Shaplapur Ghat leads with 381 households, followed by Moheshkhali Ghat with 257 households and Madarbunia Ghat with 253 households. Shaplapur also has the most fishing boats at 160, with 120 operating daily. Shaplapur is followed by Poschim at 105 fishing boats, with 80 operating daily. Despite its large number of fishing households, Moheshkhali has relatively few fishing boats at 42, of which 35 operate daily. Madarbunia has 33 fishing boats, with 25 operating daily.

Landing operations are busiest at Shaplapur, which lands 915 tons—a relatively large volume compared to other landing sites. Lying at the crossroads of a national road (Marine Drive) and an inland road, Shaplapur has developed rapidly over the last two years and is close to the refugee camp. At the time of interviews for the survey (October 2021), approximately 300 fishing boats were being unloaded, with daily landing volumes of 20 to 50 tons and peak loads exceeding 50 tons. Along the access road to the beach stand about 20 fish trader buildings for sorting, rinsing, and shipping the fish, as well as a private ice plant with a capacity of making 30 tons/day. It is progressively developing into a base of distribution for fish to retail markets. Due to growing demand for ice, another ice plant of the same capacity is under construction and is scheduled to be completed within the year. Of the landed fresh fish, 20% is consumed locally, including in the refugee camp, and 80% is shipped to distant retail markets in Cox's Bazar, Chattogram, Dhaka, and other markets, as well as to export processing plants in Cox's Bazar. The market has already surpassed the level of subsistence fishing. It is increasing its landing capacity and seems to be the landing site along the Bay of Bengal with the most potential for distribution base development.

(2) Distribution base for consumer markets landing sites

Table 5-2 Distribution Base for consumer markets Landing Sites

#	Landing site	Number of fisherman	Number of boats gather at the beach	Contribution to fish distribution	Total annual catch landed (MT)	Access to power / electricity	Surrounding land
⑧	Teknaf city Ghat	997	145	Moderate	1828	Yes	Very congested
⑨	Cox's Bazar BFDC Ghat	7500	1363	High	13984	Yes	Need to rebuild
⑩	Gorokghata	4375	583	Moderate	7338	Yes	Available

Source: Survey Result

This includes Teknaf city Ghat, BFDC Ghat in Cox's Bazar, and Gorokghata in Moheshkhali Upazila. These landing sites have higher landing volumes, are more strongly positioned as bases of distribution for fresh fish, and are important for fresh fish distribution to local and distant retail markets.

BFDC Ghat is the largest distribution base in Cox's Bazar, with the highest landed volume, number of fishers, and number of fishing boats. BFDC Ghat was established in 1965/66, with the landing facilities,

ice plant, and office building updated in 2001/02. However, in a cyclone in 2012, four jetties connected to the landing facilities by stairs were lost, the northern quay wall collapsed, and the landing facility building itself was slanted. BFDC tried to repair it but was unable to restore the facilities. The building was demolished after collapsing in 2015. The floor slab on the north end of the former landing facility remains sloped, and the quay is still collapsed. Since then, a roof has been put on the pillars on the south end remnants and used as a makeshift landing facility. However, with the area flooding during high tide and handling increased landing volumes, the landing site footprint is much too small, and plans are underway to build a temporary landing shed next to the ice plant. Despite a nominal ice making capacity of 30 tons per day, the ice plant's capacity has reduced due to the age of the machinery and equipment and now falls well short of meeting demands during the fishing season. As a base for fresh fish distribution to retail markets, BFDC Ghat is an important landing site. It current lands an average 32 tons of fish per day, with 40% consumed locally and 60% shipped to distant retail markets.

Next, Teknaf City Ghat in Teknaf is a landing site situated along both sides of a small channel about 500 meters back from the Naf River. Teknaf City Ghat has 11 private vendor stands and approximately 70 fishing boats in use, handling a daily landing volume of around 20 to 30 tons. As river fishing on the Naf was banned after the massive inflow of refugees from neighboring Myanmar, Teknaf City Ghat sources have shifted from 40% of landing volume from the Naf River before the ban to currently only handling catches from the Bay of Bengal. Ten percent of landed catches are consumed locally, and the rest is shipped to Chattogram and Dhaka. Teknaf has three of its own ice plants but also gets ice supplied from Cox's Bazar during the fishing season. Given their downtown locations, each ice plant site is small, and being privately-owned, they are hard to expand.

The Gorokghata landing site is located on the eastern tip of Moheskhali Island, on 1.5 hectares of sandy beach facing the Gorokghata canal. Formerly submerged underwater at high tide, sand was brought in to build the site in 2017. While 583 fishing boats reportedly use Gorokghata for landing, they also use BFDC Ghat, and the larger fishing boats sometimes go to Chattogram to unload. Gorokghata has two of its own ice plants, although insufficient ice supply forces boats to go to Cox's Bazar for ice during the fishing season. Eight auctioneers have Gorokghata sites, both servicing local consumers and shipping fish to Chattogram. With the Bangladeshi government gradually developing transportation infrastructure on Moheshkhali Island, the area will likely be more convenient for distribution to Chattogram than Cox's Bazar in the future.

(3) Raw fish for drying landing sites

Table 5-3 Raw Fish for Drying Landing Sites

#	Landing site	Drying yard Area	Active processor	Contribution to drying fish distribution	Need for access roads	Access to Fuel pomp (for fishing activity)	Surrounding land
⑪	Gotibanga	47.5	71	Low	High	No	Available
⑫	Sonadia	250	250	High	Very high	No	Available
⑬	Nazirtek	225	1328	High	Medium	No	Available

Source: Survey Result

These sites are located in regions that prosper in dried fish. The catches unloaded here are distributed to fish drying operators in the hinterland; a relatively low amount is distributed as fresh fish. In terms of scale, of the three landing sites, Nazirtek services the biggest market with 1,328 operators in the nearby fish drying area. It also has the largest landing volume and produces the highest volume of dried fish. In order, Nazirtek is followed by Sonadia with 250 merchants and Gotibanga with 71 merchants. Nazirtek is Bangladesh's largest producer of dried fish. However, the entire area has already been scheduled as a site for airport expansion with plans taking shape to relocate the drying plants to a newly constructed fisheries processing complex on the opposite shore of the Bakkhali River. Thus, as no landing will take place on the site in the near future, Nazirtek is not suited for an infrastructure development project. After Nazirtek, second in processing production is Sonadia, located on the southern tip of Moheshkhali Upazila. Sonadia has almost no landing facilities. Fish drying is a large-scale but seasonal operation in Sonadia, active during the dry season from November to March. The fish drying operators and workers move into the island at the end of the rainy season to set up for drying operations and then withdraw around the beginning of the rainy season. Although seasonal, the production is large in scale, and the landing site has a great need for development. Landing work is inefficient, resulting in accelerated deterioration and significant losses of the landed fish. After production at the drying yard, roads on the distribution route for the fish productions fish is dysfunctional due to flood damage to the bridge that crosses the waterway on the island, so securing a physical distribution route for the products is a major challenge.

5-1-2 Proposal for Fisheries Value Chain Infrastructure for Target Landing Sites

Upon examination of the three groups of landing sites in the target regions, three options for development of fisheries value chain infrastructure were proposed.

(1) Landing sites important to communities livelihood along the Bay of Bengal

Few landing facilities on the Bay of Bengal provide the functions essential to landing catches, even on the beaches where fishing boats gather in large numbers. These sites require landing center facilities for collection, rinsing, sorting, weighing, packing, and shipping of the landed fish. The facilities require a clean water supply for rinsing catches, as well as enough floor area to drain the rinsing water used in

sorting and rinsing to maintain cleanliness. They also require somewhere to store the ice used to chill the fish during transport for packaging and shipping, as well as a fishing net storehouse to store fishing nets when not in use.

Cyclones are frequent on the shores along the Bay of Bengal, and community people, including fishers and their families, often deal with water damage from storm surges, gale force winds, and flooding. Still, the area does not have enough evacuation shelters. Thus, landing centers should ideally double as cyclone shelters for the community people in the event of a disaster.

The landing center facilities shall have a solid structure and be equipped with a collection, rinsing and sorting workspace, a packaging and shipping workspace, a deep well and water storage tank, an ice storage house, a packaging warehouse, an administrative office, and an assembly hall.

While it would be ideal to construct landing center facilities at each landing site along the Bay of Bengal with high landing volumes where fishing boats gather, not just those listed in Table 5-1 above, the site with the most urgent need is Shaplapur. The Shaplapur landing site area has exploded since the extension of Marine Drive in 2017. Currently, the site lands over 20 tons of fish per day, which is approaching the average landing volumes of the BFDC Ghat. Also, the site is shipping to Refugees Camp and more to distant retail markets such as Chattogram, and Dhaka.

A Coast Guard captain stationed in Shaplapur reports that they perform rescues for about 10 maritime accidents involving fishing boats per year in the area. With no rescue boats, however, they are forced to perform the rescues using private boats for emergencies. Despite there being five Coast Guard stations along the 70 km of coastline south of Cox's Bazar along the Bay of Bengal, only the Cox's Bazar and Teknaf stations have rescue boats. Given the urgency of maritime accidents, necessity is high for deploying rescue boats. Although the number of marine accidents is relatively high in this area due to the large number of small fishing boats compared to other areas, recently the number of marine accidents has been decreasing due to training of fishermen by the Coast Guard. We believe that the efforts of the Coast Guard are very important in reinforcing the safety of the fishers in the target area. Also, light beacons are needed for safety for fishing boats returning to shore at night.

The facilities required for the Shaplapur Landing Center (tentative name) are: a collection, rinsing, and sorting workspace, a packaging and shipping workplace, a deep well and water storage tank, an ice storage, cold storage, a packaging warehouse, an administrative office, a fisheries cooperative office, a fish trader cooperative office, meeting rooms, a community assembly hall, a Monitoring post for Coast Guard, nighttime light beacons, a fishing gear storehouse, a rescue boat, a trailer for the rescue boat, a boat garage for the rescue boat and trailer, a disaster equipment storehouse, a rescue and safety equipment storehouse, and an access road.

The development of landing center facilities is expected to keep the landed fish clean, streamline shipping, reduce the currently substantial quality loss during landing and shipping, reduce post-harvest loss and, as a result, to increase fisher's income. The increased landing activity is expected to revitalize the regional economy, to boost employment opportunities, which should help to improve employment and household incomes in a host community that has been impacted by job competition since the massive inflow of refugees. Also, it should help to ensure the safety of community people in the event of cyclones.

The following items are expected to result from the development of the landing center.

・Reduction of quality deterioration of landed fresh fish by shortening the time from landing to shipping

・Improvement of hygiene by washing fresh fish for shipment in fresh water (deep well)

・Improvement of fresh fish shipping capacity (packing and shipping areas, access roads)

・Stable supply of fresh marine products to consumer markets in the region

・Shortened time required to prepare for fishing by reducing the time required to load ice for fishing (ice storage).

・Improving the life of fishing nets by preventing them from degrading due to solar radiation, etc. (fishing net storage)

・Ensuring the safety of returning from fishing at night and in stormy weather (light beacon)

・Strengthening training activities for fishers on handling fresh fish, hygiene, marine safety, etc. (meeting room)

・Reduction of marine casualties in the target area through habitual monitoring by the Coast Guard (monitoring stations)

・Improvement of life-saving systems by cutting the time between the occurrence of a marine accident and the dispatch of a rescue boat (rescue boat)

・Expanding in employment opportunities associated with boosting fishing activities and increase in the number of fishers using the facilities as a result of the activation of landing activities.

The new landing center will enable the handling of fresh fish in a hygienic environment, which is not currently possible. It is also expected that 20 to 50 tons of fresh fish per day will be handled in a hygienic environment for shipment to community markets, consumer markets in Cox's Bazar and Chattogram, and even export markets. Further research is needed to collect data on the amount of fresh fish that can be handled per day.

As for the beneficiaries, it is estimated that there are 2,000 fishermen and 5,000-6,000 related fisheries such as fish traders and consumers.

(2) Distribution base for consumer markets landing sites

Representing the largest landing site for Bangladeshi artisanal fisheries, BFDC Ghat in Cox's Bazar was damaged in a cyclone, and its landing facilities were left in disrepair, leaving its handling capacity insufficient. This insufficiency is a delimiting factor to the improvement of the artisanal fisheries value chain. With BFDC Ghat unable to handle the increased landing demand, fishing boats are forced to stand by for hours to unload their catches, auctioning and handling their catches in unhygienic manners in congested and chaotic conditions. Also, reduced capacity of the aging ice plant has further limited the already insufficient ice supply for the fishing season. The biggest issue to be solved is the delays in landing fish from the fishing boats which induce fear of food safety of the handled fish due to the degradation of BFDC Ghat functionality. BFDC has made plans to build a temporary landing shed and

update ice making machine components and has begun implementing its plan in part. However, these measures are only meant to temporarily restore the post-landing handling area to near its old state. This may not resolve the issues of meeting the increasing landing demands, and it will not resolve the previous issues of landing efficiency. The best solution is to demolish the collapsed north end landing building abandoned by BFDC Ghat and riverbank, then build new landing buildings and landing piers befitting of the current landing volumes and restore the riverbank to withstand disasters.

BFDC Ghat will require the following new facilities: An auction site, cold storage, a packaging and shipping workspace, a packaging warehouse, a deep well and water storage tank, an auctioneer office, a fish trader office, a BFDC office, a parking lot, landing piers, and gangways.

The existing facilities on the BFDC Ghat compound include the landing building and ice plant building, as well as an office building, residential building, fish trader office, and a canteen, fishing supply, and daily goods shop. Also, construction has started on the temporary landing shed and fish processing complex construction office. The BFDC Ghat grounds are not big enough and securing enough land for construction is a major issue. There is nowhere in the vicinity to temporarily relocate the landing operation during construction work and, due to the nature of the facilities, they cannot be kept closed for too long. It will take some deliberation to figure out how to proceed with the construction while still keeping BFDC Ghat operational.

Repairing the BFDC Ghat will shorten landing wait times for fishing boats and streamline landing work, which will in turn improve the freshness of landed fish and enable hygienic handling of fish. This will lead to improved quality of fish in distribution and supply consumers with superior, safer seafood in higher quantity. This will also mean that there will be no fishing boats that are compelled to go to Chittagong for landing their catch after waiting in vain at BFDC Ghat for a long time for landing. Shorter waiting times for landing and streamlined landing work will also reduce the burden on fishers in unloading the fish catches.

Currently, there are about 10 fishing boats a day landing at the BFDC Ghat, but because the boats are landed on a first-come, first-served basis, the earliest boats can land at 6:00 AM, so they have to wait at the river in front from midnight. In the case of boats arriving at the BFDC Ghat after 6:00 AM, the landing takes place around 11:00 to 12:00 AM. In addition, large fishing boats can only dock at floating pontoon in the BFDC Ghat, which makes fishing boats moor in the river front and use small carriers to carry the fish to the landing center, which is inefficient. Regarding the size of the fishing boats landing fish to BFDC, the boat length was about 15m at the time of the field survey.

By reforming the landing environment, the planned facility is expected to reduce the waiting time and increase the number of landing fishing vessels at a time, which could have the following effects.

・Multiple the number of vessels that can land at the same time and increase in the number of vessels that use the facilities per day through the construction of pontoons

・Shortening the auction time after landing by expanding the auction site

・Improvement in the efficiency of cleaning, sorting, and packaging of fresh fish by expanding fish handling area

・Reduction in vehicle congestion and improvement shipping efficiency by securing parking and traffic space for trucks for shipping

・Increase in the number of fishing boats using the facilities, reduction the time from landing to transporting, and increase in the volume of fish handled through improved shipping efficiency

・Diminution of deterioration in quality of landed fresh fish by reduction of the time from landing to transporting

・Conservation of fuel for fishing vessels compelled to go to alternative landing sites

・Increase in the number of fishermen using the facilities as a result of revitalization of landing activities and increase in employment opportunities associated with activation of the series of fisheries activities

If the BFDC Ghat pontoons are upgraded to the planned three new pontoons of the same size, the number of boats that can be landed at the same time will quadruple to four large boats or eight medium-sized boats, compared to one large boat or two medium-sized boats with the existing pontoons. This will greatly reduce the time required for landing and waiting times for landing.

In addition, the existing fish handling area is approximately 1,130m^2, including two adjacent buildings, but the planned facility will have a floor area of approximately 2,200m^2 for a single fish handling building, which will double the area available for simultaneous fish handling. The time required for cleaning, sorting, trading, packing, and shipping after landing will be greatly reduced, and combined with the shortened waiting time for fishing boats to unload and land fish due to the expansion of the landing pier, fish freshness at the BFDC Ghat will be greatly improved.

Further research is needed to collect data on the current landing time of fishing boats and the amount of fish that can be simultaneously handled per unit of landing site. Currently, the maximum amount of landing at existing facilities is about 30 tons per day, but at the planned facility, it is thought that multiple fishing boats will be able to land and handle their fish at the same time, so a maximum of 60 tons per day will be landed. It will be possible to shorten the time required for landing.

As for the beneficiaries, it is estimated that there are fishermen, middlemen and consumers who use the BFDC Fisheries Center, the number of fishermen is currently estimated to be 7,500.

(3) Landing sites of raw fish for drying

While a key landing site for dried fish production, Nazirtek will not be a target site as the fish drying operators are being relocated. Located on the western tip of Sonadia Island at the southern end of Moheshkhali Upazila, Sonadia is conveniently located for artisanal fishing boats to sail into the Bay of Bengal, and many fish drying operators come to Sonadia during the dry season, which is suitable for drying fish. There is great need for landing site development. Although seasonal, the production is large in scale, and there are significant economic losses from degraded fish quality due to the poor landing site. Also, the mounting points for the bridge along the transport route for the processed fisheries have been washed out, making truck transport impossible and posing a major obstacle to product transportation. Most of the inhabitants of Sonadia Island depend on fishing and salt production for their livelihoods, and

the illiteracy rate is high at 96%. It is estimated that 73% of the fishers do not own their own fishing boats or gears and have to rely on their owners, and because fish products go through seven levels of intermediary distributors, fish prices are kept low and they do not get a fair evaluation of their fishing activities[130]. Moheshkhali Upazila also has two other areas where fishing boats cluster in Gotibanga and Gorokghata. At both locations, wide tidal ranges greatly limit the time available for fishing boats, and most of the larger artisanal fishing boats from this area unload their catches at BFDC Ghat in Cox's Bazar. Few unload locally on Moheshkhali. This points to a strong demand for developing a local landing site. Without a local landing site, fishers are forced to wait long times at the overwhelmed BFDC Ghat and, in some cases, must go all the way to Chattogram to unload. Development on Moheshkhali would improve this situation.

The Sonadia Landing Center (tentative name) will require the following facilities: A collection, rinsing, and sorting workspace, primary processing facilities, a deep well and water storage tank, a product storehouse, a packaging warehouse, an administration office, a fisher's cooperative office, meeting rooms, a community assembly hall, nighttime light beacons, a fishing gear storehouse, and access road.

The Sonadia Landing Center can only be reached by boat at high tide, and there are considerable restrictions on transportation, including the fact that the land access road is only accessible by foot as it is closed to vehicles. In addition, interviews with local fishermen and processors revealed that freshness deterioration of landed products is a problem due to the lack of landing facilities in the area.

Development of Sonadia Landing Center facilities is expected to prevent the landed fish from degrading in quality, leading to production of quality dried fish, as well as to reduce quality loss during storage, shorten distribution times, reduce distribution costs and, as a result, to increase fisher's income.

The site will also serve as an alternative site for repairing and drying fishing nets due to the relocation of Nazirtek, which is expected to promote employment of workers involved in such work.

The development of landing facilities and access roads is expected to increase the efficiency of landing activities in the target area, improve the freshness of the raw fish for processing, and improve the product transportation.

・Enhancement in the freshness of raw fish for processing by increasing the efficiency of landing operations

・Amelioration in the quality of processed products by enhancement the freshness of raw fish for processing.

・Reduction in the time required for fishing net maintenance by improving the environment for net repair and drying.

・Securing employment for fishing net repair and net drying work

・Improvement in the efficiency of transporting raw materials such as dried fish to the dried fish processing yards scattered around the area by building access roads

・Reduction in the distribution time of processed marine products such as dried fish by upgrading

[130] Challenges of Artisanal Fishermen: A case study from Sonadia Island, Rahman et al. 2020

access roads

The development of the Sonadia Landing Center will enable the handling of fresh fish in hygienic conditions, which is currently not possible. It is also expected that at Sonadia, where about 9,000 tons of dried fish are processed annually, raw fish for drying can be landed in a hygienic environment, and this improved-quality raw fish will be used in dried fish processing.

Further research is needed to collect data on the amount of raw fish landed at Sonadia.

Beneficiaries are dried fish processors and consumers, and the number of processing workers engaged in dried fish processing yard in Sonadia is estimated to be 1,200-1,500.

5-2 Possibility of Coordination with the Proposed Projects and Both JICA Projects and Other Donor Projects

(1) Shaplapur Landing Center

Once the Shaplapur Landing Center facilities are complete under the Japanese government's grant aid program, it is hoped that the users can manage and operate the facilities for themselves. To this end, a Shaplapur Landing Center Management Council comprised of fishermen representatives and community members will be established. Under the supervision of the Management Council, facility personnel will run the facilities autonomously funded by facility usage fees. Within the framework of the Japanese government's grant aid program, cooperation such as assistance in establishing organizations for operating the facilities constructed in the project, development of operational rules, and personnel training can be implemented as soft components. Based on experiences in implementing the Project for the Improvement of Artisanal Fishery Centers in other developing countries, it is necessary to work together with and educate fishers and the community over a long period. Currently, under the Bangladesh Sustainable Coastal and Marine Fisheries Project (BSCMFP), the World Bank is planning to build production infrastructure for artisanal fisheries and building capacity in the community. Coordinating with BSCMFP on this project in management after infrastructure development and participation in community management to leverage their experience and results and the lessons learned can be expected to make project implementation more effective.

In the Preparatory Survey for the Development of the Southern Chittagong Region of Bangladesh by JICA, the development of the Kitchen Market in Shaplapur is one of the proposed sub-projects. The development of nearby consumer markets can contribute to the promotion of local consumption of landed fish and the reduction of post-harvest losses. Accordingly, by collaborating with the above project, it is expected that the distribution of fresh fish landed at the Shaplapur Landing Center for local consumption will be more operative, the distribution volume will be augmented, and the transportation time will be shortened and the quality of fresh fish will be ameliorated by rectifying the fresh fish handling environment.

(2) BFDC Ghat

After the implementation of the BFDC Ghat Improvement Plan through the Japanese government's grant aid program, although the operation of the center will basically remain unchanged, the improvement of the fresh fish handling facilities will require further perfection of the sanitation environment and the freshness and quality of the fish handled. At the BFDC Ghat, with support from USAID, the Enhanced Coastal Fisheries in Bangladesh II (ECOFISH II) is currently being conducted to clean the landing site twice a month in efforts to prevent contamination of the fish and maintain fish quality. In educating the community on how to keep fish fresh and handle them hygienically, landing site sanitation management, and other topics, it is expected that the experience and knowledge gained from ECOFISH II will be employed to implement the project more effectively. As WorldFish might to continue its support to the fisheries sector in Bangladesh after ECOFISH II is completed, it might be effective in case the work will be done in cooperation with WorldFish.

(3) Sonadia Landing Center

As with Shaplapur Landing Center, coordinating with BSCMFP at Sonadia Landing Center on this project in management after infrastructure development and participation in community management to leverage their experience and results and the lessons learned can be expected to make project implementation more effective. In addition, there is a plan to improve the road to Gotibanga through a road improvement project funded by the Japanese government, and if access from Gotibanga to the Sonadia Landing Center is secured in conjunction with this plan, the transportation of processed fish to Chattogram is expected to become more efficient and accelerated than to Cox’s Bazar.

5-3 Proposed soft component (management and operation) support

Although it is envisaged that BFDC will continue to manage and operate the BFDC Ghat, for the Shaplapur Landing Center and Sonadia Landing Center, independent management and operation by the users and the community is desired. Recognizing that the maintenance, operation and management of the facility is the uppermost issue after the completion and delivery of the facility, the management and operation plan should be discussed with the implementing agencies, and an organization that can generate maintenance and management costs while ensuring transparency of accounting is required. Therefore, support for the establishment of the organization and training of management and operational personnel are required.

5-4 Considerations on Possible Japanese Technologies

The level of support required on site is not requiring high skill, but rather support in raising standards for each process in landing work and the distribution stage thereafter from their current levels. The equipment required for the facilities of the proposed Shaplapur Landing Center, BFDC Ghat, and Sonadia Landing Center projects is basic equipment that only needs to meet basic requirements, which can be

procured on the markets. As generic products are available on the market, there is no need for products that require Japanese high-end technology for this project.

Since the BFDC Ghat requires to continue landing operations during the construction period, the construction work shall be carried out, in the area separated from the area secured for landing operations within the BFDC compound, without interfering the landing operations, which requires complex construction management and a high level of safety assurance. In addition, because the existing facilities have been endangered by the riverbank erosion in front of them, it is necessary to carry out marine (river) engineering works to prevent river erosion in parallel with the construction of the planned buildings. As the contractor shall have such construction work capabilities and ripe experiences both in marine (river) engineering works and building construction works it is preferable to employ a Japanese contractor.

In response to the dissatisfaction expressed by administrators regarding the durability of some of the facilities built by local contractors at cyclone centers provided by other donors, for the Shaplapur Landing Center, the construction of a landing facility on a sandy beach in a severe environment with heavy rainfall and cyclone risk during the rainy season requires a contractor capable of constructing a strong structure and durable on time, so construction by a Japanese contractor is preferable.

For the Sonadia landing site, a contractor who can construct a facility with a strong structure and high durability on time is required, as is the case with the Shaplapur, and a contractor who can construct the facility on time is required for a site with no access roads, so construction by a Japanese contractor is preferred.

5-5 Summary of issues to be considered when conducting preparatory surveys for cooperation for the proposed projects

The survey items for each of the projects which are considered necessary to be studied with special attention in the preparatory survey for cooperation are shown as follows.

5-5-1 Considerations for a cooperative preparatory survey at the Shaplapur Landing Center

5-5-1-1. Executing agency

Finance and Planning of the DoF has been confirmed to be the executing agency, in case the Grant aid project would be carried out. As for the executing agency for the development of fisheries infrastructure, the DoF is in charge of the Sustainable Coastal and Marine Fisheries Project of the World Bank, but construction of the 16 landing sites planned as a subproject is not yet at the implementation stage.

5-5-1-2. Confirmation of the background, purpose, and contents of the project

・Review the results of this survey and confirm the background and objective of this project with regard to the development plan in Bangladesh

・For the beneficiary population, obtain the latest statistics from the national statistics office and local governments.
・In the case of fisher's camps, where no statistical data is available, obtain information that allows for proper estimation.
・Discuss the requested components with the counterpart based on the priority level of the survey results. Obtain materials and information to verify the validity of each component.
・Conduct a baseline survey to evaluate the effectiveness of the grant aid and to develop evaluation indicators.

5-5-1-3. Survey on fisheries value chain and fishery distribution

・In the preparatory survey for cooperation, survey the actual distribution status from the target sites to the major consumption areas, and obtain the latest data on the fisheries value chain in each route. For items for which no data is available, conduct a survey to enable estimation and to understand the actual distribution volume and distribution situation.
・Obtain the latest landing data for Shaplapur. In addition, check the method of obtaining the data in detail to verify the validity of the data.
・Check the amount of ice used when fishing boats leave the shore and when fish is distributed.

5-5-1-4. Coastal engineering survey

The site is located on a sandy beach in a cyclone prone area and the hazards of high waves, strong winds, sand movement shall be surveyed to ensure the safety of the facility.

5-5-1-5. Natural condition survey

As for the topographical survey and geotechnical survey, which are part of the natural condition survey in the preparatory survey for cooperation, it is considered appropriate to outsource them to a local survey company.

Table 5-4 Natural Condition Survey (Draft)

Study items	Study contents and specifications	Quantity
1. Land topographical surveying	・Construction site (survey of the site and surrounding topography and site boundaries, existing buildings, infrastructure installation routes and connection points, trees and other land features) ・Land for road and drainage planning (plan topography, longitudinal and transverse survey 1.0km x 30m) Deliverables: Survey drawings (1/500 in plan, longitudinal cross-sectional view) Including digital data	20,000m^2 30,000m^2
2. Geotechnical survey	・Onshore boring (including penetration tests, sample collection, and laboratory analysis)	10 borings @40m
3. Meteorological and oceanographic survey	・Literature survey, natural disaster history survey ・Tide level and wave survey ・Water quality survey (COD, pH, E. coli, etc.)	1 survey 1 survey 6 samples

5-5-1-6. Operations, maintenance, and management costs survey

・Survey the status of facilities, operation, and maintenance of nearby public markets.

・Explain the project contents to the implementing agencies, relevant communities, fisher's associations and fishery stakeholders, and the Coast Guard to discuss the operations using the facilities, management and operation system after establishing the management body, and maintenance issues.

・Study the activities, roles, and capacity of existing organizations such as fisher's associations, and consider their collaboration in the management system after the completion of the facilities.

・Discuss the request from the counterpart and the specifics of the trainings for management and operation.

5-5-1-7. Facility planning survey (civil engineering and architecture)

・Survey the use of fishing boats and transport vehicles (number of boats, fishing days, fishing return time, number of vehicles used, dwell time, etc.)

・Survey the seasonal and temporal variation of fresh fish landings.

・Review the scale and specifications of facilities such as landing sites to ensure optimal planning, taking into account the status of similar facilities in Bangladesh.

・Review the size and specifications of the wastewater treatment facility based on the standards for public facilities in Bangladesh and the sanitation standards to be conformed in Bangladesh.

5-5-1-8. Equipment planning survey

・In the procurement of equipment, give consideration to the ease of operation and management of the implementing organizations.

・For the rescue boats in Shaplapur, confirm the detailed plans of the operational agencies, including the necessity of such boats. Also survey the needs of the parties involved, the past operational performance of the operating agency, the availability of personnel, and specific operational plans.

5-5-1-9. Survey on procurement situation, construction plan, and cost estimation

・Survey the local contractor's construction capacity, technical capabilities, personnel structure, and a list of major construction equipment.

・Pay particular attention to large machinery related to civil engineering work .

・Survey the status of local procurement of materials, equipment, consumables, parts, etc., and the most appropriate suppliers (local, Japanese, third countries).

・Survey the status of local procurement of aggregates and the most suitable suppliers.

5-5-1-10. Survey on environmental and social considerations

・When conducting a preparatory survey for cooperation, explain to the executing organization that the survey will be conducted in accordance with the JICA Environmental Guidelines, and ensure that the

recipient government understands the survey.

・It is necessary to start preparing for EIA as early as possible because it is expected to take some time from the application to the approval. Provide the following support as needed.

- Screening under Bangladesh's EIA system based on the contents of the facility (confirmation of categories)
- Support for the selection process of EIA consultants (preparation of specifications, etc.)
- EIA process check

・Procedures for the construction of new facilities in ECAs (ecologically critical areas)

- Confirm with the Department of Environment and ECA management organizations based on the contents of the facility.

・The Forest Department has planted trees along the sandy beach of Marine Drive as a windbreak and erosion control measure. The Forest Department, Department of Environment and a group entrusted with management by the Forest Department needs to be included as a stakeholder for tree felling in the target area.

・Based on the results of consultations and surveys with partner countries, prepare a draft monitoring form for the JICA Environmental Guidelines.

・Other items for consideration are shown in Appendix-5.

5-5-1-11. Survey of Site Conditions

・Survey the latest development plans in the vicinity of the project site. In particular, confirm whether or not there is a plan for road expansion on Marine Drive, the scale of the content, budget, and implementation schedule.

・Survey the basic infrastructure required for the project, such as electricity. In particular, the status of existing infrastructure is particularly important for facility planning, so collect information from each related organization and discuss the sharing of information with this project.

5-5-1-12. Survey on the items to be borne by the counterpart

The following is a summary of the responsibilities borne by Bangladesh in this survey. In the survey, be confirmed and hold substantive discussions on each item, including the responsible organization, the executing agency, the schedule for implementation by the counterpart, the monetary amount to be borne by the counterpart for the items to be covered, and the method of budgeting.

・Cutting or transplanting of trees in the construction site of the project site

・Implementation of environmental impact assessments and acquisition of permits

・Application for and acquisition of all permits and approvals related to the project (construction permits in ECA, building permits, infrastructure permits, construction permits, etc.)

・Connecting the power supply for the new facility to the site.

・Securing budgets for items to be borne during implementation of the plan

・Facilitation of plan implementation (customs clearance for importing materials and equipment, stay

permission of Japanese engineers and stuffs in relation with the Project)

・Maintenance and operation after construction

・Post-construction environmental monitoring

5-5-1-13. Formation of survey team, etc.

Based on the contents of the preparatory survey for cooperation, the following team composition is recommended.

・Chief Consultant / facility operation plan

・Civil engineering planning / coastal topography and natural condition survey

・Fisheries facility planning and cost estimation

・Fisheries value chain / equipment planning

・Environmental and social considerations / gender considerations

5-5-2 Points to be considered in conducting cooperative preparatory survey for BFDC Ghat

5-5-2-1. Executing agency

The Planning Division of the Bangladesh Fisheries Development Corporation (BFDC) has been confirmed to be the executing agency in case the Grant aid project would be carried out. There will be no problem with tax exemption procedures under the Japanese Grant aid program.

Regarding the financial status of the BFDC Ghat, Annual balance in 2019-2020 and 2020-2021 are as follows.

Table 5-5 Annual balance of BFDC Ghat (BDT)

Annual balance	2019-2020	2020-2021
Royalty & Commission	8,667,942	7,074,170
Ice Sale	6,505,673	6,787,867
Rent & Lease	1,962,124	2,195,838
Miscellaneous Income	683,785	956,902
Annual income	17,819,524	17,014,777
Administrative Expenses	3,039,295	3,177,489
Operating Expenses	8,008,392	8,112,722
Miscellaneous Expenses	11,960	14,682
Annual Expenses	11,059,647	11,304,893

Source: BFDC

5-5-2-2. Confirmation of the background, purpose, and contents of the project

・Review the results of this survey and confirm the background and objective of this project with regard to the development plan in Bangladesh

・For the beneficiary population, obtain the latest statistics from the national statistics office and local governments.

・Discuss the requested components with the counterpart based on the priority level of the survey results. Obtain materials and information to verify the validity of each component.

・Conduct a baseline survey to evaluate the effectiveness of the grant aid and to develop evaluation indicators.

5-5-2-3. Survey on fisheries value chain and fishery distribution

・In the preparatory survey for cooperation, survey the actual distribution status from the target sites to the major consumption areas, and obtain the latest data on the fisheries value chain in each route. For items for which no data is available, conduct a survey to enable estimation and to understand the actual distribution volume and distribution situation.
・Survey the current status of the scale and capacity of landing facilities, including the number of fishing boats landing at the BFDC and the time required for landing.
・Obtain the latest data on landings, number of boats, number of brokers, etc. at the BFDC Ghat. In addition, check the method of obtaining the data in detail to verify the validity of the data.
・Check the amount of ice used when fishing boats leave the port and when marine products are distributed.

5-5-2-4. Fisheries civil engineering

・In the past, the foundation of the landing site building was washed out by the river in front of it, causing the building to slope. Survey the cause of the accident, and plan effective preventive measures.
・Consider the safety measures for the pontoons installed in the river when the river rises in the front.

5-5-2-5. Natural condition survey

As for the topographical survey and geotechnical survey, which are part of the natural condition survey in the preparatory survey for cooperation, it is considered appropriate to outsource them to a local survey company. Accordingly, water quality and flow surveys should be conducted directly by Japanese consultants or partially subcontracted, taking into account the capabilities of the subcontractor.

Table 5-6 Natural Condition Survey (Draft)

Study items	Study contents and specifications	Quantity
1. Land topographical surveying	・Construction site (survey of the site and surrounding topography and site boundaries, existing buildings, infrastructure installation routes and connection points, trees and other land features) ・Land for road and drainage planning (plan topography, longitudinal and transverse survey 1.0km x 30m) Deliverables: Survey drawings (1/500 in plan, longitudinal cross-sectional view) Including digital data	20,000m^2 30,000m^2
2. River topographical surveying	Bathymetric survey (landing site and surrounding shoreline) 200m x 100m Deliverables: Plane 1/500, cross-sectional view (*if necessary) Including digital data	20,000m^2
3. Geotechnical survey	・Onshore boring (including penetration tests, sample collection, and laboratory analysis)	10 borings @40m

Study items	Study contents and specifications	Quantity
4. Meteorological and oceanographic survey	・Literature survey, natural disaster history survey ・Flow condition survey (flow direction and velocity survey) ・Tide level survey ・Water quality survey (COD, pH, E. coli, etc.)	1 set 1 set 1 set 6 Samples

5-5-2-6. Operations, maintenance, and management costs survey

・Study the operation and maintenance status of the existing BFDC Ghat.

・Because the BFDC must be involved in the project as the main operator, explain the contents of the project to BFDC and discuss the operation system after the completion of the facilities.

・Discuss the request from the counterpart and the specifics of the training for management and operation .

5-5-2-7. Facility planning survey (civil engineering and architecture)

・Survey the use of fishing boats and transport vehicles (number of boats, fishing days, fishing return time, number of vehicles used, mooring time, etc.)

・Survey the seasonal and temporal variation of fresh fish landings.

・Review the scale and specifications of facilities such as landing sites will to ensure optimal planning, taking into account the status of similar facilities in Bangladesh.

・Review the size and specifications of the wastewater treatment facility based on the standards for public facilities in Bangladesh and the sanitation standards to be conformed in Bangladesh.

・It is necessary to consider whether or not to include the construction of new religious facilities (mosques) in the project, and to confirm the requirement for construction specific to mosque.

5-5-2-8. Survey on procurement situation, construction plan, and cost estimation

・Survey the local contractor's construction capacity, technical capabilities, personnel structure, and ownership of major construction equipment.

・Pay particular attention to large machinery related to civil engineering work.

・Survey the status of local procurement of materials, equipment, consumables, parts, etc., and the most appropriate suppliers (local, Japanese, third countries).

・Survey the status of local procurement of aggregates and the most suitable suppliers.

5-5-2-9. Survey on environmental and social considerations

・When conducting a preparatory survey for cooperation, explain to the counterpart organization that the survey will be conducted in accordance with the JICA Environmental Guidelines, and ensure that the recipient government understands the survey.

・It is necessary to start preparing for EIA as early as possible because it is expected to take some time from the application to the approval. Provide the following support as needed.

- Screening under Bangladesh’s EIA system based on the contents of the facility

(confirmation of categories)

- Support for the selection process of EIA consultants (preparation of specifications, etc.)
- EIA process check

・Hold stakeholder meetings to explain the restrictions on use during construction to users and to obtain their approval.

・In the BFDC, there is a mosque in the center of the site, which was built in 2002 at the request of the users. In order to secure a route for construction vehicles, it is necessary to demolish existing facilities, and the mosque falls under this category. In case of new construction or demolition, inform BFDC Headquarters (Dhaka), BFDC Cox's Bazar, and obtain approval by holding a stakeholder meeting.

・Other items for consideration are shown in Appendix-5.

5-5-2-10. Survey of Site Conditions

・Survey the latest development plans in the vicinity of the project site. In particular, the BWDB's project for revetment of the frontal river will have a significant impact on the consideration of revetment design and revetment construction in this project. Share information with the BWDB on the timing of the revetment work by BWDB, the shape of the planned revetment, and on the revetment structure, construction method and construction period planned for this project, and consider the structure, construction method and construction period.

・Survey the basic infrastructure required for the project, such as electricity. In particular, the status of existing infrastructure is particularly important for facility planning, so collect information from each related organization and discuss the sharing of information with this project.

5-5-2-11. Survey on the items to be borne by the counterpart

The following is a summary of the responsibilities borne by Bangladesh in this survey. In the survey, hold substantive discussions on each item, including the responsible organization, the implementing agency, the schedule for implementation by the counterpart, the monetary amount to be borne by the counterpart for the items to be covered, and the method of budgeting.

・Clearing of the land for the project site (including removal of debris from the building foundation)

・Cutting or transplanting of trees in the construction site of the project site

・Implementation of environmental impact assessments and acquisition of permits

・Application for and acquisition of all permits and approvals related to the project (building permits, infrastructure permits, construction permits, etc.)

・Securing budgets for items to be borne during implementation of the plan

・Facilitation of plan implementation (customs clearance for importing materials and equipment, procedures for staying in Japan)

・Maintenance and operation after construction

・Post-construction environmental monitoring

5-5-2-12. Formation of survey team, etc.

・Chief Consultant / facility operation plan
・Fishery distribution
・Fisheries engineering /natural condition survey
・Fisheries facility planning
・Construction management planning and cost estimation
・Environmental and social considerations / gender considerations

5-5-3 Considerations for conducting a cooperative preparatory survey at the Sonadia Landing Center

5-5-3-1. Executing agency

It was confirmed that Finance and Planning of the DoF will be the executing agency, and it is also possible to implement tax exemptions and other items to be borne by the recipient.

5-5-3-2. Confirmation of the background, purpose, and contents of the project

・Review the results of this survey and confirm the background and objective of this project with regard to the development plan in Bangladesh
・For the beneficiary population, obtain the latest statistics from the national statistics office and local governments.
・Discuss the requested components with the counterpart based on the priority level of the survey results. Obtain materials and information to verify the validity of each component.
・Conduct a baseline survey to evaluate the effectiveness of the grant aid and to develop evaluation indicators.

5-5-3-3. Survey on fisheries value chain and fishery distribution

・In the preparatory survey for cooperation, survey the actual distribution status from the target sites to the major consumption areas, and obtain the latest data on the fisheries value chain in each route. For items for which no data is available, conduct a survey to enable estimation and to understand the actual distribution volume and distribution situation.
・The fish price and quality will also be investigated in the fisheries value chain survey.
・Obtain the latest landing data for Sonadia. In addition, check the method of obtaining the data in detail to verify the validity of the data.
・For the construction of access roads from neighboring villages to the Sonadia Landing Center, confirm the development plan and development status of the target area, draw up appropriate multiple proposals, discuss them with the counterpart, and confirm the counterpart's needs, the position in the fishing village, and the effect of these proposals as a component of fishing village development.

5-5-3-4. Coastal engineering survey

The site is located on a sandy beach in a cyclone prone area and the hazards of high waves, strong winds, sand movement will be surveyed to ensure the safety of the facility.

5-5-3-5. Natural condition survey

As for the topographical survey and geotechnical survey, which are part of the natural condition survey in the preparatory survey for cooperation, it is considered appropriate to outsource them to a local survey company. Accordingly, water quality and flow surveys should be conducted directly by Japanese consultants or partially subcontracted, taking into account the capabilities of the subcontractor.

Table 5-6 Natural Condition Survey (Draft)

Study items	Study contents and specifications	Quantity
1. Land topographical surveying	・Construction site (survey of the site and surrounding topography and site boundaries, existing buildings, infrastructure installation routes and connection points, trees and other land features) ・Land for road and drainage planning (plan topography, longitudinal and transverse survey 1.0km x 30m) Deliverables: Survey drawings (1/500 in plan, longitudinal cross-sectional view) Including digital data	20,000m^2 30,000m^2
2. River topographical surveying	Bathymetric survey (landing site and surrounding shoreline) 200m x 100m Deliverables: Plane 1/500, cross-sectional view (*if necessary) Including digital data	20,000m^2
2. Geotechnical survey	・Onshore boring (including penetration tests, sample collection, and laboratory analysis)	10 borings @40m
4. Meteorological and oceanographic survey	・Literature survey, natural disaster history survey ・Flow condition survey (flow direction and velocity survey) ・Tide level survey ・Water quality survey (COD, pH, E. coli, etc.)	1 set 1 set 1 set 6 Samples

5-5-3-6. Operations, maintenance, and management costs survey

・Survey the status of facilities, operation, and maintenance of nearby public markets.

・Explain the project contents to the executing agencies, relevant communities, fishermen's associations and fishery stakeholders to discuss the use of the facilities, management and operation system, and maintenance issues.

・Study the activities, roles, and capacity of existing organizations such as fisher's associations, and consider their collaboration in the management system after the completion of the facilities.

・Discuss the request from the counterpart and the specifics of the training for management and operation .

5-5-3-7. Facility planning survey (civil engineering and architecture)

・Survey the use of fishing boats and transport vehicles (number of boats, fishing days, fishing return

time, number of vehicles used, dwell time, etc.)

・Review the scale and specifications of facilities such as landing sites will to ensure optimal planning, taking into account the status of similar facilities in Bangladesh.

・Review the size and specifications of the wastewater treatment facility based on the standards for public facilities in Bangladesh and the sanitation standards to be conformed in Bangladesh.

5-5-3-8. Survey on procurement situation, construction plan, and cost estimation

・Survey the local contractor's construction capacity, technical capabilities, personnel structure, and the list of major construction equipment. Pay particular attention to large machinery related to civil engineering work.

・Survey the status of local procurement of materials, equipment, consumables, parts, etc., and the most appropriate suppliers (local, Japanese, third countries).

・Survey the status of local procurement of aggregates and the most suitable suppliers.

5-5-3-9. Survey on environmental and social considerations

・When conducting a preparatory survey for cooperation, explain to the counterpart organization that the survey will be conducted in accordance with the JICA Environmental Guidelines, and ensure that the recipient government understands the survey.

・It is necessary to start preparing for EIA as early as possible because it is expected to take some time from the application to the approval. Provide the following support as needed.

- Support for the selection process of EIA consultants (preparation of specifications, etc.)
- EIA process check

・Procedures for the construction of new facilities in ECAs (ecologically critical areas)

- Confirm with the Department of Environment and ECA management organizations based on the contents of the facility.

Bangladesh Economic Zones Authority (BEZA) is planning "Sonadia Eco-Tourism Park (Moheshkhali Upazila, 9,467 acres)" on Sonadia Island. Confirm the land use restrictions again.

・Based on the results of consultations and surveys with partner countries, prepare a draft monitoring form for the JICA Environmental Guidelines.

・Other items for consideration are shown in Appendix-5.

5-5-3-10. Survey of Site Conditions

・Survey the latest development plans in the vicinity of the project site. In particular, confirm whether or not there is a plan for road improvements for the road to Gotibanga, the scale of the content, budget, and implementation schedule.

・Survey the basic infrastructure required for the project, such as electricity. In particular, the status of existing infrastructure is particularly important for facility planning, so collect information from each related organization and discuss the sharing of information with this project.

5-5-3-11. Survey on the items to be borne by the counterpart

The following is a summary of the responsibilities borne by Bangladesh in this survey. In the survey, hold substantive discussions on each item, including the responsible organization, the implementing agency, the schedule for implementation by the counterpart, the monetary amount to be borne by the counterpart for the items to be covered, and the method of budgeting.

・Cutting or transplanting of trees in the construction site of the project site
・Implementation of environmental impact assessments and acquisition of permits
・Application for and acquisition of all permits and approvals related to the project (building permits, infrastructure permits, construction permits, etc.)
・Securing budgets for items to be borne during implementation of the plan
・Facilitation of plan implementation (customs clearance for importing materials and equipment, procedures for staying in Japan)
・Maintenance and operation after construction
・Post-construction environmental monitoring

5-5-3-12. Formation of survey team, etc.

Based on the contents of the preparatory survey for cooperation, the following team composition is desirable.

・Chief Consultant / facility operation plan
・Civil engineering planning / coastal topography and natural condition survey
・Fisheries facility planning and cost estimation
・Fisheries value chain
・Environmental and social considerations / gender considerations

Appendix

1. Name of Team members
2. Plan (Draft)
3. Construction Schedule (Draft)
4. Project Cost Estimation (Draft)
5. Reference for Environmental Consideration

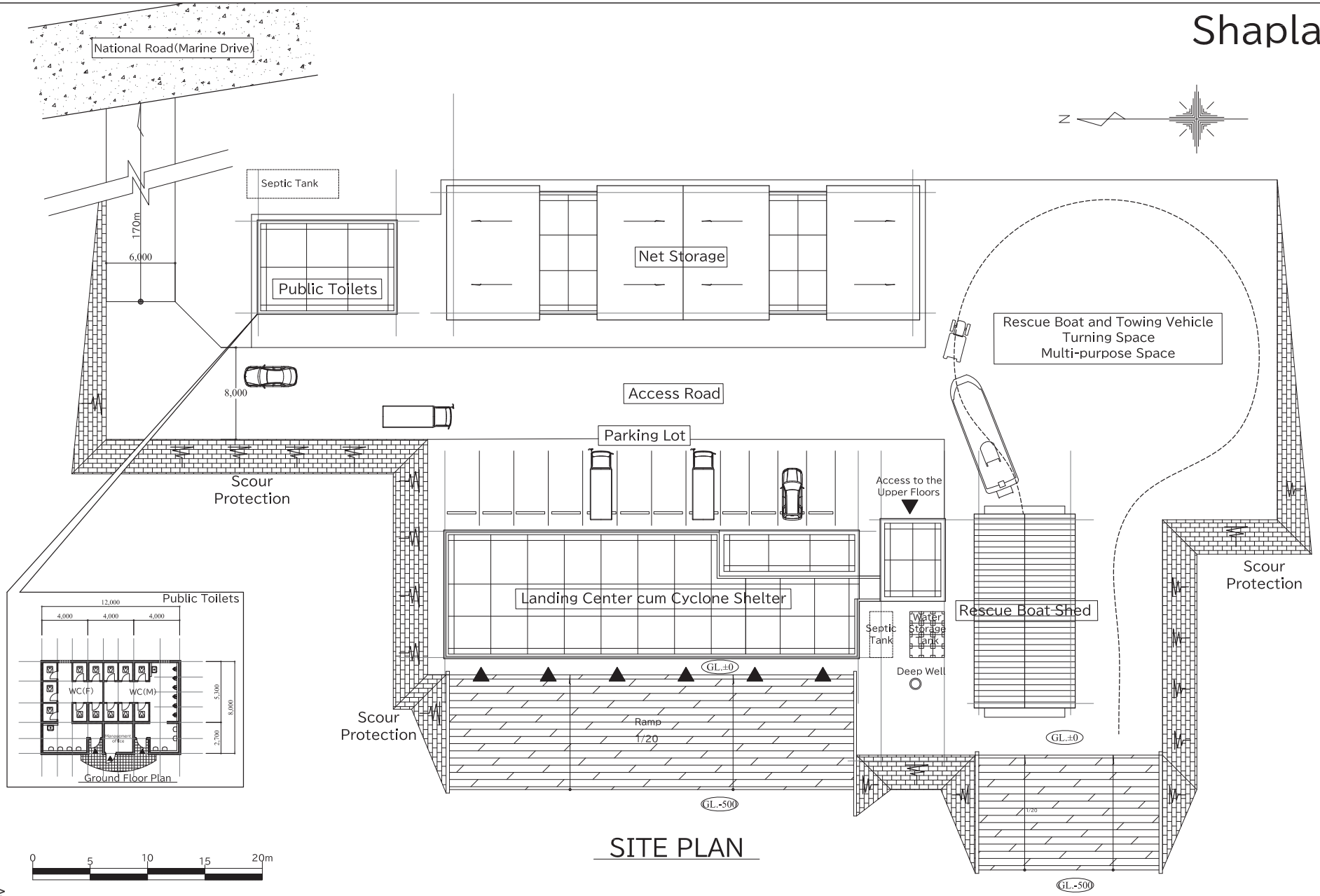
1. Name of the Team members

Kuniaki TAKAHASHI	Project Manager/ Fishing Village Development / Socioeconomic Analysis	Fisheries Engineering Co., Ltd.
Akinori SAKO	Fisheries Infrastructure Plan - Civil Engineering / Project Cost Estimation	Alpha Hydraulic Engineer Consultants Co., Ltd.
Hidataka EBATA	Fisheries Value Chain / Fish Processing	Fisheries Engineering Co., Ltd.
Yuka AKAI	Environmental & social considerations	Fisheries Engineering Co., Ltd.

2. Plan (Draft)

2. 1　Plan（Project for Construction of Shaplapur Fish Landing Center）

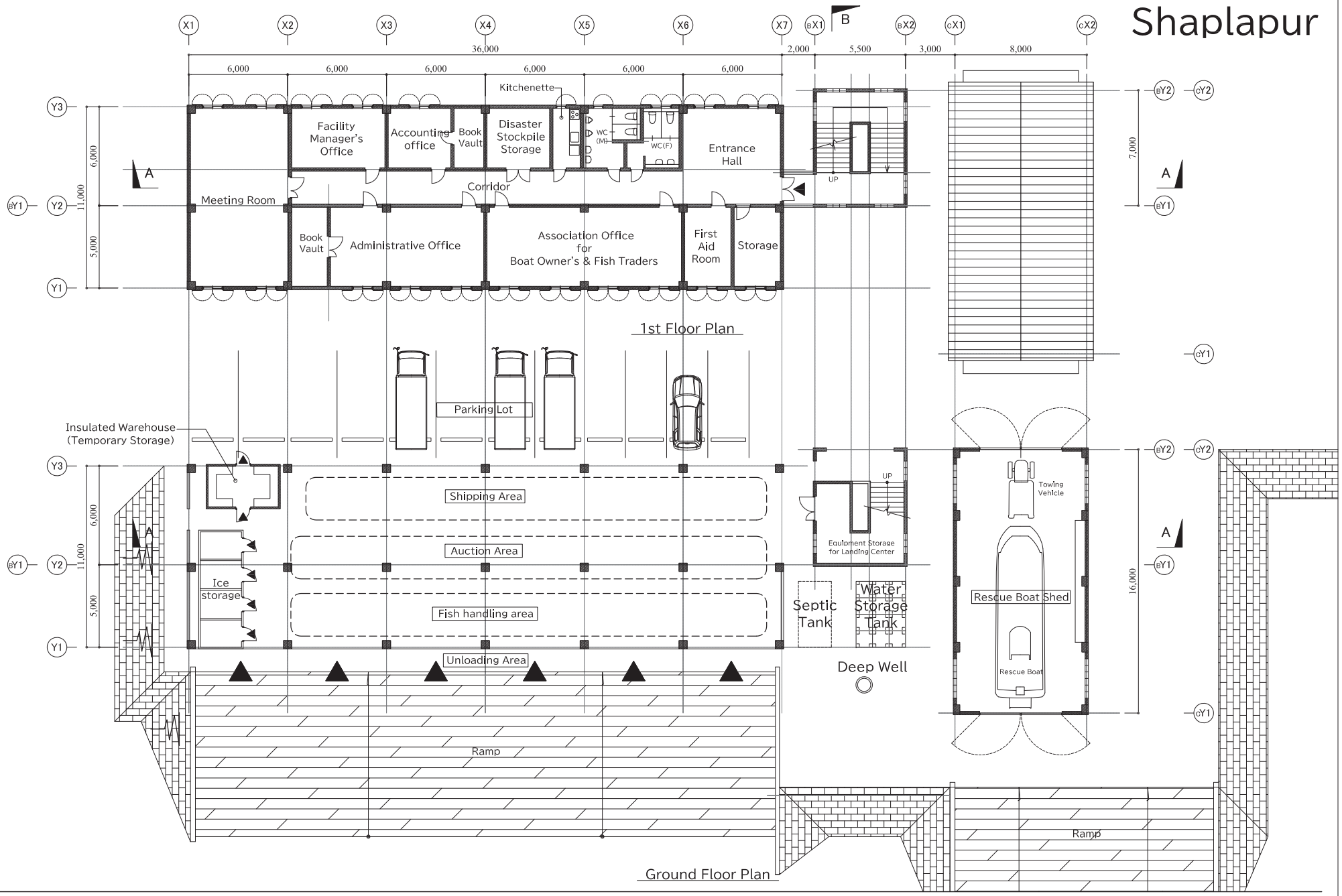
Shaplapur



SITE PLAN

Ap-9

Shaplapur



Ap-10

DATA COLLECTION SURVEY ON FISHERIES VALUE CHAIN INFRASTRUCTURE DEVELOPMENT IN SOUTH CHATTOGRAM REGION IN PEOPLE'S REPUBLIC OF BANGLADESH

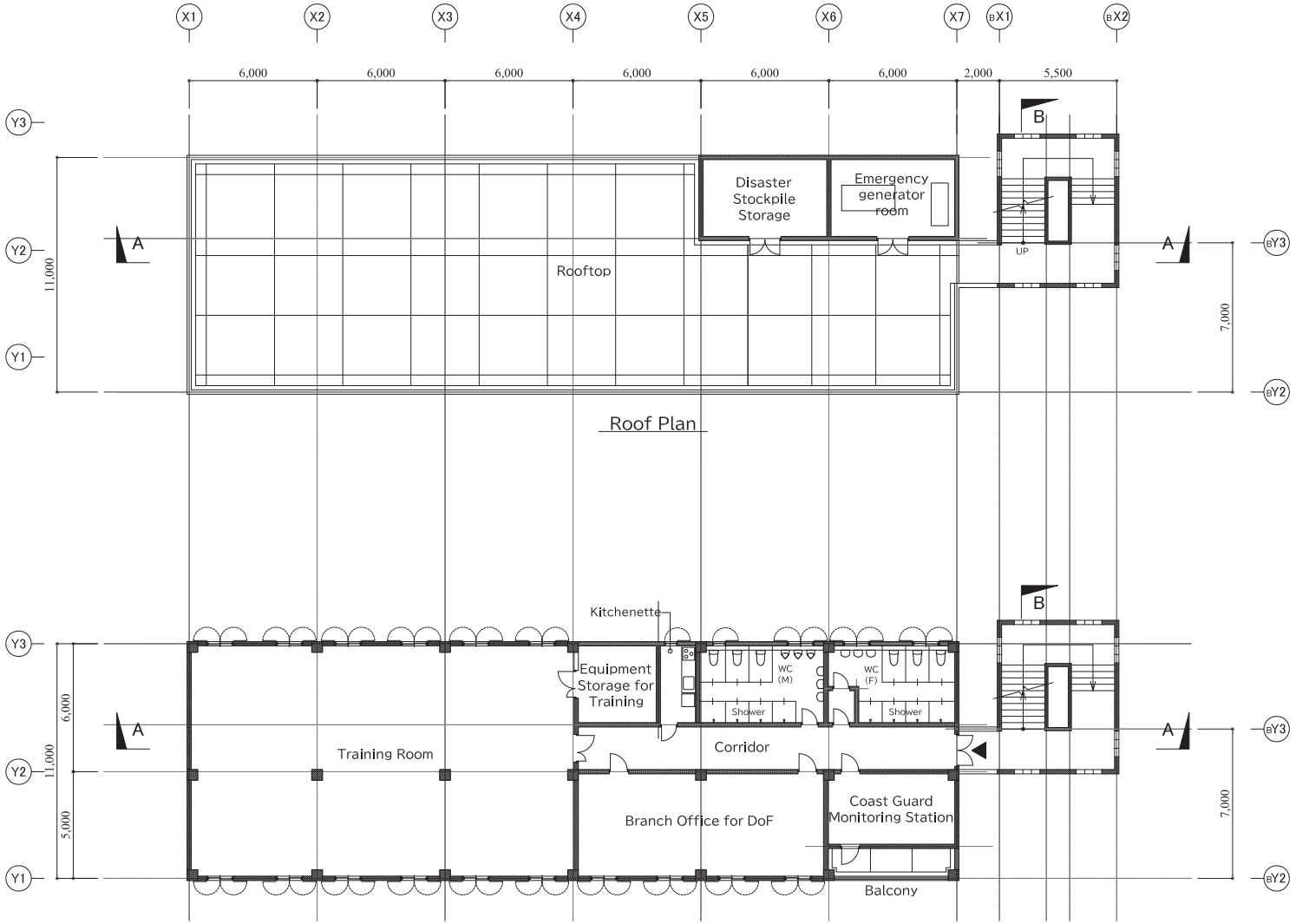
Project for Construction of Shaplapur Fish Landing Center

P L A N (Ground Floor & 1st Floor)

S=1/200

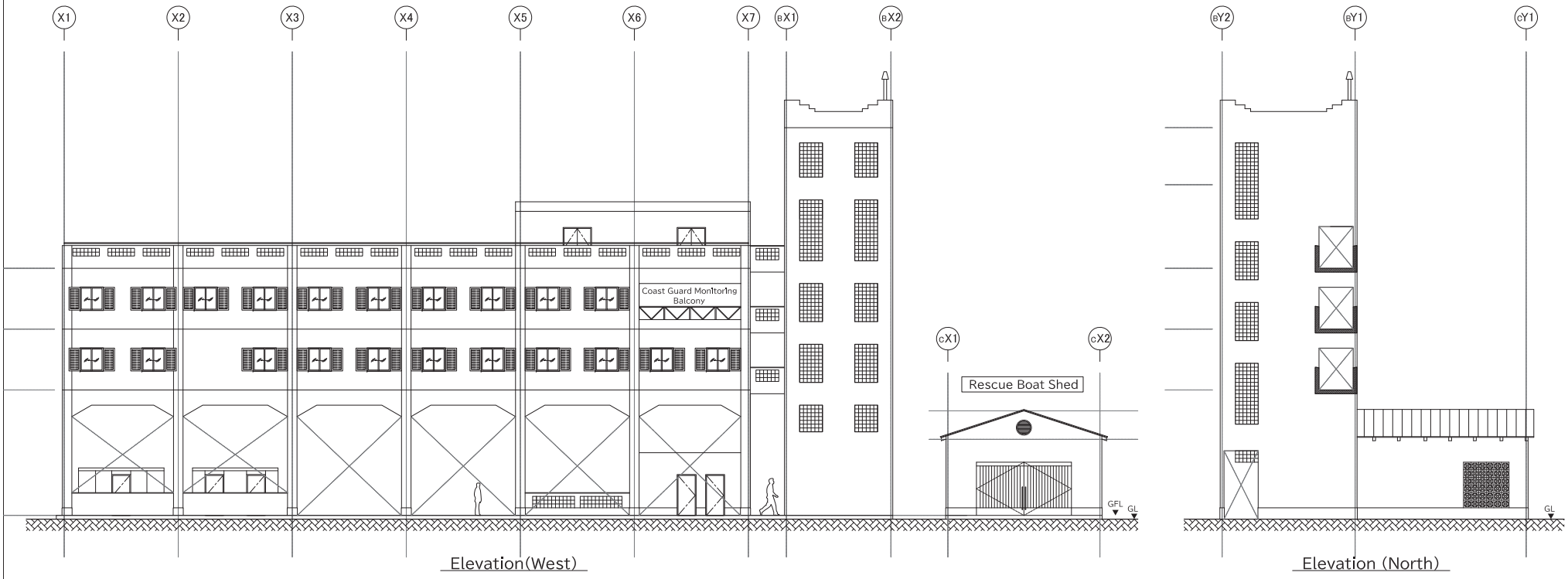
02

Shaplapur



Ap-11

Shaplapur

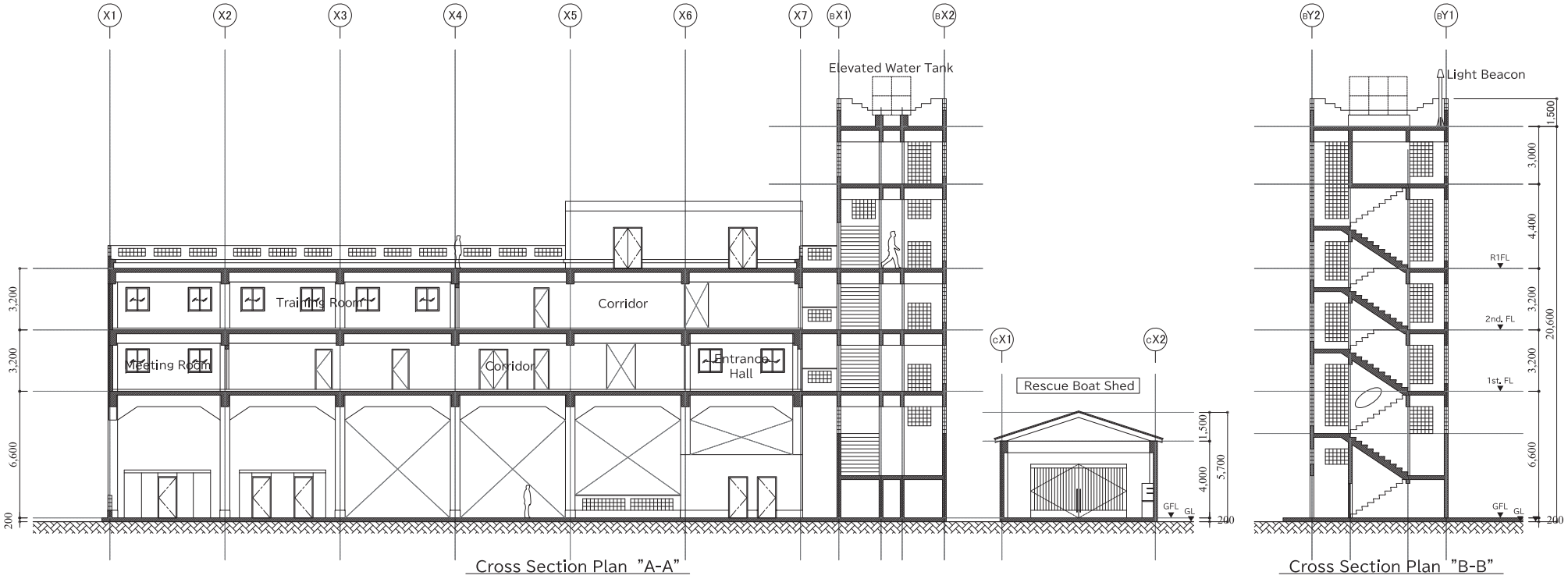


Elevation(West)

Elevation (North)

Ap-12

Shaplapur

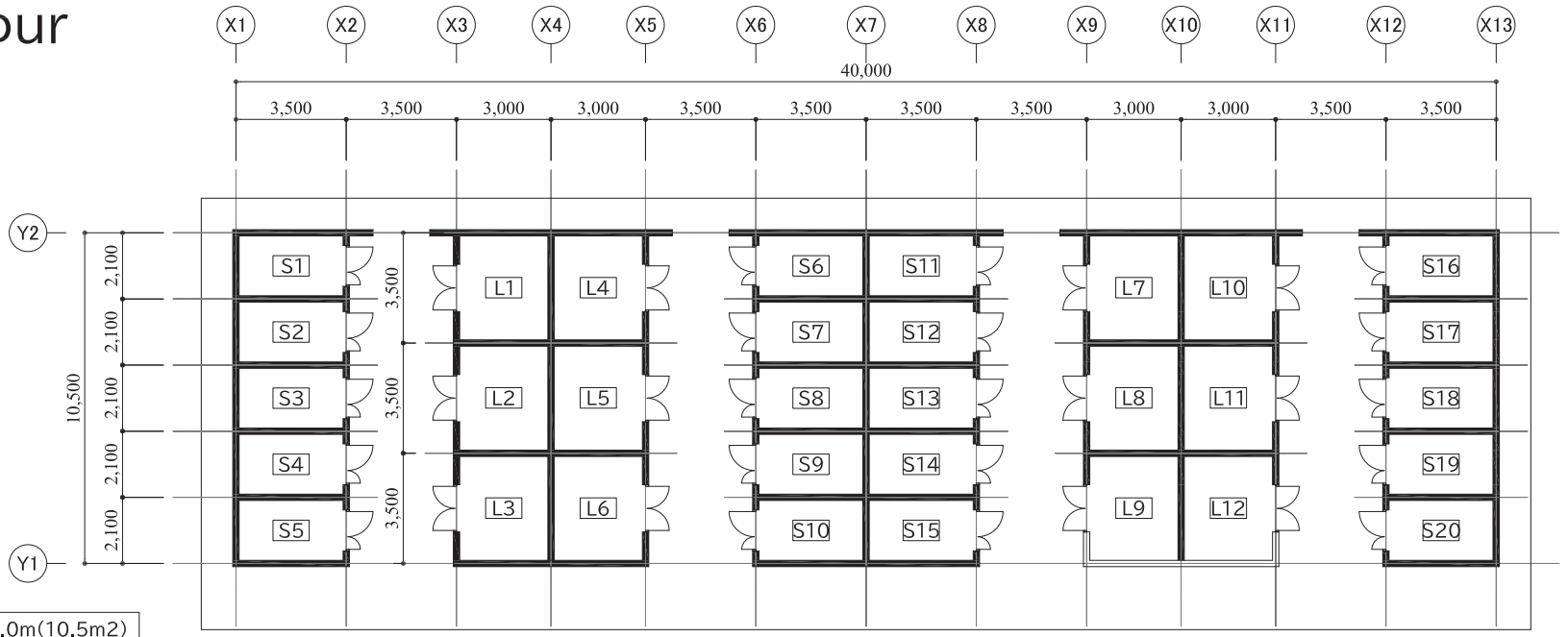


Cross Section Plan "A-A"

Cross Section Plan "B-B"

Ap-13

Shaplapur



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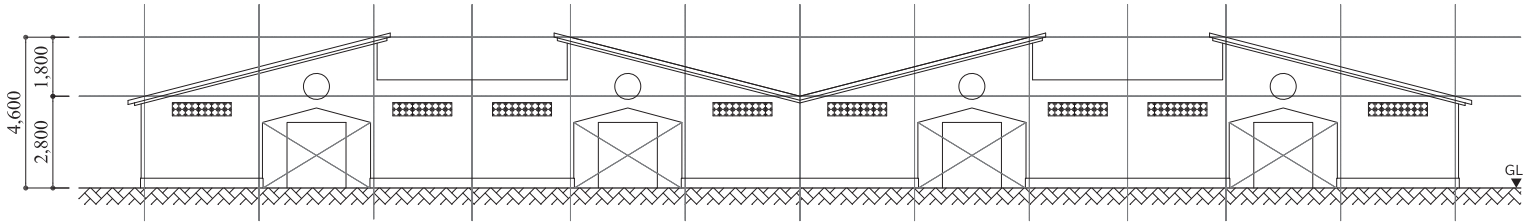
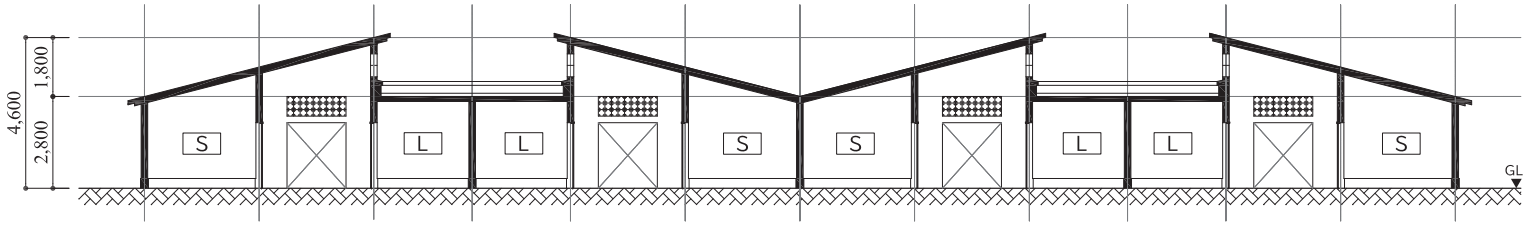
S-Type: 2.1m x 3.5m(7.4m2)

PLAN S=1/150



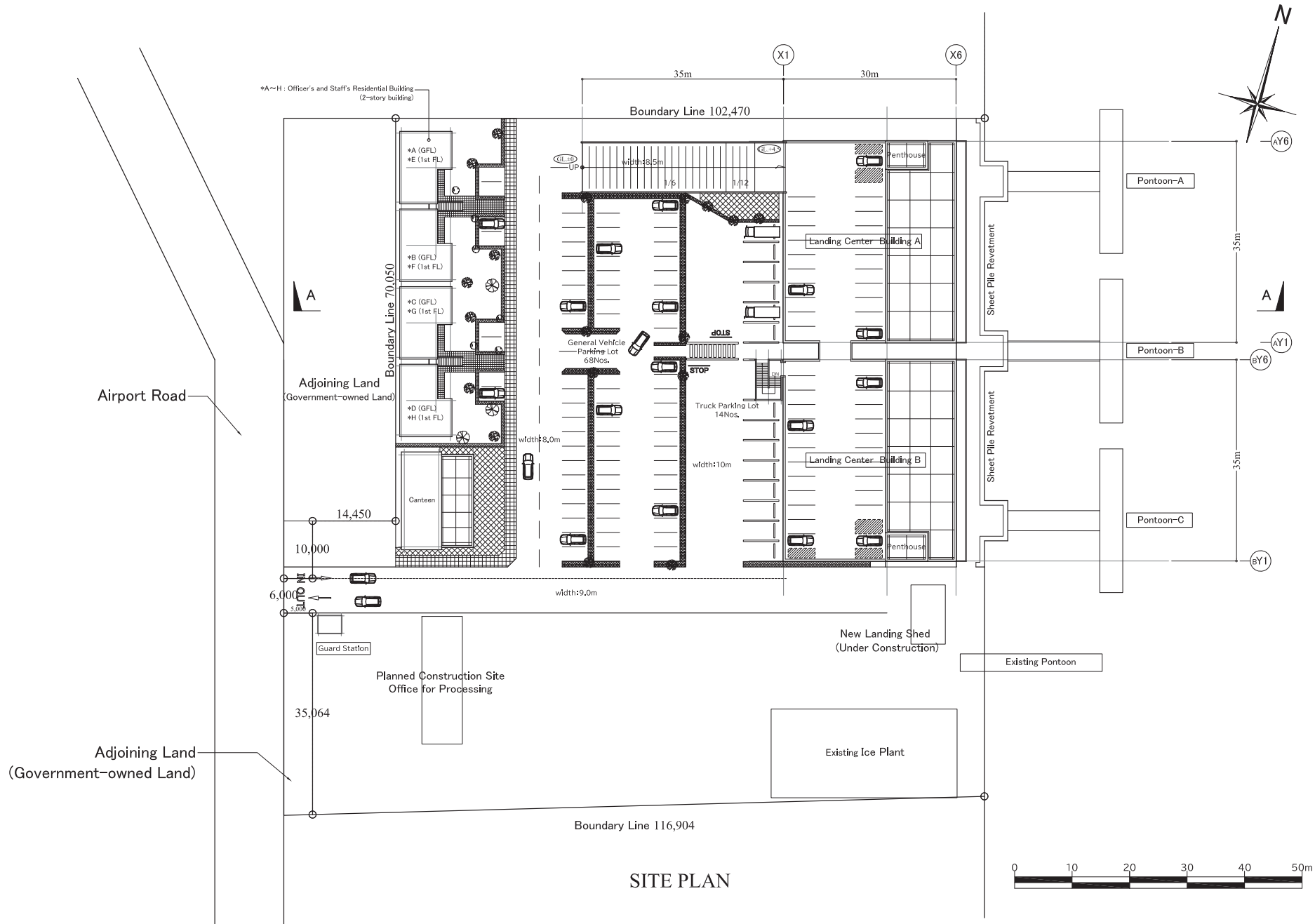
Elevation(West) S=1/150



Cross Section Plan S=1/150

Ap-14

2. 2　Plan（Project for Improvement of Cox's Bazar BFDC Fisheries Ghat）



SITE PLAN

Ap-17

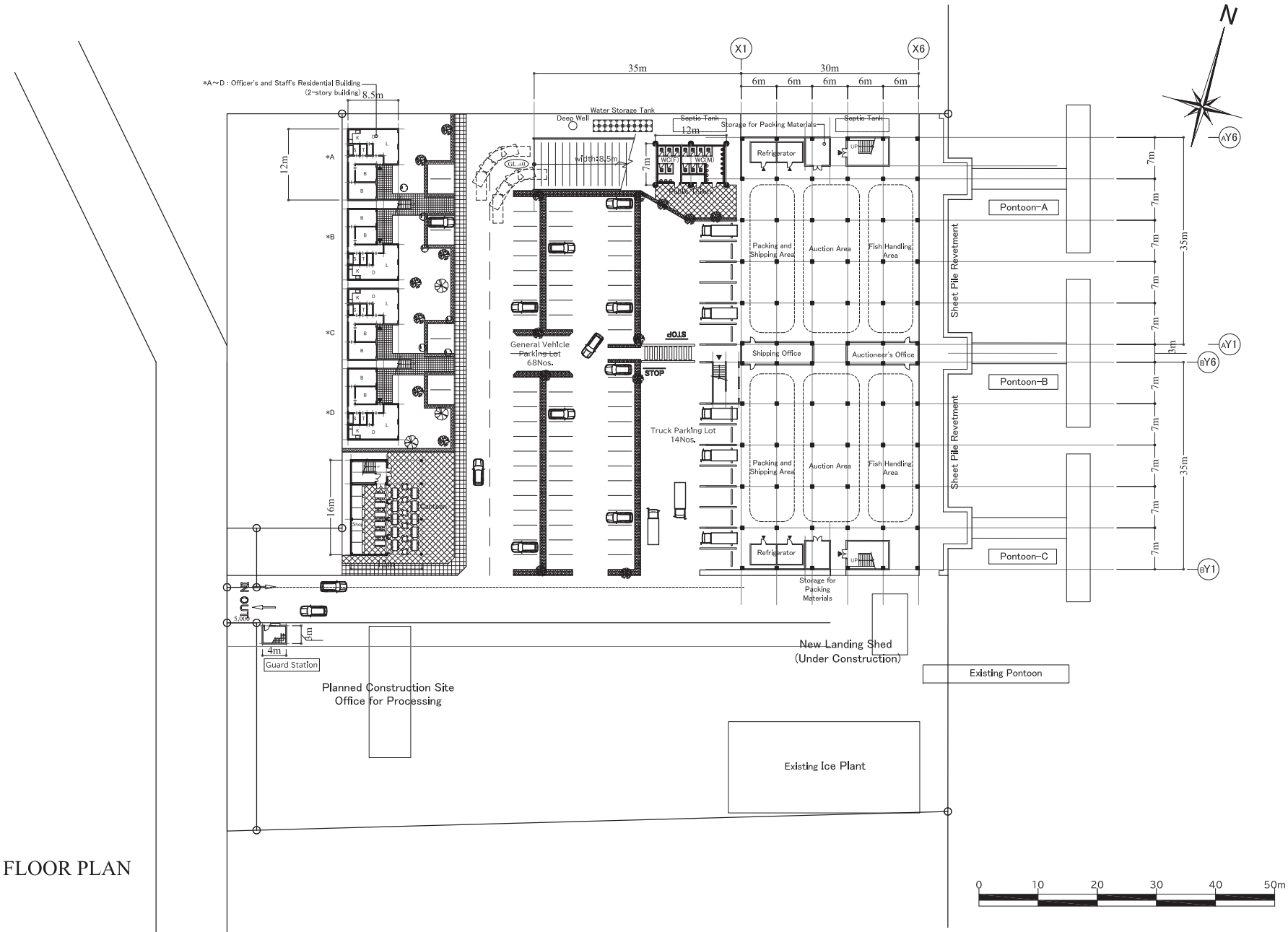
DATA COLLECTION SURVEY ON FISHERIES VALUE CHAIN INFRASTRUCTURE DEVELOPMENT IN SOUTH CHATTOGRAM REGION IN PEOPLE'S REPUBLIC OF BANGLADESH

Project for Improvement of Cox's Bazar BFDC Fisheries Ghat

SITE PLAN

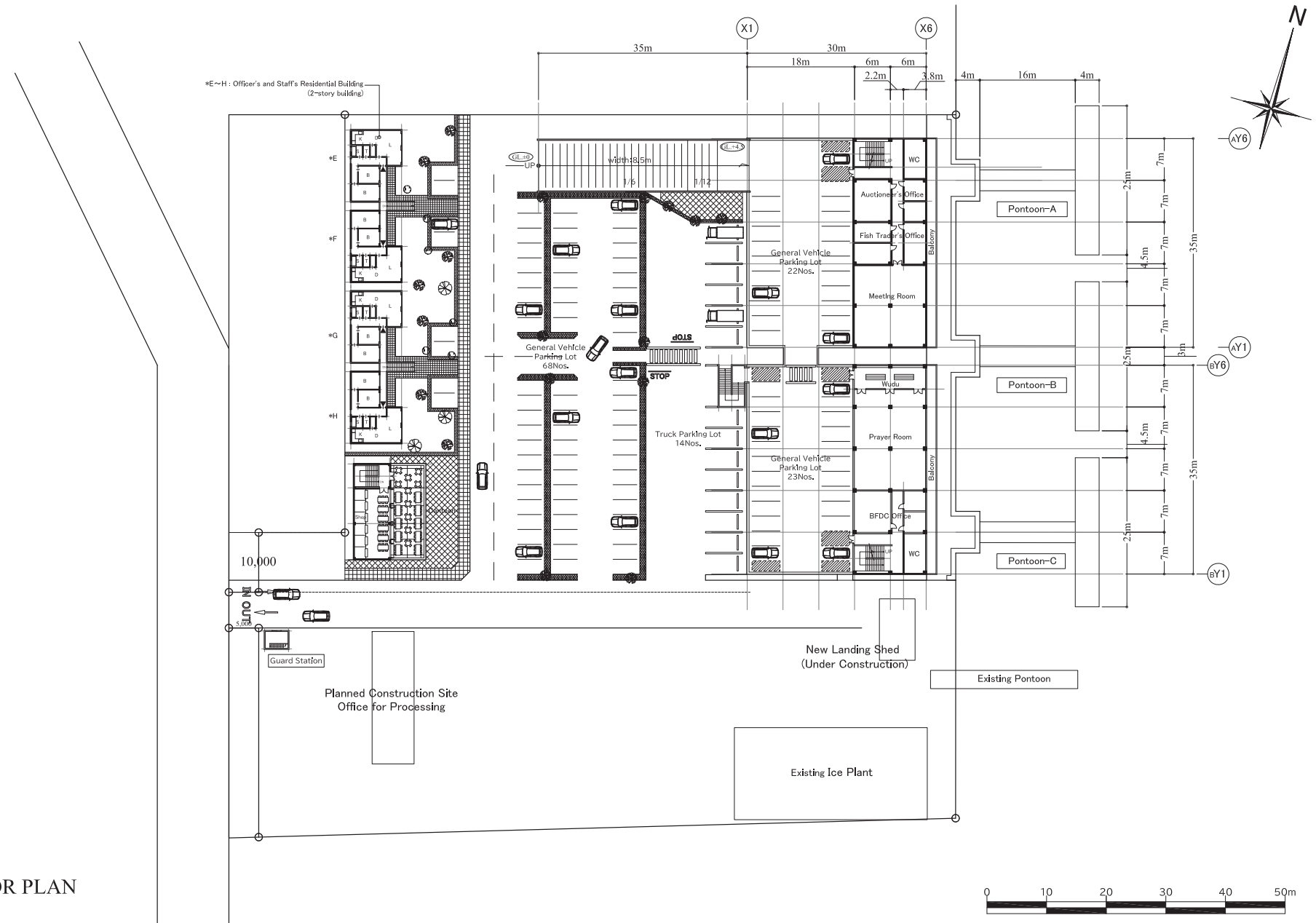
S=1/600

01



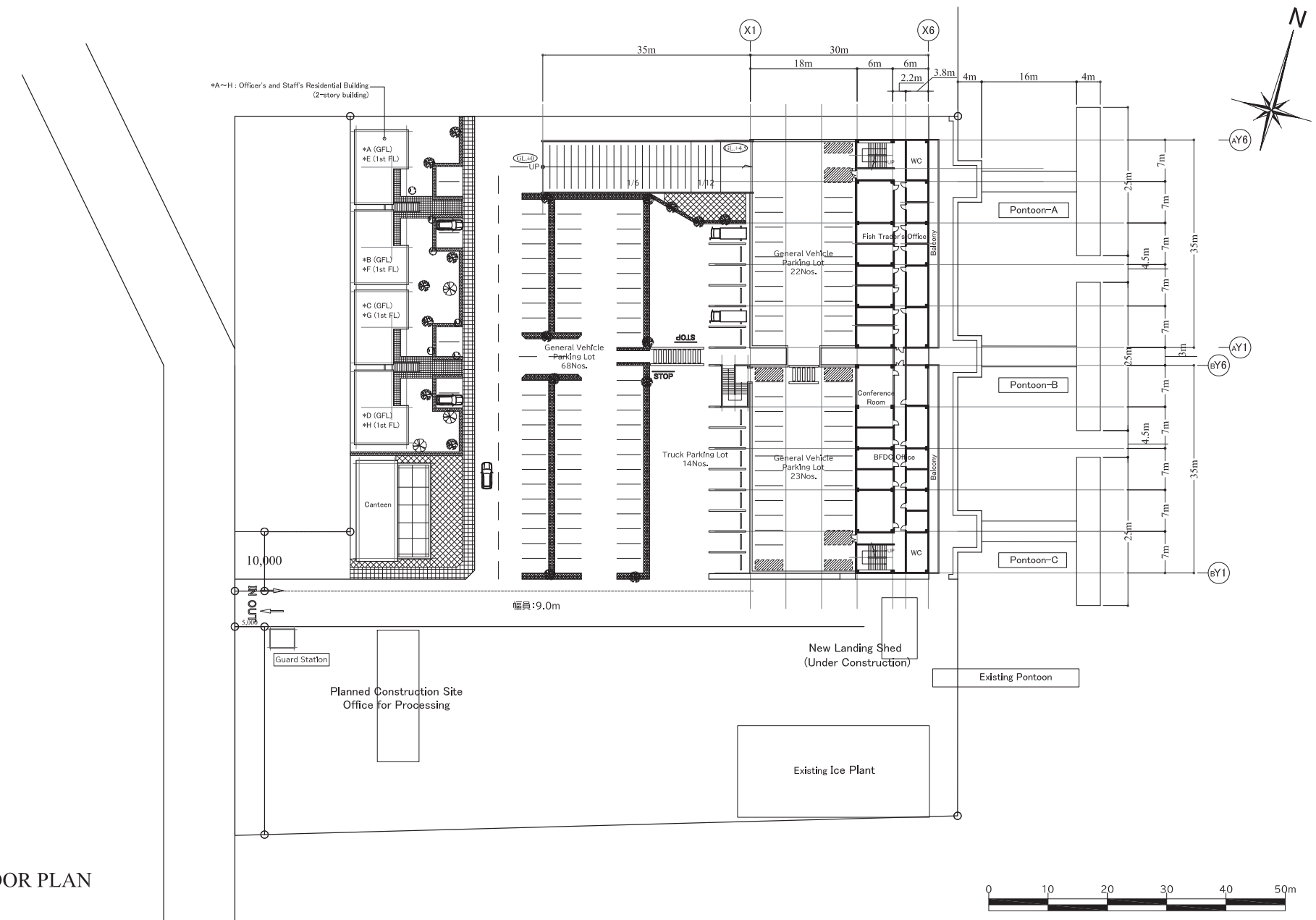
GROUND FLOOR PLAN

Ap-18



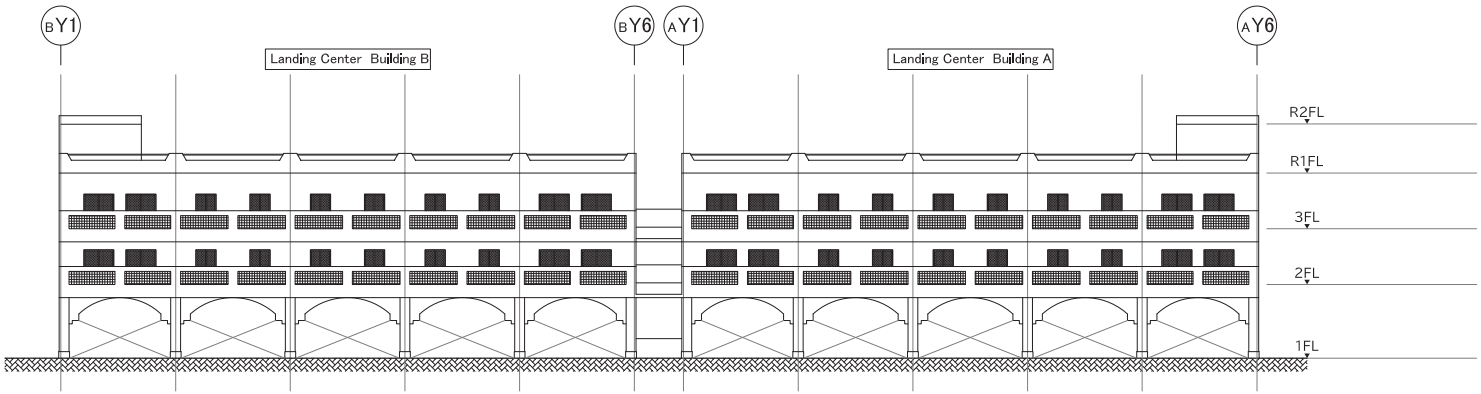
1st FLOOR PLAN

Ap-19

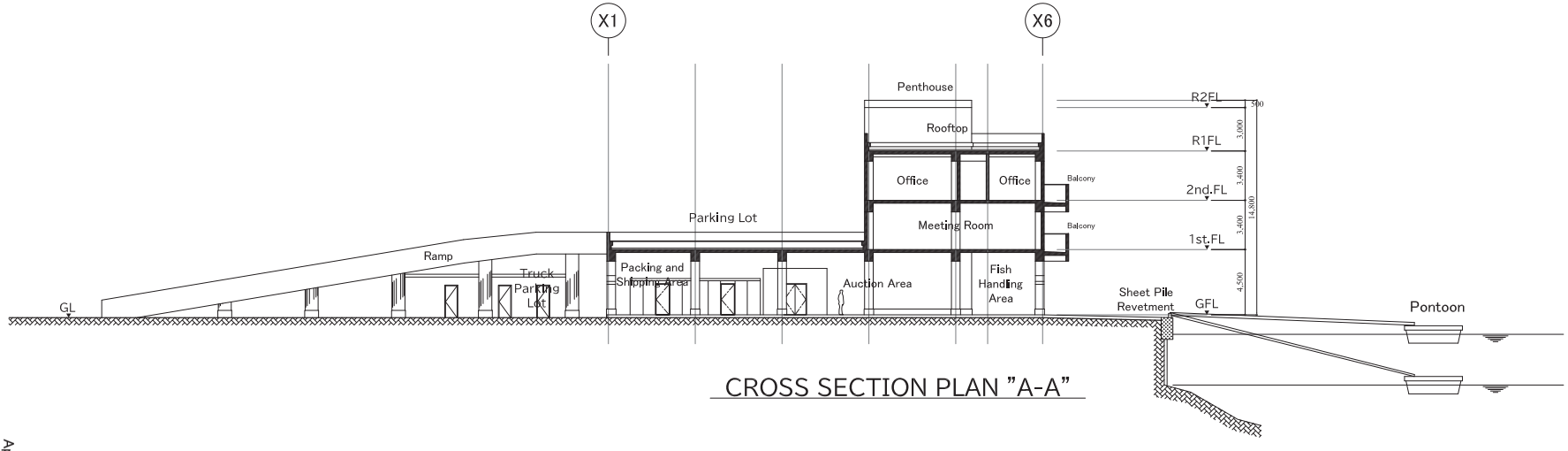


2nd FLOOR PLAN

Ap-20



ELEVATION (EAST)

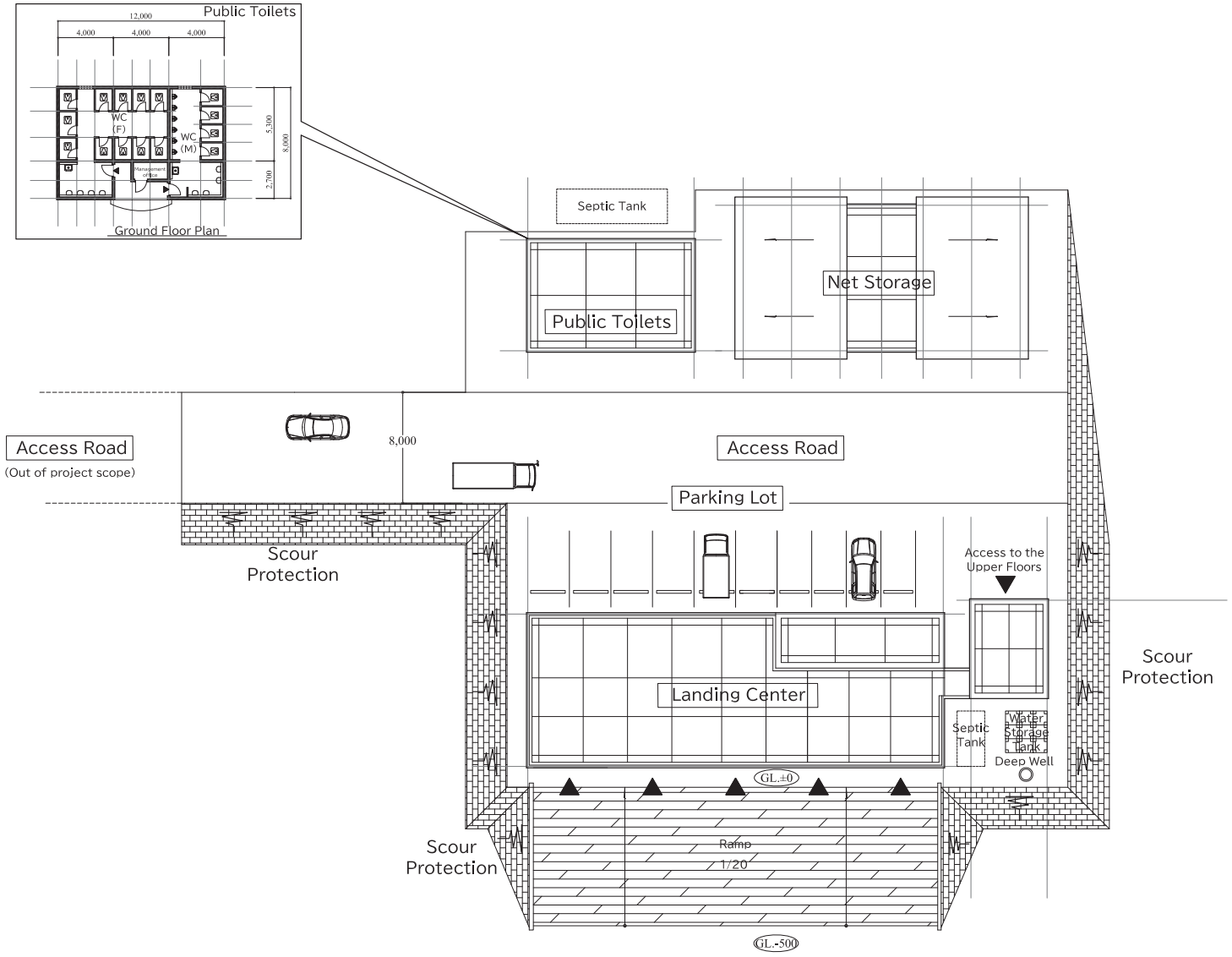


CROSS SECTION PLAN "A-A"

Ap-21

2. 3 Plan（Project for Construction of Sonadia Fish Landing Center）

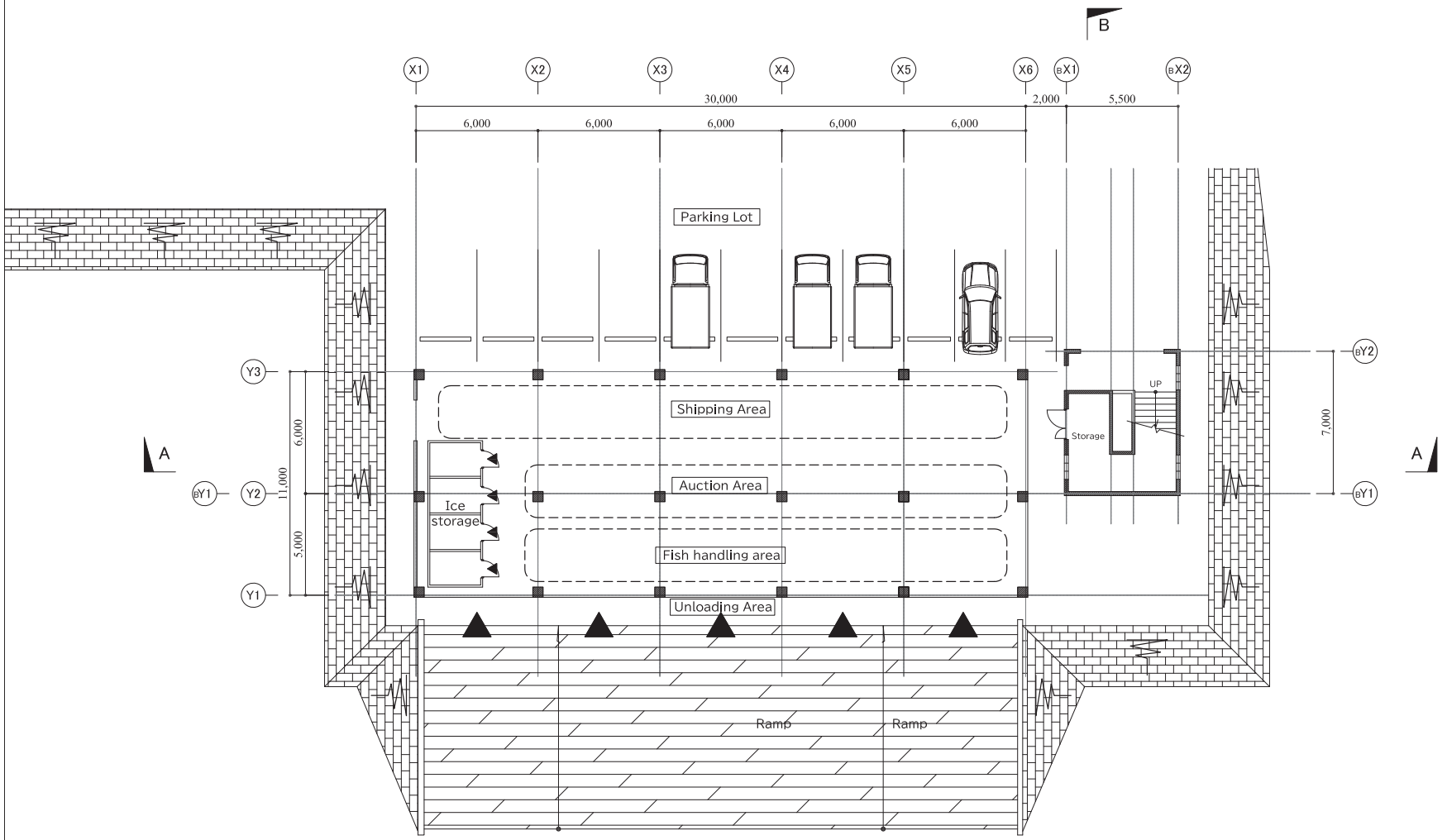
Sonadia



SITE PLAN

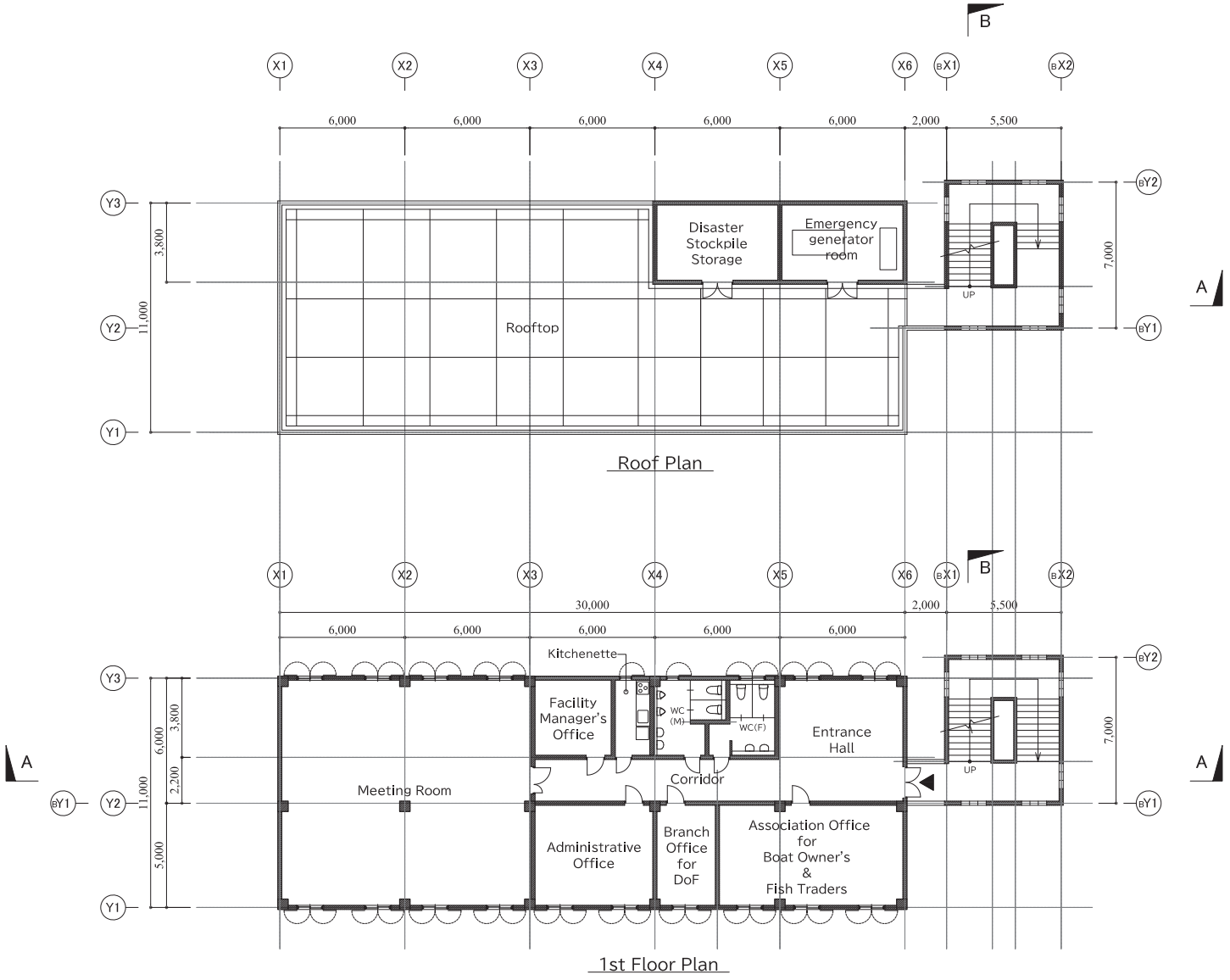
0 5 10 15 20m

Ap-25



Ground Floor Plan

Ap-26


B
X1
X2
X3
X4
X5
X6
BX1
BX2
6,000
6,000
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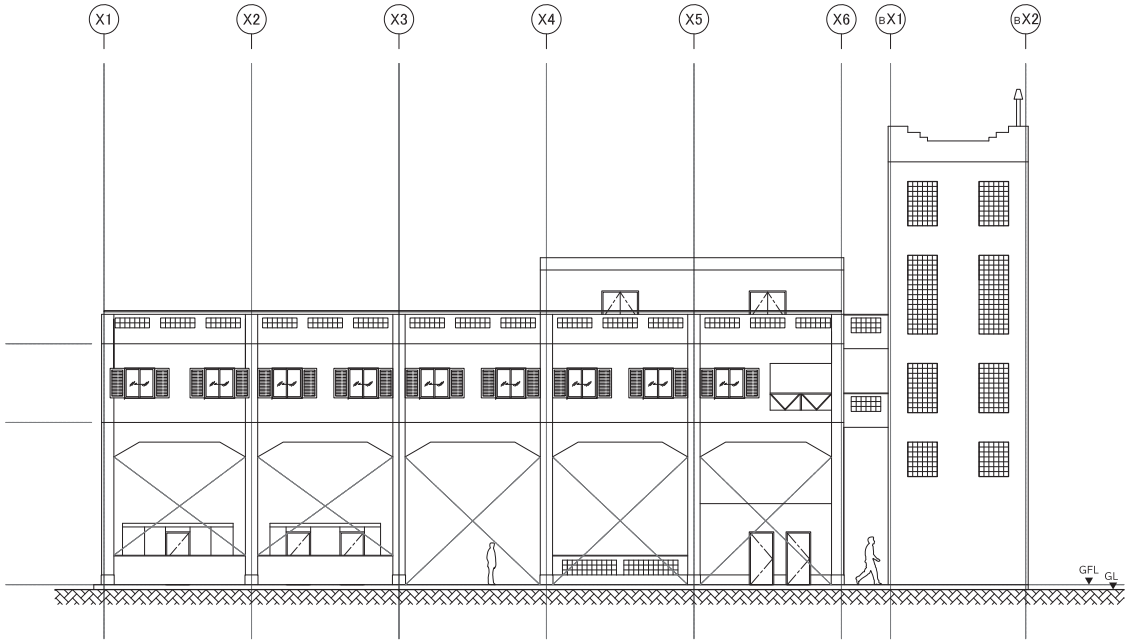
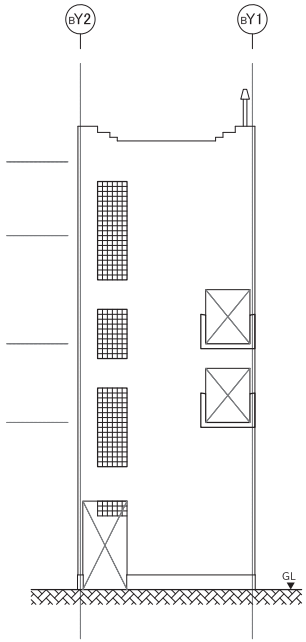
6,000
6,000
2,000
5,500
Y3
Y2
Y1
BY2
BY1
3,800
11,000
7,000
Disaster Stockpile Storage
Emergency generator room
Rooftop
UP
A
Roof Plan
B
30,000
Kitchenette
Facility Manager's Office
WC (M)
WC(F)
Entrance Hall
Corridor
Meeting Room
Administrative Office
Branch Office for DoF
Association Office for Boat Owner's & Fish Traders
6,000
2,200
5,000
1st Floor Plan

Ap-27

Sonadia

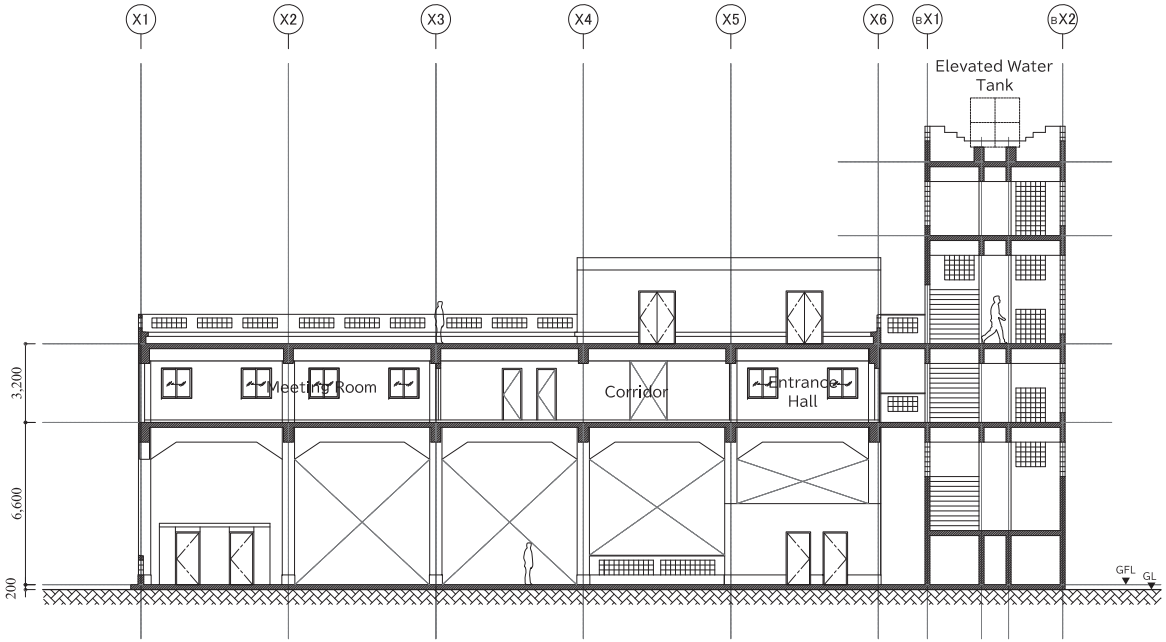


Elevation (South)

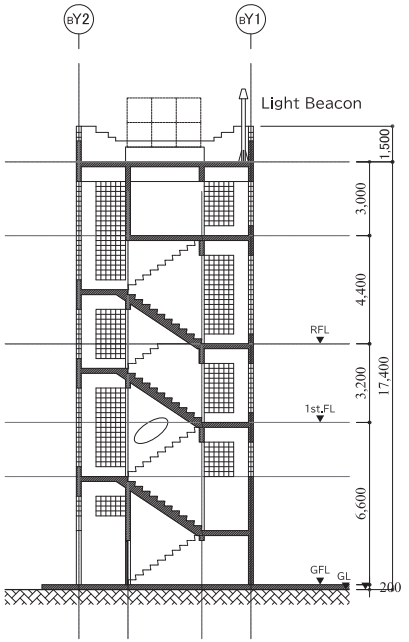


Elevation (West)

Ap-28



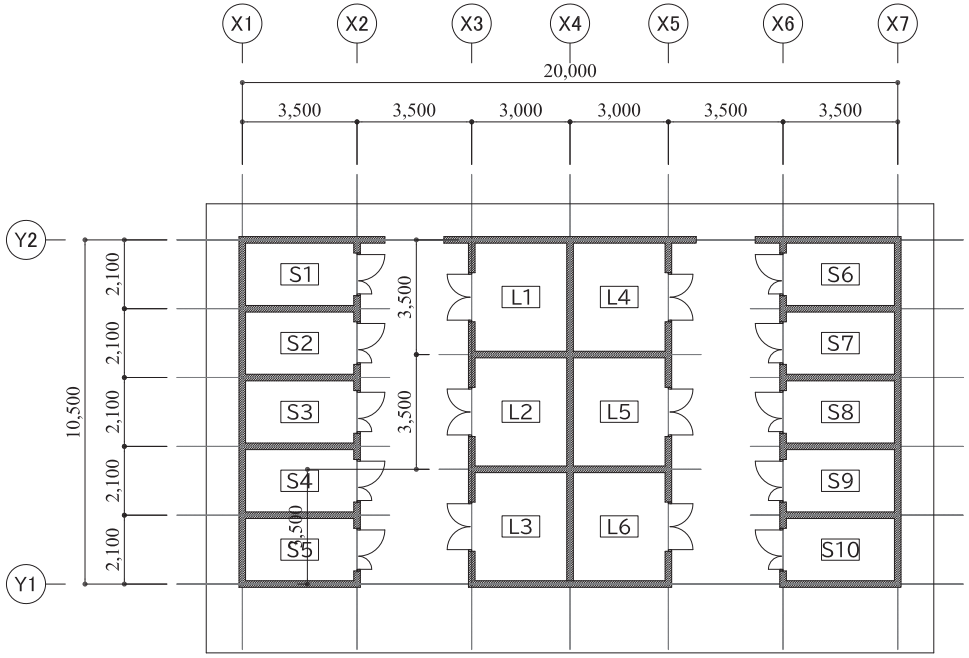
Cross Section Plan "A-A"



Cross Section Plan "B-B"

Ap-29

Sonadia



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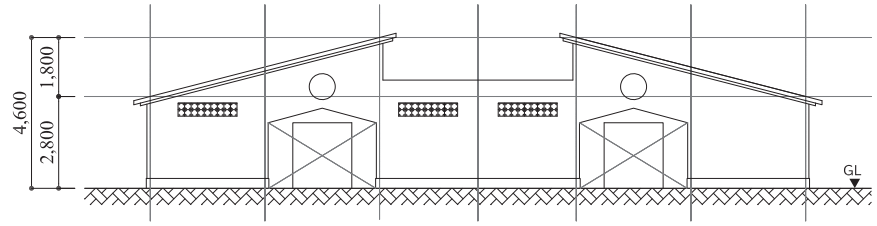
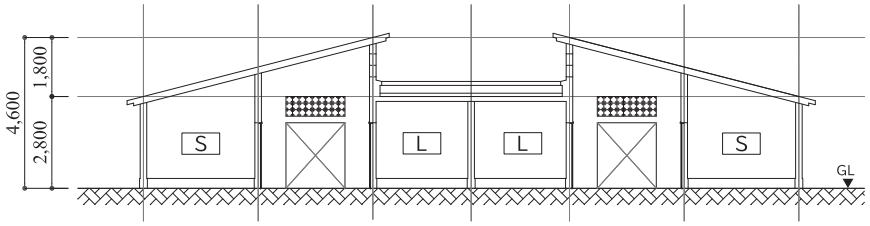
S-Type: 2.1m x 3.5m(7.4m2)

PLAN S=1/150



Elevation(South) S=1/150

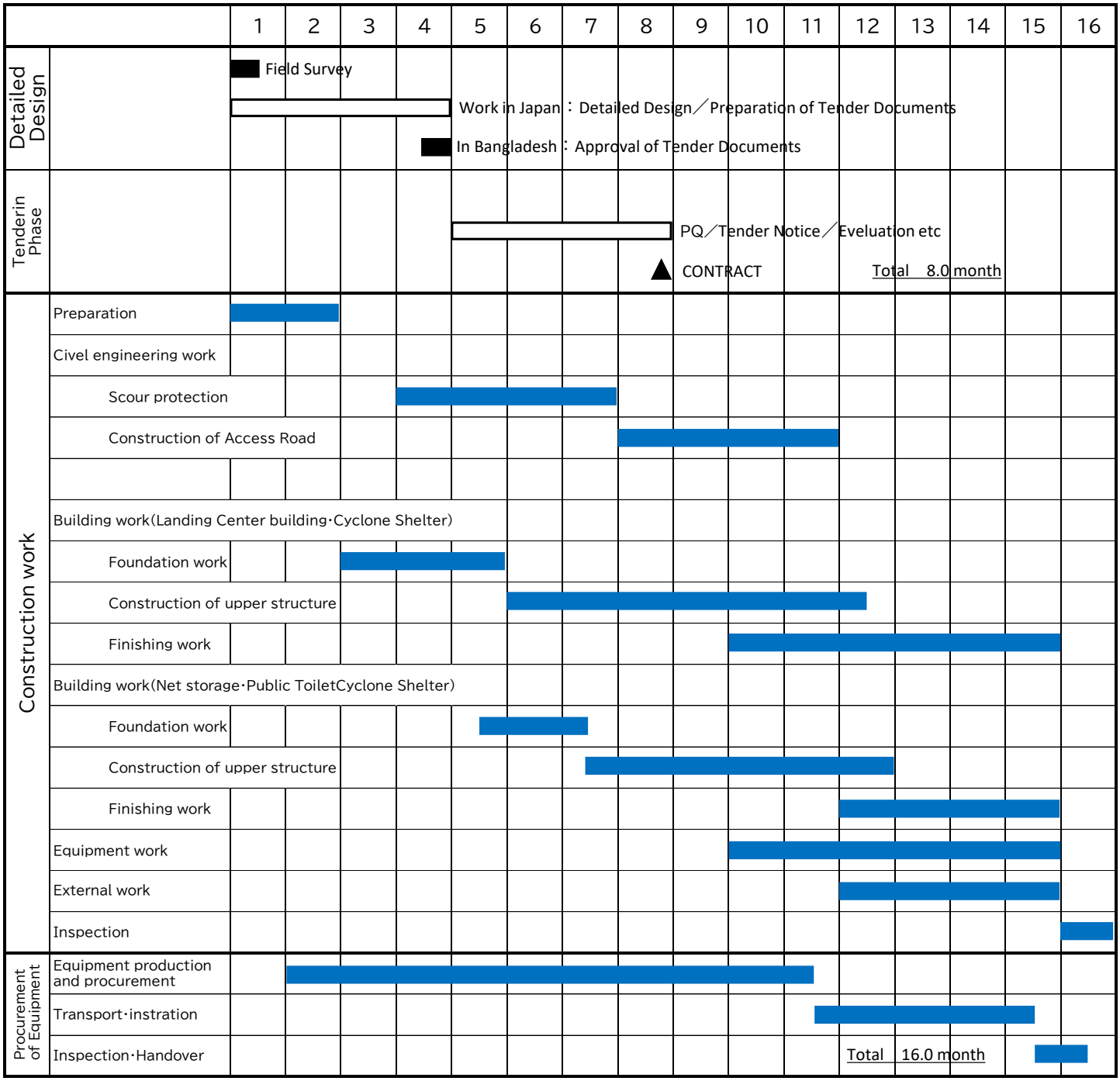


Cross Section Plan S=1/150

Ap-30

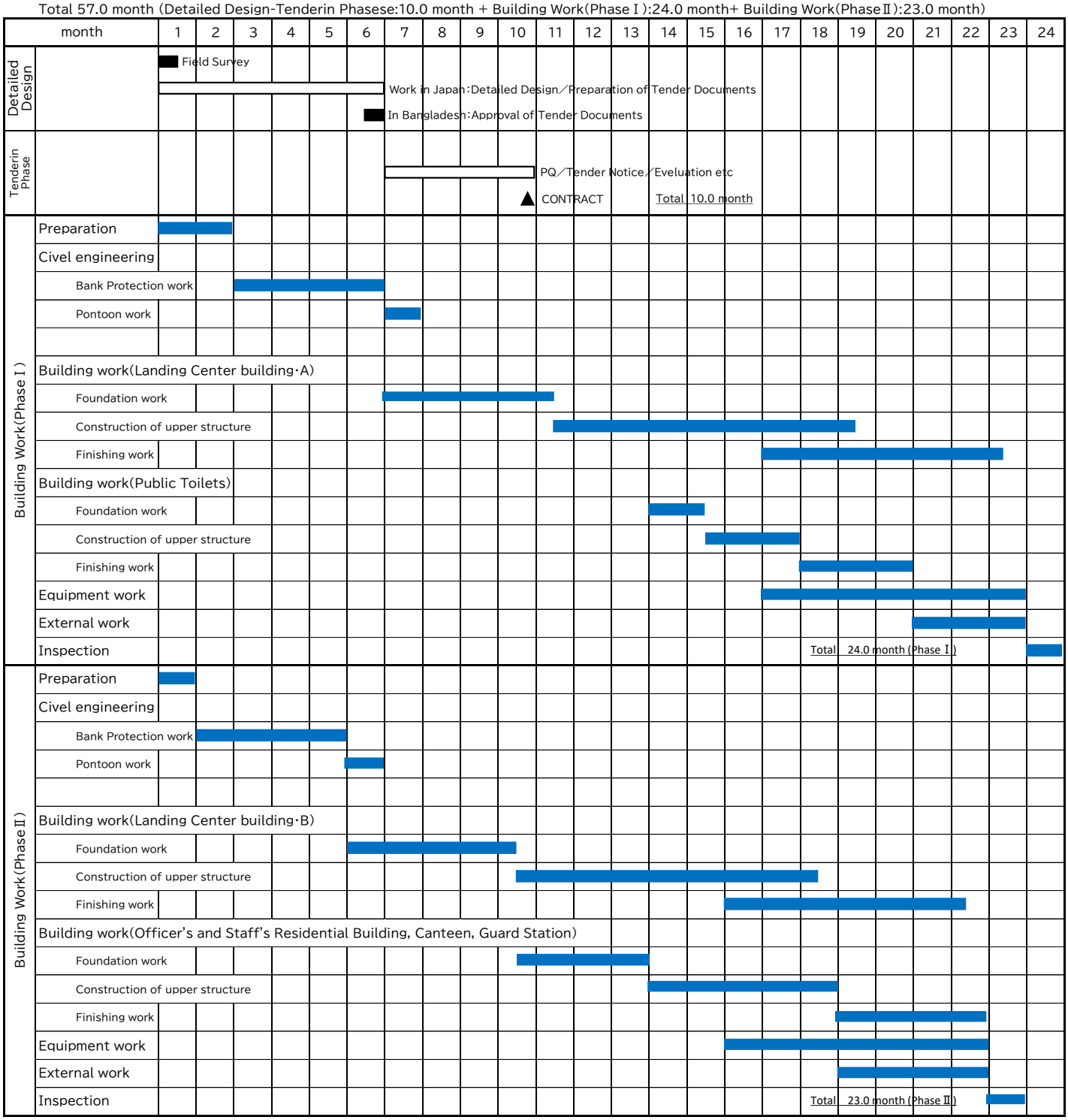
3. Construction Schedule (Draft)

3.1 Construction Schedule (Draft) of Project for Construction of Shaplapur Fish Landing Center

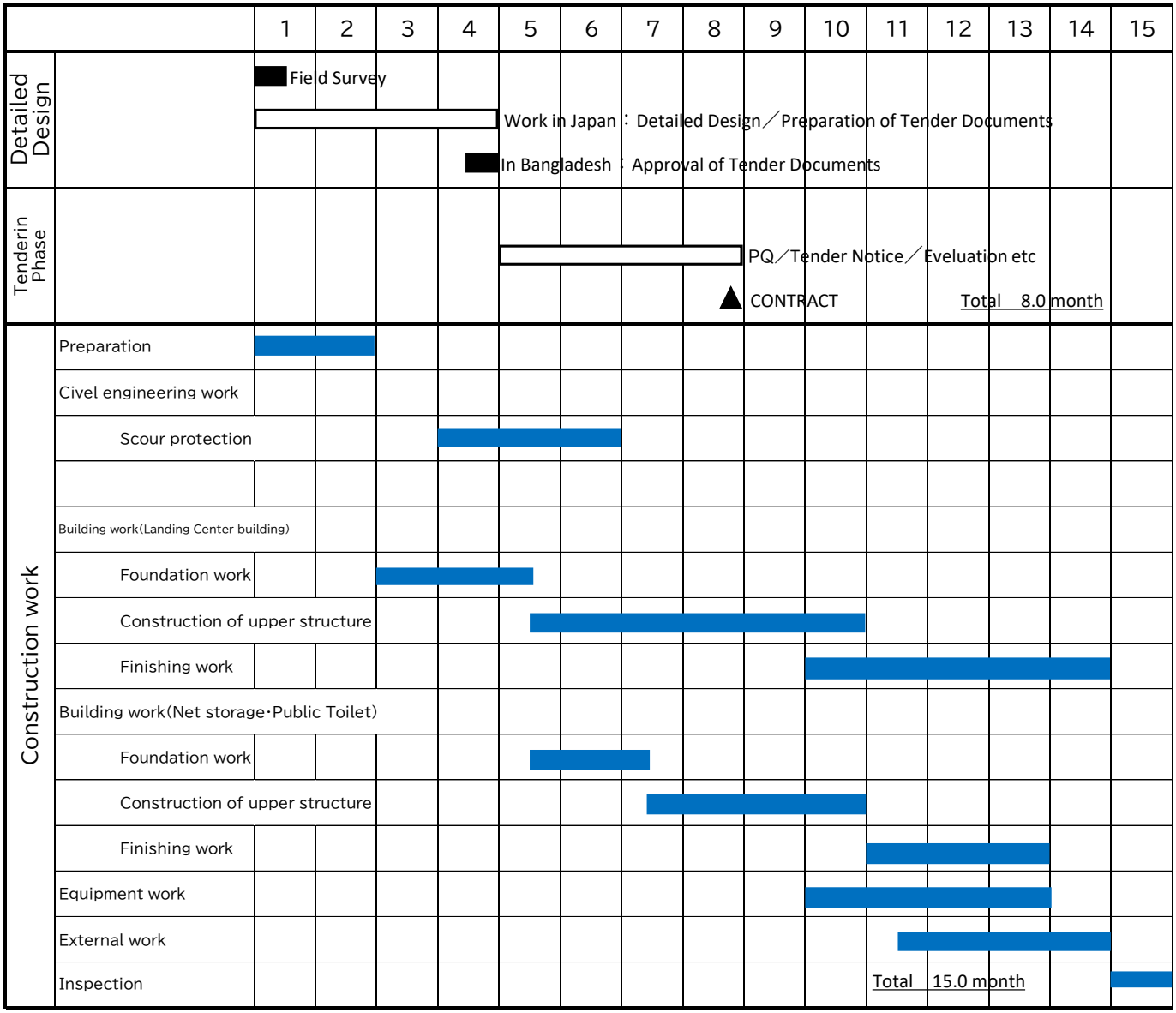


3.2 Construction Schedule (Draft) of Project for Improvement of Cox' sBazar BFDC Fisheries Ghat

Total 57.0 month (Detailed Design-Tenderin Phasese:10.0 month + Building Work(Phase Ⅰ):24.0 month+ Building Work(Phase Ⅱ):23.0 month)



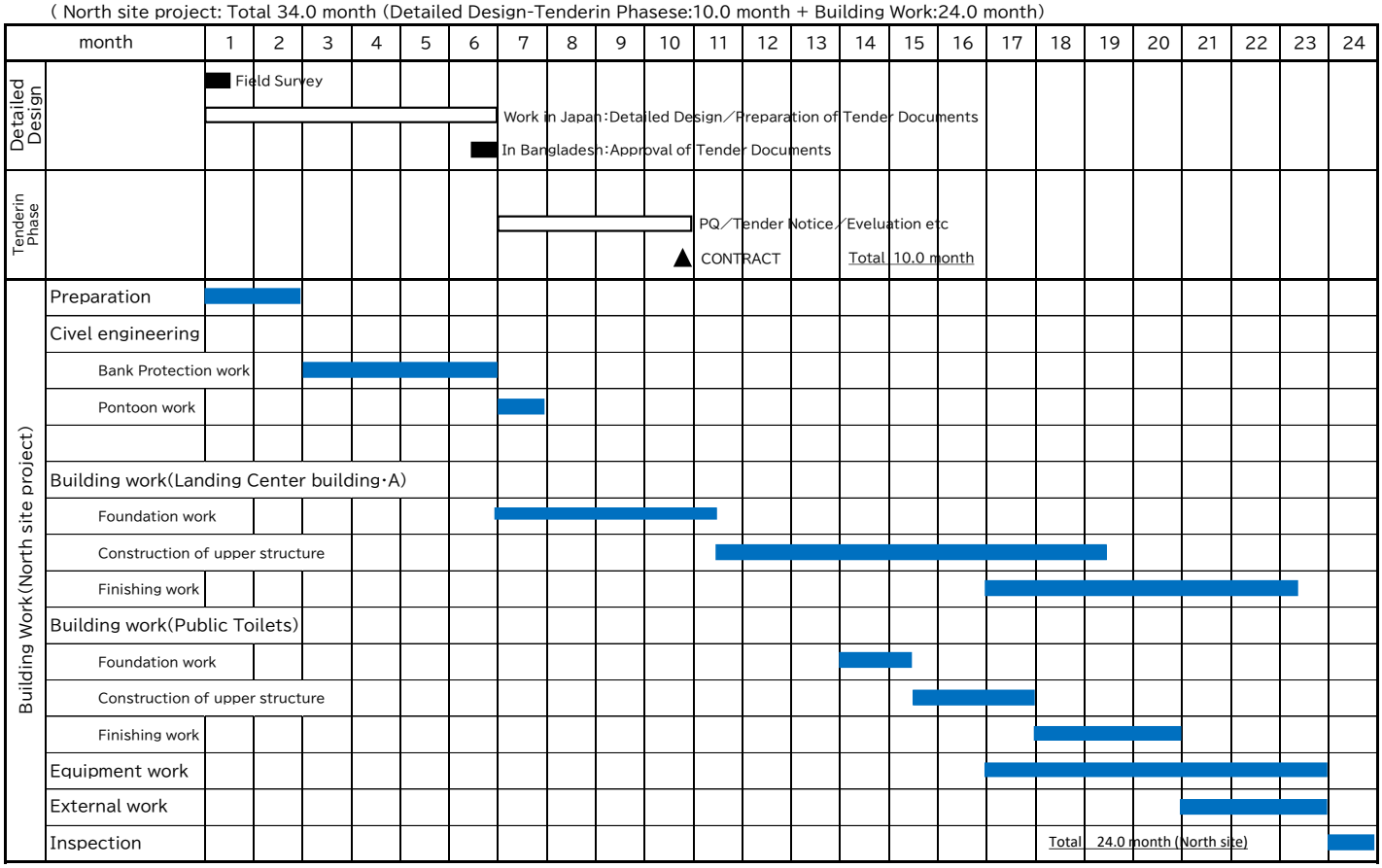
3.3 Construction Schedule (Draft) of Project for Construction of Sonadia Fish Landing Center



3.4 Construction Schedule as an altenate plan for Improvement of Cox' sBazar BFDC Fisheries Ghat : 2 divided projects（Draft）

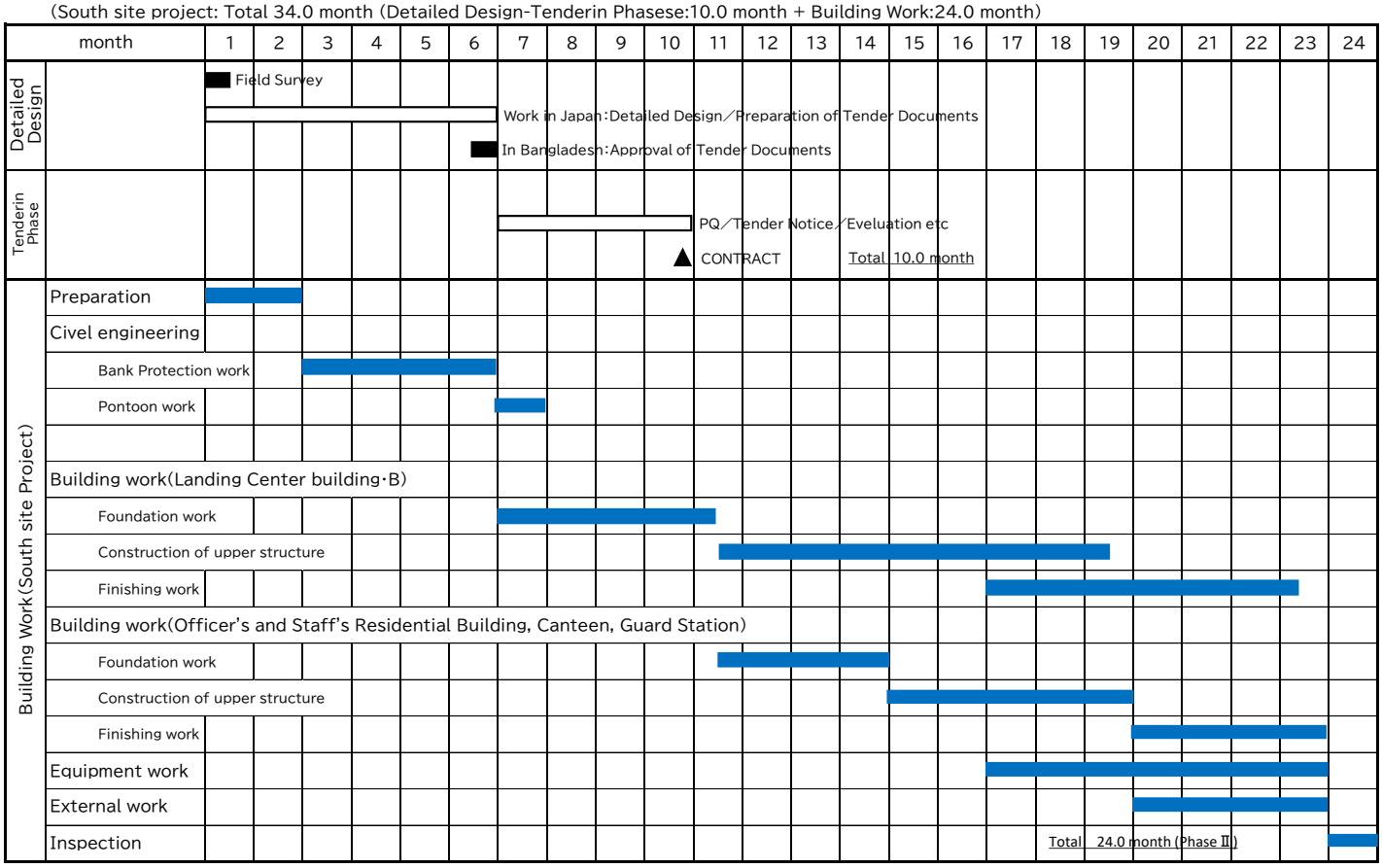
North site project Construction Schedule

(North site project: Total 34.0 month (Detailed Design-Tenderin Phasese:10.0 month + Building Work:24.0 month)



South site project Construction Schedule

(South site project: Total 34.0 month (Detailed Design-Tenderin Phasese:10.0 month + Building Work:24.0 month)



4. Project Cost Estimation (Draft)

4.1 Project Cost Estimation（Project for Construction of Shaplapur Fish Landing Center)

Items		Amount (Million JPY)		
Facilities	Civil engineering facilities (Access Road, Scour Protection, Paving of ramp area,etc.)	136	772	840
	Building facilities (Landing Center Building, Net Storage, Public Toilets, Rescue Boat Shed)	636		
Equipment	Rescue Boat, Towing Vehicle, etc.		68	
Soft Component			10	145
Detailed Design・Supervision			135	
Total				985

4.2 Project Cost Estimation (Project for Improvement of Cox's Bazar BFDC Fisheries Ghat)

Items		Amount (Million JPY)	
Facilities	Civil engineering facilities (Sheet Pile Revetment, Pontoon, etc.)	549	1,936
	Building facilities (Landing Center Building, etc.)	1,387	
Soft Component		10	339
Detailed Design・Supervision		329	
Total			2,275

4.3 Project Cost Estimation (Project for Construction of Sonadia Fish Landing Center)

Items		Amount (Million JPY)	
Facilities	Civil engineering facilities (Scour Protection, Paving of ramp area, etc.)	64	415
	Building facilities (Landing Center Building, Net Storage, Public Toilets)	351	
Soft Component		10	126
Detailed Design・Supervision		116	
Total			541

<estimated conditions>

・Rate: USD1=\113.84, BDT1=\1.35 (November 2021)

・The m^2 unit price of the facility is based on local interviews and our experience in other countries.

・The unit price is based on a direct foundation without piles as the ground conditions are good.

・Indirect costs are based on JICA costing guidelines.

・The overhead cost is based on the JICA costing guidelines.

・The design and supervision cost is estimated based on the actual man-months and unit costs of other project assuming the expected construction period.

4.4 Project Cost Estimation as alternate plan for Improvement of Cox's Bazar BFDC Fisheries Ghat (2 divided projects consist of North site project and South site project)

North site project

Items		Amount (Million JPY)	
Facilities	Civil engineering facilities (Sheet Pile Revetment, 2 Pontoons, etc.)	371	941
	Building facilities (Landing Center Building A, Public Toilets,etc.)	570	
Soft Component		0	189
Detailed Design・Supervision		189	
Sub Total			1,130

South site project

Items		Amount (Million JPY)	
Facilities	Civil engineering facilities (Sheet Pile Revetment, 1 Pontoon, etc.)	244	1,038
	Building facilities (Landing Center Building B, Residential Building, Canteen, etc.)	794	
Soft Component		10	200
Detailed Design・Supervision		190	
Sub Total			1,238

Items	Amount (Million JPY)
Total of two devided projects (North site project and South site project)	2,368

5. Reference for Environmental Consideration

(1) BFDC Fisheries Center

Environmental item	Main points for consideration
Explanation for local stakeholders	At the time of this survey, an overview of the currently envisioned facilities was explained to the relevant ministries and agencies. ・As it is highly probable that landing activities will continue during the construction period, an explanation must be given to facility users regarding any limitations that may be caused by the construction. ・Regarding the mosque (religious facility) located at the center of the site, an explanation must be given to facility users if it becomes necessary to demolish the existing mosque and build a new one in another location within the site due to site limitations. ・If the project is implemented, an overview of the construction must be explained to neighboring residents who are expected to be affected by the construction (sound, vibration, etc.).
Consideration of alternative plans	Temporary relocation to a nearby site is not envisioned, and it is assumed that construction will be considered for within the current site.
Water quality	Factors caused by project implementation that may worsen the water quality beyond its current state are not expected. However, if the addition of processing functions is envisioned, it will be necessary to confirm this.
Waste materials	Factors caused by project implementation that may increase waste beyond the current state are not expected. However, if the addition of processing functions is envisioned, it will be necessary to confirm this.
Noise and vibration	Noise and vibration countermeasures for adjacent areas during construction must be considered.
Foul odors	Factors caused by project implementation that may worsen foul odors beyond the current state are not expected. However, if the addition of processing functions is envisioned, it will be necessary to confirm this.
Nature reserves	Not applicable, as it is an existing facility.
Ecosystems	Not applicable, as it is an existing facility.
Groundwater	Well water is used in the BFDC. Care must be taken not to impact this during construction.
Topography/Geology	Since riverbank erosion is progressing on the side in front of the Bakkhali River, the project proposal envisions the construction of a revetment in front of BFDC, assuming that a revetment for the foundation portion is essential for onshore construction. Therefore, modification of the riverbank in front of BFDC is expected.

Environmental item	Main points for consideration
Resettlement	Not applicable, as construction is expected to be conducted on the premises of an existing facility. However, since BFDC staff quarters are located in the existing facilities, temporary relocation of staff is expected.
Lifestyle/Livelihood	No negative impacts on the livelihoods of local residents due to project implementation are expected.
Cultural heritage	Not applicable as construction is expected to be conducted on the premises of an existing facility.
Landscape	Not applicable, as construction is expected to be conducted on the premises of an existing facility.
Ethnic minority groups / Indigenous peoples	Not applicable, as construction is expected to be conducted on the premises of an existing facility.
Labor environment for project implementation	Consideration will be given to ensure the safety of workers during project implementation.

(2) Shaplapur

Environmental item	Main points for consideration
Explanation for local stakeholders	At the time of this survey, an overview of the currently envisioned facilities was explained to the relevant ministries and agencies. Interviews were held with fishers and boat owners in Shaplapur regarding the current situation.
Consideration of alternative plans	Shaplapur is one of the most active naturally occurring landing sites along the Bay of Bengal. It has a bazaar and space for a beach hinterland, making it a suitable landing site.
Water quality	Factors caused by project implementation that may worsen the water quality beyond its current state are not expected. However, if the addition of processing functions is envisioned, it will be necessary to confirm this.
Waste materials	Factors caused by project implementation that may increase waste beyond the current state are not expected. However, if the addition of processing functions is envisioned, it will be necessary to confirm this. Currently, disposal for everyday waste such as plastic waste is not properly implemented.
Noise and vibration	Although there are no residents on the beach side, noise and vibration countermeasures for adjacent areas during construction must be considered.
Foul odors	Factors caused by project implementation that may worsen foul odors beyond the current state are not expected. However, if the addition of processing functions is envisioned, it will be necessary to confirm this.
Nature reserves	See Ecosystems below.

Environmental item	Main points for consideration
Ecosystems	・The beach along the Bay of Bengal is designated as an ECA (Ecologically Critical Area). Discussions with the Department of Environment and various administrative organizations are expected to be necessary. ・The Forest Department has been planting trees on the beach side of the national highway as a windbreak and erosion control measure. It is expected that tree felling in the target project area will be confirmed with stakeholders including the Forest Department, Department of Environment, and groups commissioned by the Forest Department for management.
Groundwater	As there is an existing well on the beach side, care must be taken to ensure it is not impacted by the construction.
Topography/Geology	As new landing facilities will be built, a portion of the natural beach will be lost.
Resettlement	Not applicable, as there are no residences on the beach side.
Lifestyle/Livelihood	No negative impacts on the livelihoods of local residents due to project implementation are expected.
Cultural heritage	There are no cultural heritage sites in the vicinity of the project site that need to be protected.
Landscape	There are no particular landscapes that need consideration in the vicinity of the project site. However, since there are no human-made structures on the beach side, consideration should be given to the appearance of the facilities, to the extent possible, while prioritizing the safety of fishing vessels.
Ethnic minority groups / Indigenous peoples	There are no ethnic minority groups or indigenous peoples living in the area.
Labor environment	Consideration will be given to ensure the safety of workers during project implementation.

(3) Sonadia

Environmental item	Main points for consideration
Explanation for local stakeholders	At the time of this survey, an overview of the currently envisioned facilities was explained to the relevant ministries and agencies.
Consideration of alternative plans	As the Sonadia Eco-tourism Park is being planned by the Bangladesh Special Economic Zone Authority (BEZA) on Sonadia Island, land use restrictions must be confirmed.
Water quality	Factors caused by project implementation that may worsen the water quality beyond its current state are not expected. However, if the addition of processing functions is envisioned, it will be necessary to confirm this. Since this will be new facility, the formulation of usage rules should be included so

Environmental item	Main points for consideration
	that water quality around the site is not worsened by, for example, effluent from fishing boats using the facility.
Waste materials	Factors caused by project implementation that may increase waste beyond the current state are not expected. However, if the addition of processing functions is envisioned, it will be necessary to confirm this. Since this will be new facility, access from land will be limited; therefore, a plan must be formulated together with facility construction regarding waste collection and disposal methods, including for everyday waste.
Noise and vibration	Although there are no residential areas, a plan that takes noise and vibration during construction into account is necessary.
Foul odors	Factors caused by project implementation that may worsen foul odors beyond the current state are not expected. However, if the addition of processing functions is envisioned, it will be necessary to confirm this.
Nature reserves	See Ecosystems below.
Ecosystems	・The beach along the Bay of Bengal is designated as an ECA (Ecologically Critical Area). Discussions with the Department of Environment and various administrative organizations are expected to be necessary. ・The Forest Department has been planting trees on the beach side of the national highway as a windbreak and erosion control measure. It is expected that tree felling in the target project area will be confirmed with stakeholders including the Forest Department, Department of Environment, and groups commissioned by the Forest Department for management.
Groundwater	As there is an existing well on the beach side, care must be taken to ensure it is not impacted by the construction.
Topography/Geology	As new landing facilities will be built, a portion of the natural beach will be lost.
Resettlement	Not applicable, as there are no residences on the beach side.
Lifestyle/Livelihood	No negative impacts on the livelihoods of local residents due to project implementation are expected.
Cultural heritage	No impacts are expected, as there are no cultural heritage sites in the vicinity of the project site that need to be protected.
Landscape	There are no particular landscapes that need consideration in the vicinity of the project site. However, since there are no human-made structures on the beach side, the project should be studied to give consider to the appearance of the facilities, to the extent possible, while prioritizing the safety of fishing vessels.

Environmental item	Main points for consideration
Ethnic minority groups / Indigenous peoples	No impacts are expected, as there are no ethic minority groups or indigenous peoples living in the area.
Labor environment	Consideration will be given to ensure the safety of workers during project implementation.